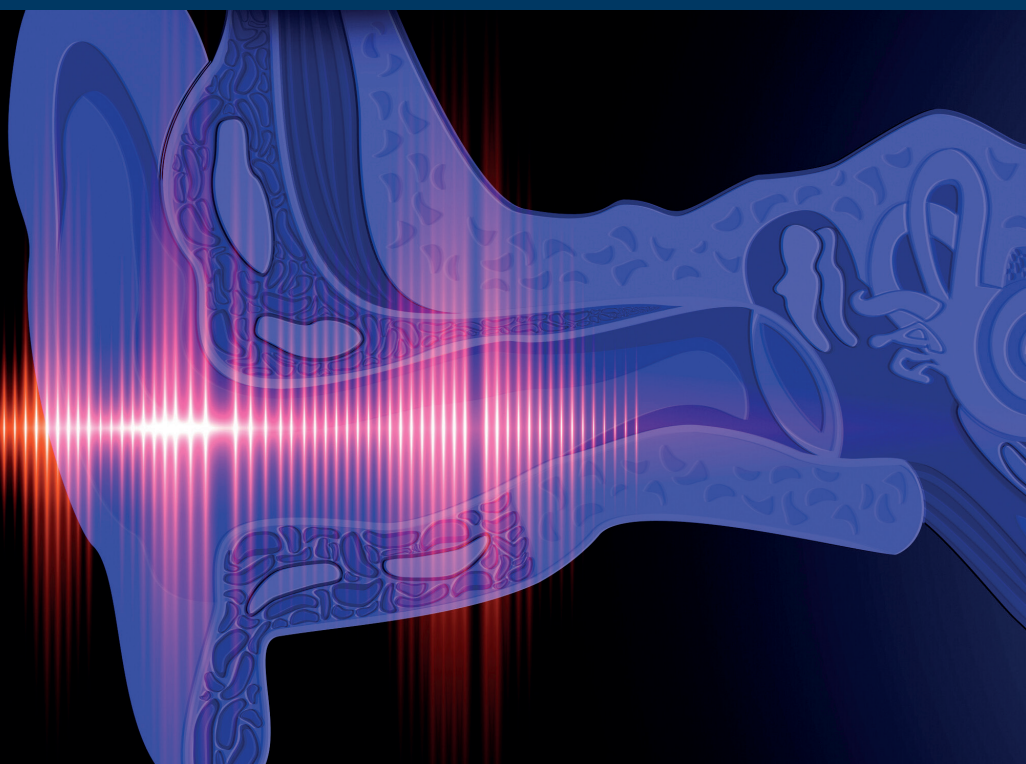




AOSIS

# COMPLEXITIES AND CHALLENGES IN PREVENTIVE AUDIOLOGY

An African perspective



Edited by Katijah Khoza-Shangase

**COMPLEXITIES  
AND CHALLENGES  
IN PREVENTIVE  
AUDIOLOGY**

An African perspective



Published by AOSIS Books, an imprint of AOSIS Publishing.


### **AOSIS Publishing**

15 Oxford Street, Durbanville 7550, Cape Town, South Africa  
Postnet Suite 110, Private Bag X19, Durbanville, 7551, Cape Town, South Africa  
Tel: +27 21 975 2602  
Website: <https://www.aosis.co.za>

Copyright © Katijah Khoza-Shangase (ed.). Licensee: AOSIS (Pty) Ltd  
The moral right of the authors has been asserted.

Cover image: Original design created with the use of a stock image. The image is [https://stock.adobe.com/sk/images/hear-the-sound-wave/96252495?asset\\_id=96252495](https://stock.adobe.com/sk/images/hear-the-sound-wave/96252495?asset_id=96252495), released under the appropriate Adobe Stock License terms.

Published in 2022  
Impression: 2

ISBN: 978-1-77995-212-7 (print)  
ISBN: 978-1-77995-213-4 (epub)  
ISBN: 978-1-77995-214-1 (pdf) 

DOI: <https://doi.org/10.4102/aosis.2022.BK311>

How to cite this work: Khoza-Shangase, K (ed.) 2022, *Complexities and challenges in preventive audiology: An African perspective*, AOSIS Books, Cape Town.

Printed and bound in South Africa.

Listed in OAPEN (<http://www.oapen.org>), DOAB (<http://www.doabooks.org/>) and indexed by Google Scholar.  
Some rights reserved.

This is an open-access publication. Except where otherwise noted, this work is distributed under the terms of a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License (CC BY-NC-ND 4.0). A copy of which is available at <https://creativecommons.org/licenses/by-nc-nd/4.0/>. Enquiries outside the terms of the Creative Commons license should be sent to the AOSIS Rights Department, at the above address or to [publishing@aosis.co.za](mailto:publishing@aosis.co.za).



The publisher accepts no responsibility for any statement made or opinion expressed in this publication. Consequently, the publishers and copyright holder will not be liable for any loss or damage sustained by any reader as a result of their action upon any statement or opinion in this work. Links by third-party websites are provided by AOSIS in good faith and for information only. AOSIS disclaims any responsibility for the materials contained in any third-party website referenced in this work.

Every effort has been made to protect the interest of copyright holders. Should any infringement have occurred inadvertently, the publisher apologises and undertakes to amend the omission in the event of a reprint.

**COMPLEXITIES  
AND CHALLENGES  
IN PREVENTIVE  
AUDIOLOGY**

An African perspective

EDITOR

Katijah Khoza-Shangase



## Health and Veterinary Sciences Domain editorial board at AOSIS

### Commissioning Editor: Scholarly Books

**Andries G. van Aarde**, MA, DD, PhD, D Litt, South Africa

### Board members

**Dirk U. Bellstedt**, Emeritus Professor, Department of Biochemistry, University of Stellenbosch, South Africa

**Patrick Demana**, Dean of School of Pharmacy, Sefako Makgatho Health Sciences University, South Africa

**Charlene Downing**, Department of Nursing, University of Johannesburg, South Africa

**Charles Hongoro**, Peace and Sustainable Security sub-programme, Developmental, Capable and Ethical State Research Programme, Human Sciences Research Council, Pretoria, South Africa; and, Extraordinary Professor, School of Health Systems and Public Health, University of Pretoria, Pretoria, South Africa

**Katijah Khoza-Shangase**, Audiology Department, School of Human & Community Development, University of the Witwatersrand, South Africa

**Gugu G. Mchunu**, Professor and Executive Dean of Faculty of Health Sciences, Durban University of Technology, South Africa

**Gubela Mji**, Director and Professor, Centre for Disability and Rehabilitation Studies at the Global Health Department, Faculty of Medicine and Health Sciences, Stellenbosch University, South Africa

**Meera Padhy**, Centre for Health Psychology, University of Hyderabad, Hyderabad, Telangana, India

**John M. Pettifor**, Department of Paediatrics and Child Health, University of the Witwatersrand, South Africa

**C.W. van Staden**, Centre for Ethics and Philosophy of Health Sciences, University of Pretoria, South Africa

**Caryn Zinn**, School of Sport and Recreation, Auckland University of Technology, New Zealand

### Peer review declaration

The publisher (AOSIS) endorses the South African 'National Scholarly Book Publishers Forum Best Practice for Peer Review of Scholarly Books'. The manuscript underwent an evaluation to compare the level of originality with other published works and was subjected to rigorous two-step peer review before publication, with the identities of the reviewers not revealed to the editor(s) or author(s). The reviewers were independent of the publisher, editor(s), and author(s). The publisher shared feedback on the similarity report and the reviewers' inputs with the manuscript's editor(s) or author(s) to improve the manuscript. Where the reviewers recommended revision and improvements, the editor(s) or author(s) responded adequately to such recommendations. The reviewers commented positively on the scholarly merits of the manuscript and recommended that the book be published.

## Research justification

The success of any preventive health care programme is reliant on a functional health care system. Within this system of care, health care professionals, including audiologists, can only practise safely and effectively if they possess an appreciation of the complexities and challenges that exist in that context. Preventive audiology is positioned where health care professionals have such awareness that aids them to recognise opportunities for errors that can cause harm to patients and where they take steps to prevent these mistakes. This edited book, *Complexities and challenges in preventive audiology: An african perspective*, is a sequel to another book by the current editor, titled *Preventive audiology: An African perspective*. While in the process of editing that book, the editor identified that there existed a lacuna of contextually relevant collation of evidence on complexities and challenges faced by the field of audiology within the African context in implementing preventive audiology. The goal of this book is to delve into these complexities and challenges for various key areas in audiology. All chapters deliberate on evidence-based perspectives grounded in the African context, with deliberate and preferential reliance on contemporary, locally relevant evidence that allows for accurate reflection of current complexities and challenges in ear-and-hearing health care delivery within the African context. Contributors were encouraged to be as comprehensive as possible in their review of the literature within the African context, where available. Complexities brought about by the context are also covered in this book, such as cultural and linguistic diversity as well as traditional and alternative health care, regarding preventive audiology within the South African context. As each chapter explores prevailing complexities and challenges, potential solutions and recommendations for all challenges identified are also offered, having carefully and deliberately engaged with local evidence, local context and local policies and regulations to ensure an Afrocentric contribution to the world of evidence. All chapters in the book have a goal of ensuring that increased efforts are directed towards the provision of clinical services that are driven through best practice by contextually relevant and responsive evidence.

The aforementioned is performed with strict observance of academic writing protocols such as critical engagement with evidence and adherence to plagiarism rules through consistent referencing. The case for preventive audiology has been made in the previous book in this series; thus, the focus of this edited book is on the complexities and challenges towards achieving this goal within the African context. All chapters underwent a two-stage rigorous independent peer review by experts in the field and an independent review via AOSIS Publishers.

The chapters contain no plagiarism, and the book represents a scholarly discourse. The book's target audience consists of specialists in the field of Audiology and Public Health.

**Katijah Khoza-Shangase**, Department of Audiology, Faculty of Humanities, School of Human and Community Development, University of the Witwatersrand, Johannesburg, South Africa



# Contents

Abbreviations and acronyms, boxes, figures and tables appearing in the text and notes	xiii
List of abbreviations and acronyms	xiii
Box list	xvi
List of figures	xvi
List of tables	xvii
Notes on contributors	xix
Acknowledgements	xxv
<b>Chapter 1: Complexities and challenges in preventive audiology within the African context</b>	<b>1</b>
<i>Katijah Khoza-Shangase</i>	
1.1. Introduction	1
1.2. Exploration of the health care context within which preventive audiology must be located: Systems thinking approach	4
1.3. Challenges faced by African health systems and potential solutions	10
1.4. Conclusion	20
<b>Chapter 2: Implementation of early hearing detection and intervention in South Africa</b>	<b>23</b>
<i>Katijah Khoza-Shangase</i>	
2.1. Introduction	23
2.2. Early hearing detection and intervention programmes' implementation-related challenges: From detection to intervention	27
2.3. Challenges with follow-up return rate	33
2.4. Challenges with early hearing detection and intervention programmes data management (capturing, standardisation and reporting)	35
2.5. COVID-19-related early hearing detection and intervention programmes' complexities, challenges and opportunities	37
2.6. Conclusion	39
<b>Chapter 3: Complexities and challenges with implementation of communication therapeutic approaches to early intervention in audiology in the African context</b>	<b>41</b>
<i>Aisha Casoojee &amp; Katijah Khoza-Shangase</i>	
3.1. Introduction	41
3.2. Communication therapeutic approaches	43



3.3. Factors influencing the choice of communication therapeutic approaches	47
3.4. Complexities and challenges with choice of communication therapeutic approaches in Africa	49
3.5. Conclusion	53

**Chapter 4: Complexities with family-centred early hearing detection and intervention services in Africa** **55**

*Ntsako P. Maluleke & Katijah Khoza-Shangase*

4.1. Introduction	55
4.1.1. Lack of knowledge of infant hearing impairment	59
4.1.2. Universal newborn hearing screening is not mandated	61
4.1.3. Services are fragmented	64
4.1.4. Distance and transport challenges	64
4.1.5. Cost of services	65
4.1.6. Resource constraints	66
4.1.7. Language and culture	67
4.2. Conclusion	68

**Chapter 5: Challenges and complexities with assessment and management of middle ear pathologies in Africa** **71**

*Ben Sebothoma & Katijah Khoza-Shangase*

5.1. Introduction	71
5.1.1. Consequences of untreated middle ear pathologies	74
5.1.2. Risk factors for middle ear pathologies	74
5.2. Available detection/identification and preventive methods for middle ear pathologies	77
5.2.1. Wideband acoustic immittance	78
5.2.2. Pure tone audiometry	79
5.2.3. Otoacoustic emissions	80
5.2.4. Clinical examination of the middle ear	81
5.3. Available intervention methods for middle ear pathologies	84
5.4. Complexities with identification and management of middle ear pathologies	84
5.5. Conclusion	88

<b>Chapter 6: Challenges and complexities with assessment and management of ototoxicity in South Africa</b>	<b>91</b>
<i>Katijah Khoza-Shangase</i>	
6.1. Introduction	91
6.2. Exploration of challenges and complexities in ototoxicity assessment and management	96
6.2.1. Adult population	96
6.2.2. Paediatric population	102
6.3. Challenges and complexities in vestibulotoxicity assessment and management	105
6.4. Conclusion	106
<b>Chapter 7: Exploration of complexities in the management of occupational noise-induced hearing loss in the mining sector in sub-Saharan Africa</b>	<b>107</b>
<i>Nomfundo F. Moroe &amp; Katijah Khoza-Shangase</i>	
7.1. Introduction	107
7.2. Occupational noise-induced hearing loss in the mining and mineral sector	108
7.3. Occupational noise-induced hearing loss in sub-Saharan Africa explored	110
7.3.1. Occupational health and safety as a human rights requirement	111
7.3.2. Neglect of basic human rights within the mining industry in Africa	113
7.3.3. The neglect of occupational noise-induced hearing loss in the mining sector in South Africa	115
7.4. Complexities in the management of occupational noise-induced hearing loss in sub-Saharan Africa	118
7.4.1. Mineworkers' awareness and attitudes towards noise exposure	119
7.4.2. The absence of audiologists in hearing conservation programmes' decision-making	120
7.4.3. Lag in the use of information and communication technologies for efficient record-keeping	121
7.4.4. Hearing conservation programmes as complex interventions	121
7.4.5. Focus on the effectiveness of hearing conservation programmes rather than on the implementation process	122
7.5. Conclusion	123

**Chapter 8: Complexities with hearing conservation programmes in South African mines: Applying complex interventions theory 125**

*Nomfundo F. Moroe & Katijah Khoza-Shangase*

8.1. Introduction	125
8.1.1. Definition and description of complex interventions for health improvement	126
8.1.2. Realist reviews and evidence-based complex interventions	128
8.1.3. Hearing conservation programmes in South Africa	129
8.1.4. Hearing conservation programmes as complex interventions	131
8.1.4.1. Feature 1: Complex interventions are theory-driven	132
8.1.4.2. Feature 2: Complex interventions are active	133
8.1.4.3. Feature 3: Complex interventions comprise long journeys	134
8.1.4.4. Feature 4: Complex interventions are non-linear in their implementation chains	134
8.1.4.5. Feature 5: Complex interventions are fragile	135
8.1.4.6. Feature 6: Complex interventions are prone to be borrowed	135
8.1.4.7. Feature 7: Complex interventions are open systems that feed back on themselves	135
8.1.5. Other settings where complex interventions have been implemented in sub-Saharan Africa	136
8.1.6. Considerations in implementing hearing conservation programmes as complex interventions	137
8.2. Conclusion	139

**Chapter 9: Using machine learning systems to predict occupational hearing loss for mineworkers in South Africa: A case study of ethical challenges to research in preventive audiology in the mining industry 141**

*Liepollo Ntlhakana*

9.1. Introduction	142
9.2. Predicting occupational hearing loss using machine learning systems	145
9.3. Record-keeping methods for occupational noise-induced hearing loss prevention	147
9.4. Ethical guidelines for electronic health records	148
9.5. Ethical issues when using machine learning systems to predict and prevent occupational noise-induced hearing loss	149
9.5.1. Confidentiality	150
9.5.2. Justice	150

9.5.3. Beneficence	152
9.5.4. Autonomy	152
9.6. Recommendations	153
9.7. Conclusion	154

## **Chapter 10: Complexities with context: Cultural and linguistic diversity challenges in preventive audiology in Africa** **155**

*Munyane Mophosho, Khetsiwe P. Masuku & Katijah Khoza-Shangase*

10.1. Introduction	155
10.2. Cultural, linguistic and contextual diversity	161
10.3. Preventive health care	162
10.4. Preventive audiology	162
10.5. Factors influencing the provision of culturally and linguistically appropriate preventive audiology at the various levels of prevention	167
10.6. Recommendations	171
10.7. Conclusion	174

## **Chapter 11: Complexities linked to traditional healing and alternative health care practices and preventive audiology in South Africa** **177**

*Dhanashree Pillay, Najeebah Moola & Tshepang Serooe*

11.1. Introduction	178
11.2. Healing in context	179
11.3. History of South Africa: Complexities linked to traditional healing and alternative health care being shaped by religion	181
11.4. Complexities linked to traditional healing and alternative health care: Global overview with a focus on South Africa	185
11.4.1. Rehabilitation health care and its links to traditional healing and alternative health care	188
11.4.1.1. Theme 1: Traditional healing and alternative health care as a substitute to biomedicine	189
11.4.1.2. Theme 2: Traditional healing and alternative health care is perceived positively and negatively	189
11.4.1.3. Theme 3: Rehabilitation health care professionals' perceptions, thoughts and experiences related to traditional healing and alternative health care within the current health care system in South Africa	191
11.4.1.4. Theme 4: Training at university	193

Contents

11.4.1.5. Theme 5: Herbal medication or dietary changes for prevention and treatment within the Muslim communities	193
11.4.2. Prevention is better than a cure	194
11.5. Solutions and recommendations	195
11.6. Conclusion	196
<b>References</b>	<b>197</b>
<b>Index</b>	<b>269</b>

# Abbreviations and acronyms, boxes, figures and tables appearing in the text and notes

## List of abbreviations and acronyms

AAA	American Academy of Audiology
AABR	automated auditory brainstem response
AAC	augmentative and alternative communication
ABR	auditory brainstem response
AFMC	Association of Faculties of Medicine of Canada
AI	artificial intelligence
AIDS	acquired immunodeficiency syndrome
AOM	acute otitis media
APDs	auditory processing difficulties
ART	antiretroviral therapy
ASHA	American Speech-Language-Hearing Association
AVT	auditory verbal therapy
BANC	basic antenatal care
BP	before present
BRIC	Brazil, Russia, India and China
BSA	British Society of Audiology
CAAC	Centre for Augmentative and Alternative Communication
CARTA	Consortium for Advanced Research Training in Africa
CDC	Centers for Disease Control and Prevention
CHW	community health worker
CIs	complex interventions
CLD	cultural and linguistic diversity
COVID-19	coronavirus disease 2019
CSDH	Commission on the Social Determinants of Health
CSOM	chronic suppurative otitis media
CHL	conductive hearing loss
CMO	context, mechanism and outcomes
CoP	code of practice
CSIR	Council for Scientific and Industrial Research

CTAs	communication therapeutic approaches
DALYs	disability-adjusted life years
DHS	district health system
DME	Department of Minerals and Energy of South Africa
DMRE	Department of Mineral Resources and Energy of South Africa
DPOAE	distortion-product otoacoustic emission
DoH	Department of Health
EAL	English Additional Language
EBIs	evidence-based interventions
ECI	early communication intervention
EHDI	early hearing detection and intervention
EHSs	electronic health care systems
EI	early intervention
EPIC	equitable population-based innovations for communications
ERIC	expert recommendations for implementing change
FC-EHDI	family-centred early hearing detection and intervention
FCEI	family-centred early intervention
GDP	gross domestic product
GNR	Regulation Gazette Number
GPs	general practitioners
HAART	highly active antiretroviral therapy
HAIs	health care-associated infections
HCPs	hearing conservation programmes
HCWs	health care workers
HICs	high-income countries
HI HOPES	Home Intervention Hearing and Language Opportunities Parent Education Services
HIV	human immunodeficiency virus
HPDs	hearing protection devices
HPCSA	Health Professions Council of South Africa
ICTs	information and communication technologies
JCIH	Joint Committee on Infant Hearing
k-NN	k-nearest neighbour
LMICs	low- and middle-income countries
LOCHI	longitudinal outcomes of children with hearing impairment
LSL	listening and spoken language
MHSC	South African Mine Health and Safety Council
MHSI	South African Mine Health and Safety Inspectorate
MLSs	machine learning systems

MRC	Medical Research Council
NGO	non-governmental organisation
NHI	national health insurance plan
NHS	newborn hearing screening
NICU	neonatal intensive care unit
NIHL	noise-induced hearing loss
NIHSS	National Institute for the Humanities and Social Sciences
NIOSH	National Institute for Occupational Safety and Health
NLPF	National Language Policy Framework
NPRC	National Patients' Rights Charter
OAEs	otoacoustic emissions
ODMWA	<i>Occupational Diseases in Mines and Works Act</i>
OHL	occupational hearing loss
OHS	occupational health and safety
OME	otitis media with effusion
OMPs	occupational medical practitioners
ONIHL	occupational noise-induced hearing loss
OM	otitis media
OHSA	<i>Occupational Health and Safety Act 85 of 1993</i>
PADI	People for the Awareness of Disability Issues
PANDA	patient and decision aids
PDMS	proactive data management system
PHC	primary health care
PLH	percentage loss of hearing
PoPIA	<i>Protection of Personal Information Act</i>
PPE	personal protective equipment
RRs	realist reviews
SAAA	South African Association of Audiologists
SABS	South African Bureau of Standards
SADC	Southern African Development Community
SAHPRA	South African Health Products Authority
SAHR	South African Health Review
SAMRAC	Safety in Mines Research Advisory Committee
SANS	South African National Standards
SASLHA	South African Speech-language Hearing Association
SHIFT	Successful health care Improvement from Translating
SLH	speech, language and hearing
StatsSA	Statistics South Africa



STS	standard threshold shift
SVM	support-vector machine
TAC	treatment action campaign
TB	tuberculosis
TEOAE	transient evoked otoacoustic emission
THAH	traditional healing and alternative health care
TNHS	targeted newborn hearing screening
TORCH	toxoplasmosis, rubella, cytomegalovirus, herpes simplex and HIV
TWA	time-weighted average
UHC	universal health coverage
UNAIDS	Joint United Nations Programme on HIV/AIDS
UNHS	universal newborn hearing screening
URTI	upper respiratory tract infections
USA	United States of America
US FDA	United States Food and Drug Administration
VEMPs	Vestibular-evoked Myogenic Potentials
vHIT	video head impulse test
VNG	videonystagmography
WAI	wideband acoustic immittance
WHO	World Health Organization

### **Box list**

Box 4.1: Risk factors for infant and childhood hearing impairment. 60

### **List of figures**

Figure 1.1:	Important elements of the system that need to be considered in the systems thinking approach to health care.	5
Figure 1.2:	Factors that make health care complex.	7
Figure 1.3:	Health systems building blocks.	11
Figure 2.1:	Complexities and challenges in the implementation of EHDI.	25
Figure 4.1:	Complexities and challenges hindering the national implementation of FC-EHDI.	57
Figure 7.1:	Complexities in the management of occupational noise-induced hearing loss in the sub-Saharan Africa.	119

Figure 8.1:	Features of hearing conservation programmes as complex interventions.	132
Figure 8.2:	Challenges to complex interventions design at every step of design implementation.	138
Figure 10.1:	The six building blocks of a health system.	161
Figure 10.2:	Examples of tertiary-level preventive initiatives.	167
Figure 10.3:	Tertiary intervention strategies in audiology.	169
Figure 10.4:	Aspects to consider during the implementation of preventive audiology at the different levels of prevention.	173

### **List of tables**

Table 4.1:	Adapted early hearing detection and intervention time frames for the South Africa context.	62
Table 9.1:	Summary of ethical principles.	150
Table 9.2:	Summary of regulations for South African mines.	151
Table 9.3:	Summary of datasets used for hearing conservation.	151
Table 11.1:	Types of traditional healing and alternative health care in the South African context.	190



# Notes on contributors

## **Katijah Khoza-Shangase**

Department of Audiology, Faculty of Humanities,  
School of Human and Community Development,  
University of the Witwatersrand,  
Johannesburg, South Africa  
Email: [katijah.khoza-shangase@wits.ac.za](mailto:katijah.khoza-shangase@wits.ac.za)  
ORCID: <https://orcid.org/0000-0002-6220-9606>

Katijah Khoza-Shangase holds a PhD in Speech and Hearing Therapy from the University of the Witwatersrand and is a professor and the former Head of the Speech Pathology and Audiology Department at the University of the Witwatersrand, Johannesburg, South Africa. She was a finalist in the academic category of the Businesswomen Association of South Africa's Finalist in 2017. She has played an instrumental leadership role in the Health Professions Council of South Africa (HSPCA). Khoza-Shangase has received numerous awards, primarily in the areas of research and research supervision, and for her contributions to the scholarly field of audiology. She has authored multiple publications, including peer-reviewed journal articles, technical and research reports, book chapters, articles in conference proceedings and co-edited books. Published in 2019, *Black Academic Voices: The South African Experience* received the 2020 Humanities and Social Sciences (HSS) Award in the non-fiction category from the National Institute of Humanities and Social Sciences (NIHSS) and is one of her most current contributions to the transformation and decolonisation research project. Khoza-Shangase's edited book *Early detection and intervention in audiology: An African perspective* by Wits University Press was released in 2021 and nominated for the HSS 2022 Awards. She also co-edited two special issues for the *South African Journal of Communication Disorders* (2020, 2022), titled *Occupational hearing loss in Africa: An interdisciplinary view of the current status* and *The impact of COVID-19 on SLH professions in LMICs: Challenges and opportunities explored*. Khoza-Shangase's latest research books, *Occupational noise-induced hearing loss: An African perspective* and *Complexities and challenges in preventive audiology: An African perspective*, were published in 2022 by AOSIS Books, an imprint of AOSIS Scholarly Books, a division of AOSIS Publishing. The 2022 World Scientist and University Rankings ranked her second at the University of the Witwatersrand, third in South Africa and in Africa, fourth in the BRICS countries, and 97th in the world.

## **Aisha Casoojee**

Department of Audiology, Faculty of Humanities,  
School of Human and Community Development,  
University of the Witwatersrand,  
Johannesburg, South Africa  
Email: [aisha.casoojee@wits.ac.za](mailto:aisha.casoojee@wits.ac.za)  
ORCID: <https://orcid.org/0000-0001-5700-0528>

Aisha Casoojee obtained her Bachelor of Communication Pathology degree from the University of Pretoria in 2002, and has an additional licensing in cochlear implantation after successfully completing a Health Professions Council of South Africa accredited postgraduate course at the University of Stellenbosch in 2006. She furthermore obtained her MA in Audiology in 2012 at the University of the Witwatersrand. She qualified as an auditory verbal therapist in 2013 at the University of Stellenbosch and as a reading therapist in 2014 at Read for Africa. Aisha has attended an international course in cochlear implantation at the University of Leiden, the Netherlands, and an international cochlear implantation training workshop in Melbourne, Australia. She worked as a clinician at the Chris Hani Baragwanath Hospital for several years, during which time she was an instrumental team member in the development and launch of the first ever fully state-funded cochlear implant programme in South Africa. Casoojee is a lecturer and clinical supervisor in the Audiology Department at the University of the Witwatersrand, Johannesburg, South Africa. She is a member of a variety of committees and boards, both in a professional and personal capacity, thus enhancing her community involvement. Casoojee has published chapters and journal articles and has presented at national and international congresses and symposiums. She continues to engage in research and research supervision and maintains her continuous professional development.

**Ntsako P. Maluleke<sup>a,b</sup>**

<sup>a</sup>Department of Speech-Language Pathology and Audiology, Faculty of Health Sciences, School of Health Care Sciences, Sefako Makgatho Health Sciences University, Pretoria, South Africa;

<sup>b</sup>Department of Audiology, Faculty of Humanities, School of Human and Community Development, University of the Witwatersrand, Johannesburg, South Africa  
Email: precious.slp@gmail.com  
ORCID: <https://orcid.org/0000-0003-1206-0011>

Ntsako P. Maluleke holds an undergraduate degree in Speech and Hearing Therapy and a MA in Audiology from the University of the Witwatersrand. She is an audiologist and a former lecturer in the Department of Speech-Language Pathology and Audiology at the Sefako Makgatho Health Sciences University in Ga-Rankuwa in Pretoria, South Africa. Maluleke, as an emerging researcher and scholar, has authored several peer-reviewed articles and scholarly book chapters and presented her research at various conferences. Her research interests include early hearing detection and intervention, childhood and school-age hearing impairment, and family-centred intervention. During the writing of this book, she was a PhD candidate at the University of the Witwatersrand, focusing on 'Family-centred EHDI services in South Africa: Caregivers' experience and evaluation of the process and practices in Gauteng'.

**Ben Sebothoma**

Department of Audiology, Faculty of Humanities,  
 School of Human and Community Development,  
 University of the Witwatersrand,  
 Johannesburg, South Africa  
 Email: ben.sebothoma@wits.ac.za  
 ORCID: <https://orcid.org/0000-0003-4773-3204>

Ben Sebothoma is the first Black African male to obtain a PhD in Audiology on the continent of Africa at the University of the Witwatersrand, focusing on middle ear pathologies in HIV and AIDS. He completed his undergraduate training at the University of Cape Town and his MA in Audiology at the University of the Witwatersrand. He is a clinical audiologist and a lecturer in the Department of Audiology at the University of the Witwatersrand in Johannesburg, South Africa. He has lectured and supervised undergraduate and postgraduate students. He has published several scientific research papers in accredited journals, chapters in peer-reviewed scholarly books, and presentations in local and international conference proceedings. His research areas include prevention, identification and management of middle ear pathologies across the lifespan in low- and middle-income countries.

**Nomfundo F. Moroe**

Department of Audiology, Faculty of Humanities,  
 School of Human and Community Development,  
 University of the Witwatersrand,  
 Johannesburg, South Africa  
 Email: nomfundo.moroe@wits.ac.za  
 ORCID: <https://orcid.org/0000-0001-7186-5632>

Nomfundo F. Moroe holds a PhD and is an associate professor and the former Head of the Discipline of Audiology at the University of the Witwatersrand in Johannesburg, South Africa. She is part of the Department of Higher Education and Training's (DHET) NGap Programme – a programme that involves the recruitment of competent scholars as new academics against carefully designed and balanced equity considerations and in light of the disciplinary areas of greatest need. Moroe is a passionate researcher interested in occupational audiology, complex interventions, deaf culture and deaf-blindness. She is a CARTA Fellow (Consortium for Advanced Research Training in Africa), a highly competitive programme that trains young and emerging African researchers, and she was conducting postdoctoral research funded by CARTA during the writing of the chapter. She has published several peer-reviewed articles and book chapters and presented at national and international conferences. She has co-edited a special issue scholarly journal for the *South African Journal of Communication Disorders* (AOSIS Journals 2020) titled *Occupational hearing loss in Africa: An interdisciplinary view of the current status*. Moroe's latest publication includes a co-edited book titled *Occupational noise-induced hearing loss: An African perspective* (2022) by AOSIS Books, an imprint of AOSIS Scholarly Books, a division of AOSIS Publishing.

### **Liepollo Ntlhakana**

Department of Audiology, Faculty of Humanities,  
School of Human and Community Development,  
University of the Witwatersrand,  
Johannesburg, South Africa  
Email: liepollo.ntlhakana@wits.ac.za  
ORCID: <https://orcid.org/0000-0002-8632-0616>

Liepollo Ntlhakana holds a PhD from the School of Public Health at the University of Witwatersrand with research focusing on 'Noise-induced hearing loss (NIHL) in mine workers in South Africa: Risk assessment explored'. Ntlhakana is a lecturer and Deputy Head of the Department of Audiology at the University of the Witwatersrand in Johannesburg, South Africa. She lectures and supervises both audiology undergraduate and postgraduate students. Besides teaching in the Department of Nursing's Occupational Health Nursing Programme, she is also a guest lecturer for the Audiometry short course. Ntlhakana's keen interest in occupational audiology stems from years of experience as the Occupational Audiology portfolio manager for the South African Association of Audiologists (SAAA). Her postdoctoral work focuses on developing a predictive model for the early identification of occupational noise-induced hearing loss (ONIHL).

### **Munyane Mophosho**

Department of Speech Pathology, Faculty of Humanities,  
School of Human and Community Development,  
University of the Witwatersrand,  
Johannesburg, South Africa  
Email: ebmmophosho@gmail.com  
ORCID: <https://orcid.org/0000-0002-9541-3945>

Munyane Mophosho is a retired former senior lecturer in the Department of Speech Pathology at the University of the Witwatersrand, Johannesburg, South Africa. She served as a lecturer at the University of Pretoria's Centre for Augmentative and Alternative Communication (CAAC) before joining Wits in February 2004. As a former board member of the Health Professions Council of South Africa, she has served in significant leadership roles in the speech, language and hearing professions. She received funding from the Thuthuka Research Fund from the National Research Foundation and from the National Institute of Social Science's African Pathways Programme, which included guest lecturing at the University of Ghana's Department of Speech-Language Pathology in Accra. In 2017, she was invited to be a guest lecturer on service learning to MA students in speech pathology at St John's University in the United States. She was a member of the JET Education Services' Consortia of Inclusive Education Experts (Sisonke Inclusive Education Pilot Project) in 2005. She teaches academic service learning and augmentative and alternative communication (AAC) and supervises undergraduate and postgraduate students in clinical training and research. She has published numerous peer-reviewed journal articles, technical and research reports, book chapters and

co-edited books, and she has presented in both local and international congresses over the years.

### **Khetsiwe P. Masuku**

Department of Speech Pathology, Faculty of Humanities,  
School of Human and Community Development,  
University of the Witwatersrand,  
Johannesburg, South Africa  
Email: [khetsiwe.masuku@wits.ac.za](mailto:khetsiwe.masuku@wits.ac.za)  
ORCID: <https://orcid.org/0000-0003-3413-689X>

Khetsiwe P. Masuku holds a MA in Public Health and a PhD in Augmentative and Alternative Communication (Severe Disability), and is a lecturer in the Department of Speech Pathology at the University of the Witwatersrand in Johannesburg, South Africa. Masuku lectures and supervises speech pathology students at both undergraduate and postgraduate levels. As a researcher, she is interested in the topic of disability, specifically about access for persons with disabilities and caregivers of persons with disabilities. In addition, she is interested in the implementation of disability policies in the context of the African continent. Her other research interests include research in aphasia and deafblindness. She has published several research articles and chapters in peer-reviewed journals and scholarly books.

### **Dhanashree Pillay**

Department of Audiology, Faculty of Humanities,  
School of Human and Community Development,  
University of the Witwatersrand,  
Johannesburg, South Africa  
Email: [dhanashree.pillay@wits.ac.za](mailto:dhanashree.pillay@wits.ac.za)  
ORCID: <https://orcid.org/0000-0003-0592-7780>

Dhanashree Pillay worked as a junior audiologist at the Charlotte Maxeke Johannesburg Academic Hospital – General Hospital while completing her master’s degree at the University of Pretoria under full research scholarship. She graduated with her MA in Communication Pathology (Audiology) in 2010 and obtained her PhD in 2018. Dr Pillay is a senior lecturer and current Head of Discipline (Audiology) at the University of the Witwatersrand, Johannesburg, South Africa. She is an audiologist who has worked in rural KwaZulu-Natal (KZN) and has been involved in the Red Cross Air Mercy Service Outreach Programmes within Northern KZN. She was also involved in audiological programmes in the rural and urban areas of KZN. She is a board member of the PADI (People for the Awareness of Disability Issues) organisation in South Africa and is also a member of the Standards Division at the South African Bureau of Standards (SABS), where she is involved in the writing up of policies and procedures. Dr Pillay has published in scholarly journals and has presented at both national and international conferences. She is also a journal reviewer. Pillay’s research interests focus on the areas of amplification, spirituality, religion and traditional beliefs and practices, as well as sports medicine



and noise. She is involved in the clinical and research supervision of both undergraduate and postgraduate students.

### **Najeebah Moola**

Department of Audiology, Faculty of Humanities,  
School of Human and Community Development,  
University of the Witwatersrand,  
Johannesburg, South Africa  
Email: naj.moola@gmail.com  
ORCID: <https://orcid.org/0000-0001-9060-3902>

Najeebah Moola is a speech therapist and audiologist who obtained her BA (Speech and Hearing Therapy) in 2017 from the Department of Speech Pathology and Audiology at the University of the Witwatersrand, Johannesburg, South Africa. She is currently enrolled for a MA in audiology at the same university, with her research focus on traditional and alternative health care practices and audiology in South Africa. She has attended and presented at national and international conferences and has published scholarly articles. Moola has worked in both the private and public health care sectors, including peri-urban areas, in South Africa. She is currently working in private practice and educational settings and as a clinical educator at the University of the Witwatersrand. Moola does relief work within Gauteng. She conducts and attends workshops relating to her field of work and interests. Her interests include traditional and alternative health care, transformation, central auditory processing disorders and educational audiology.

### **Tshepang Serooe**

Department of Audiology, Faculty of Humanities,  
School of Human and Community Development,  
University of the Witwatersrand,  
Johannesburg, South Africa  
Email: tpserooe@gmail.com  
ORCID: <https://orcid.org/0000-0003-0833-6265>

Tshepang Serooe is a speech therapist and audiologist who obtained her BA (Speech and Hearing Therapy) in 2016 from the Department of Speech Pathology and Audiology at the University of the Witwatersrand, Johannesburg, South Africa. She has worked in both the public and private health care sectors in South Africa, and she has also worked at a school for the deaf. She is currently a junior speech therapist and audiologist at the Tshwane District Health Care Services. Her areas of clinical interest are early childhood intervention, language development, dysphagia and amplification. Serooe has published her work in spirituality, religion and traditional beliefs and practices in audiology, and she has presented at conferences, an area she wants to pursue further in terms of research.

# Acknowledgements

I would like to acknowledge the chapter contributors for their significant contributions to this book. I wish to also acknowledge my precious family for their unending and unconditional support during the journey of putting this book together. I am also greatly indebted to the following scholars and academics who generously agreed to serve as reviewers for chapters, contributing significantly to the quality assurance of this valuable output:

- Dr S. Govender (Sefako Makgatho Health Sciences University)
- Ms S.N. Adams (University of the Witwatersrand)
- Dr K.P. Masuku (University of the Witwatersrand)
- Prof. S. Dada (Centre for Augmentative & Alternative Communication, University of Pretoria)
- Dr N.F. Moroe (University of the Witwatersrand)
- Dr A. Mupawose (University of the Witwatersrand)
- Ms N. Khan (University of KwaZulu-Natal)
- Dr J. Seedat (University of the Witwatersrand)
- Dr M. Mophosho (University of the Witwatersrand)
- Mrs N.P. Maluleke (Sefako Makgatho Health Sciences University)
- Prof. K. Joubert (University of the Witwatersrand)
- Mrs L. Petrocchi-Bartal (University of the Witwatersrand)
- Dr A. Edwards (Africa Health Research Institute)
- Dr J. Neille (University of the Witwatersrand)
- Ms N. Nagdee (University of the Witwatersrand)

This publication was made possible through a grant received from the National Institute for the Humanities and Social Sciences (NIHSS).



# Complexities and challenges in preventive audiology within the African context

**Katijah Khoza-Shangase**

Department of Audiology, Faculty of Humanities,  
School of Human and Community Development,  
University of the Witwatersrand,  
Johannesburg, South Africa

## ■ 1.1. Introduction

The success of any preventive health care programme is reliant on a functional health care system, where the World Health Organization (WHO) (2012) asserted that 'patients depend on many individuals doing the right thing at the right time'. The WHO described this as a system of care. Within this system of care, health care professionals, including audiologists, can only practise safely and effectively if they possess an appreciation of the complex relationships and interactions that occur in health care. Where health care professionals have such awareness that aids them to recognise opportunities for errors that can cause harm to patients, and where they take steps to prevent these mistakes, is where preventive health care is positioned – which is what this book is about for the African audiology profession, with South Africa being the key case study but not to the exception of the rest of the

**How to cite:** Khoza-Shangase, K 2022, 'Complexities and challenges in preventive audiology within the African context', eds. K Khoza-Shangase, *Complexities and challenges in preventive audiology: An African perspective*, AOSIS Books, Cape Town, pp. 1-21. <https://doi.org/10.4102/aosis.2022.BK311.01>

continent in some chapters. In this chapter, an introduction to preventive audiology is provided with a rationale advanced for its value within the resource-constrained African context. Then, guided by the WHO's (2010) six core components of health systems, evidence on the African health care context within which preventive audiology must be located is comprehensively explored, with a clear illustration of how challenges within this context influence preventive audiology implementation provided. All this is done with the goal of ensuring that ear-and-hearing health care practitioners within the African context avoid the context-naïve approach to service delivery (Khoza-Shangase & Mophosho 2018) and are well aware of the complexities and challenges in preventive audiology within such a context.

Khoza-Shangase (2022) asserts that preventive audiology, located within preventive health care, is an important paradigm shift that ear-and-hearing health care practitioners in low- and middle-income countries (LMICs) such as South Africa should adopt. This recommendation is fuelled by socio-economic, political and burden-of-disease contextual realities in these contexts; for South Africa, it is further driven by the South African re-engineered primary health care (PHC) strategy that steers the health care system (Mayosi et al. 2012; Naidoo 2012). Preventive audiology consists of measures taken for ear-and-hearing disease or disorder prevention and or minimisation of the consequences, which can include prevention of a number of factors, including lifestyle choices, environmental factors, genetic predisposition and burden of disease, as well as other causes. Khoza-Shangase (2022) suggests that because South Africa is a resource-constrained LMIC, carefully deliberated anticipatory actions, categorised as primordial, primary, secondary or tertiary prevention, are required to mitigate the challenge of high numbers of individuals with a preventable hearing impairment from the cradle to the grave.

With the global estimates of the prevalence of disabling hearing impairment set to increase, as reported by WHO (2018a), where the current estimates indicate just over 6% of the world's population with disabling hearing loss, all indications are there, particularly in LMICs, for strategic planning in how ear-and-hearing health care is provided. The WHO estimated that by 2050, the number of people with disabling hearing loss will grow to over 900 million globally (WHO 2018a). The author of this chapter believes that this number can be lessened or its consequences minimised if preventive audiology is effectively implemented.

Because hearing loss results from a variety of causes seen and managed within a health care system – and most of those causes are preventable – a well-functioning health care system is paramount to the success of preventive audiology initiatives and interventions. Nieman, Reed and Lin (2018) listed causes of hearing loss as including complications at birth, chronic ear infections, genetic causes, certain infectious diseases, ototoxicity and exposure to

excessive hazardous noise, as well as ageing – with a large majority of these causes being preventable in nature. Martin et al. (2006), for instance, reported that over a billion young people aged 12–35 years are at risk of preventable recreational noise-induced hearing loss (NIHL), and the WHO (2018a) reported that 60% of childhood hearing loss is caused by preventable causes. Khoza-Shangase, Moroe and Edwards (2020a) also strongly argued that the prevalence of occupational noise-induced hearing loss (ONIH), within the African context, can be significantly decreased or its effects can be minimised through efficient and effective hearing conservation programmes (HCPs) that adopt complex interventions (CIs) as an intervention paradigm. Similarly, the occurrence and effects of ototoxicity and vestibulotoxicity within LMICs have the potential to be significantly mitigated through (1) efficient preventive programmes that involve careful selection and use of potentially ear-toxic medications, where alternatives do not yet exist; (2) ototoxicity monitoring for the early detection of hearing changes followed by efficient medical intervention to halt or minimise further damage to the ear; (3) prescription of less ototoxic medications such as the use of bedaquiline for the treatment of multidrug-resistant tuberculosis (TB); (4) prescription of otoprotective agents where possible; (5) early audiological interventions, including minimised exposure to noise while on ototoxic treatment, and so on (Govender & Paken 2015; Guo et al. 2010; Khoza-Shangase 2010, 2017; Khoza-Shangase, Lecheko & Ntlhakana 2020b; Khoza-Shangase & Masondo 2021; Khoza-Shangase & Prodromos 2021; Paken et al. 2016; Tsintis & La Mache 2004).

As far as ear infections are considered a major cause of preventable hearing loss, unidentified and unaddressed middle ear pathologies have significant implications for any country's health care system, over and above consequences for the affected individual (Sebothoma & Khoza-Shangase 2020). It is estimated that over 700 million people suffer from middle ear pathologies globally, with over half of these occurring in children (WHO 2018b). Preventive measures, including early identification and effective treatment of these pathologies, can prevent serious complications, including hearing loss, which can become permanent (Avnstorp et al. 2016; Kolo et al. 2012; Sharma et al. 2015; Villa & Zachetta 2014; The WHO 2018b). All these complications can be prevented, and their effects can be significantly minimised within a well-functioning, efficient health care system.

Based on the work of Shiell, Hawe and Gold (2008) and Hawe, Shiell and Riley (2009), Greenhalgh (2020, p. 87) highlighted the crucial point that 'complexity is a feature of the system, not merely a characteristic of interventions'. These authors advanced an argument that whether an intervention is simple (where there is just one active component that is not changing) or complex (where there are multiple interacting components), the 'system' where the intervention is applied will practically always have to

change in some way to accommodate that intervention. This raises important implications for preventive audiology within the African health care system, where opportunities for positive outcomes become minimised if interventions are not clear and systematic, with collaborative communication and interactions within the system.

## ■ 1.2. Exploration of the health care context within which preventive audiology must be located: Systems thinking approach

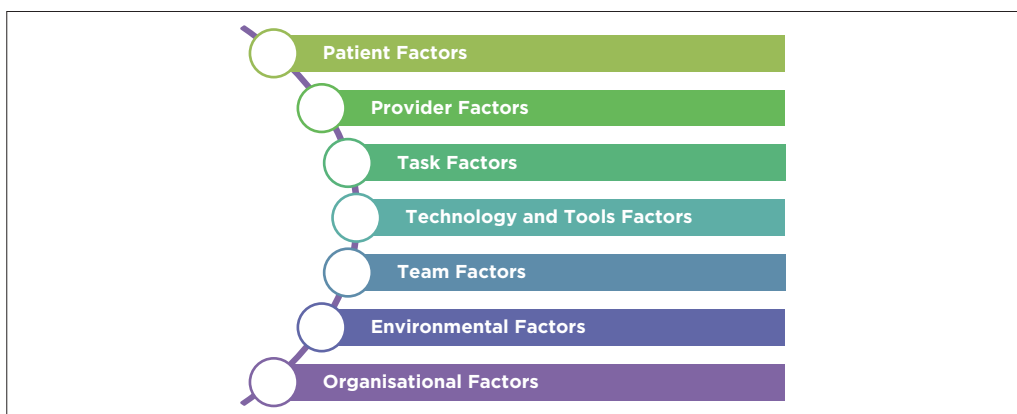
Rouse and Serban (2014) maintained that recognition of health care delivery as a complex adaptive system is pivotal to designing, implementing and monitoring a health care delivery system that is more equitable, efficient and effective, with better health outcomes production. This is the position that the author of this chapter holds insofar as the success and sustainability of preventive audiology services within any context (but more so in LMICs) are concerned. Breakthroughs in audiology and hearing science, innovations in audiological and habilitative technologies and improvements in clinical practices are discovered and published today at an increasingly rapid rate. If the African health care delivery system does not continuously take these advances on board because it is functioning in a fragmented manner, a significant number of Africans with hearing impairment will fail to access and benefit from these developments; hence, it is important to deliberate on the complexities and challenges in preventive audiology within the African context and how these can be addressed in order to be able to provide an accessible, high-quality and affordable ear-and-hearing health care for the general African population.

Plsek and Greenhalgh (2001) earlier warned that globally, across all disciplines – audiology included – and at all levels of health care, it has become more complex, with demands on health care providers increasing and diversifying, areas of specialisation becoming broader and increasing need for extensive professional development continued after qualification. This is a reality for audiology in all areas, but more so in information and communication technology (ICT) advancements and their influence on science, practice and ethics (Khoza-Shangase & Moroe 2020; Khoza-Shangase, Moroe & Neille 2021b; Khoza-Shangase, Sebothoma & Moroe 2021a; Naudé & Bornman 2021; Sebothoma et al. 2021a, 2021b). Furthermore, Plsek and Greenhalgh (2001) discussed how health care has moved from curative or treatment health care to preventive health care that is heavily dictated by published evidence, which is not always straightforward and undisputed; rather, it can be imprecise, equivocal or conflicting, as strongly argued for by Khoza-Shangase (2022) when advocating for a paradigm shift towards preventive audiology in the African context. This preventive health care approach must take cognisance

of the patient's declared preferences and values in a joint management decision about their illness, involving intervention by a multidisciplinary team.

Plsek and Greenhalgh (2001) further highlighted that the complexity in health care has also included changes in the approaches to diseases; for example, infectious diseases were previously controlled by finding the 'cause' (an alien organism) and putting up measures to contain or remove it. However, with the recent advances, current and new epidemics have fewer clear boundaries, with an understanding that they are the result of the interaction of numerous factors, including lifestyle choices, genetic predisposition and environmental context. This current posture on approaches to diseases and conditions correlates well with preventive audiology, where causes of hearing impairment are known to be a result of this very interplay and interrelatedness (Khoza-Shangase 2022).

Kannampallil et al. (2011), in their exploration of health care activities and initiatives in terms of complex systems theory, proposed a theoretical lens that can be adopted for investigating and understanding complexity in health care systems, based on what they term 'degrees of interrelatedness' of system components. These authors advanced an argument that because complex health care systems are commonly analysable, a systems thinking approach, examining interrelatedness within and between the different components, can be adopted for both functional and analysis purposes. For a systems thinking approach to be successfully implemented within health care, the WHO (2012) outlined seven elements of the system that need to be considered, and these are depicted in Figure 1.1.



Source: Adapted from Reason (1990, 1995, 2000, 2016) and Reason, Carthey and De Leval (2001).

**FIGURE 1.1:** Important elements of the system that need to be considered in the systems thinking approach to health care.



James Reason suggested the ‘Swiss cheese model’ to describe and clarify how medical adverse events occur as a sign of a system failure (Reason 1990, 1995, 2000, 2016; Reason et al. 2001). This model illustrates how outcomes of mistakes in different layers of a system are a result of numerous faults occurring in several layers, not just from one fault in one layer of a system (Perneger 2005). Specific to audiology, deafness incurred by an individual following treatment for multidrug-resistant TB can be a preventable adverse event that involves a number of mistakes at various layers, for example, (1) the government’s failure to manage social determinants of health that cause TB; (2) lack of TB screening services for early detection; (3) insufficient and or ineffective health education and awareness around TB and its treatment, as well as adherence to treatment; (4) lack of less ototoxic medications to treat TB; and (5) absence of ototoxicity monitoring and management as part of TB treatment programmes. All these challenges speak to different levels of care and to the roles of different stakeholders within a health care system; therefore, focusing on one problem at one level – and not focusing on the system, for example – does not efficiently address the challenge.

The WHO (2012) proclaimed that patients depend on a system of care for their health care needs to be efficiently met. It is, therefore, important that health care professionals, including audiologists practising within the African context, have a clear understanding of the complex relationships and interactions that exist in health care (Greenhalgh & Papoutsis 2018). Such understanding is said to facilitate practitioners’ ability to recognise the opportunities for errors that can harm patients (adverse events) and influence them to take steps to prevent such adverse events. This was advocated for by Khoza-Shangase (2022) when arguing for audiologists to ramp up efforts within the South African context to carefully consider the context within which they practise, including reflecting on the realities of the health care system they are located in and their impact on ear-and-hearing health care provision. If one follows the WHO’s (2012) definition of complex systems, the delivery of health care has been defined as fitting under a complex system because of the fact that it comprises a grouping of two or more interacting professions or an interdependent group of practitioners and professions forming a unified whole; these interacting parts are so many that it is a significant challenge to predict the behaviour of the system on the basis of knowledge of its component parts. This is core to the successful functioning of audiologists within this complex system where collaborative work is required – collaborative work that involves not only cognate health care providers but also non-professionals who serve in the role of task-shifting facilitators, as well as family members in family-centred interventions.

The World Health Organization (2012, p. 1) argued that health care is complex because of a number of factors that are applicable to audiology, as shown in Figure 1.2.



Source: Adapted from the WHO (2012, p. 1).

**FIGURE 1.2:** Factors that make health care complex.

These factors can be positive or negative influencing factors to the health care system; for example, increased specialisation of health care providers can facilitate patients' access to a broader range of services and treatments. Specialisation can also present more opportunities for errors to occur and things to go wrong (WHO 2012). Furthermore, these factors create numerous challenges for health care providers, requiring a comprehensive understanding of the system.

Health care professionals, including audiologists, may face many significant challenges in their line of duty, and they may also appreciate the various manifold components that are susceptible to dysfunction within the chain of health care delivery. The World Health Organization (2012) maintained that professionals often struggle to think in terms of systems because the concepts of systems theory often do not form part of their curriculum, and they also do not utilise its tools to understand the systems in which they provide services. This is an important consideration in both academic and clinical training of audiologists within the African context - inclusion in the curriculum of an understanding of systems approach and how this impacts health care delivery, of which audiology is a part.

Proponents of a systems approach highlight that such an approach requires stakeholders to view health care as a whole system, with all its interdependence, interrelatedness and complexity, thus transferring the attention from the individual to the health care organisation as a whole (Greenhalgh & Papoutsis 2018; Greenhalgh 2020; Kannampallil et al. 2011; Plsek & Greenhalgh 2001; Reason 1990, 1995, 2000, 2016; Reason et al. 2001). An example of the adoption of a systems approach would be where factors are addressed that influence preventive audiology initiatives, such as early hearing detection and intervention (EHDI) (e.g. lack of awareness, lack of policies and regulations mandating EHDI, poor processes and protocols, poor teamwork, equipment and human resource factors), rather than focusing on the people who are to be blamed for the lack of successful national EHDI programmes. This type of approach facilitates focusing on understanding and improving the EHDI processes, rather than blaming individuals, which yields unsustainable solutions.

Growing evidence indicates that responding to health care challenges and errors requires careful analysis of the system and creating changes to the system through a systems thinking approach (Greenhalgh 2020; Greenhalgh & Papoutsis 2018; Kannampallil et al. 2011; Khoza-Shangase et al. 2020a; Moroe 2020; Plsek & Greenhalgh 2001; Reed et al. 2018). Adoption of a system's approach calls for comprehension and action on the numerous factors involved in each of the multiple areas that comprise the health care system (WHO 2012), and this is important when preventive audiology is being planned, implemented and monitored. This approach facilitates the prevention of errors, adverse events and or challenges from occurring, or the approach

leads to the minimisation of consequences of the health care challenges (Reason 1990, 1995, 2000, 2016; Reason et al. 2001). The author of this chapter believes that preventive audiology is very well suited for the systems theory approach to health care, as its goal is in sync with systems thinking, that of preventive health care, and thus needs careful consideration in training and clinical practice by audiologists from the African context.

Although a systems approach to viewing is increasingly being adopted, Greenhalgh and Papoutsi (2018) lamented that it remains much talked about rather than acted upon or implemented. These authors believed that complexity in health care is much discussed but insufficiently investigated in health care services research and that even though (Greenhalgh & Papoutsi 2018):

[T]he significance of the complex system as an analytic lens is increasingly recognised, many researchers are still using methods that assume a closed system in which predictive studies in general, and controlled experiments in particular, are possible and preferred. (p. 1)

This 'talking about' instead of a paradigm shift to 'doing' a complex intervention, systems approach to health care has remained so despite significant and lauded work presented by Plsek and Greenhalgh (2001), where they carefully introduced complexity as a paradigm, provided an application of complexity principles to clinical care (Wilson, Holt & Greenhalgh 2001), illustrated complexity in leadership and management (Plsek & Wilson 2001) and demonstrated complexity in lifelong learning (Fraser & Greenhalgh 2001). These authors argued that if the systems approach is truly embraced, then research in health care must also investigate how the system can best address issues around unpredictability, uncertainty and emergent causality, and the author of this chapter is of the opinion that this is the only way that the goal of prevention can be achieved. Limited evidence exists, both internationally and locally, on the systems approach and the practice of audiology, and this has an influence on a clear understanding of health care systems within which audiologists must function.

This clear understanding is argued to determine how creative and adaptive solutions are to solve presenting health care needs at any given point in time. Greenhalgh and Papoutsi (2018) asserted that as the world rapidly moves, baselines also move, technologies collapse, actions are (diversely) inhibited, confidence becomes indefinable and the space between the material and political realities of the current time(s) and the evidence-based ideal may widen. This gap leads to decisions being made based on disputed or incomplete data. People consequently utilise their resourcefulness and produce adaptive solutions that make sense in their context. Khoza-Shangase and Mophosho (2018, 2021) comprehensively discussed this 'creativity' when they deliberate on the impact of cultural and linguistic diversity (CLD) in speech, language and hearing (SLH) professions' clinical training in South Africa, where adaptive

solutions have had to be made because of the lack of a culturally and linguistically appropriate (Afrocentric) knowledge base and clinical tools and measures, possibly to the detriment of the patient (Barratt, Khoza-Shangase & Msimang 2012).

Reed et al. (2018) introduced the research- and theory-driven framework to the approaches to dealing with complexity in health care, which is called successful health care improvement from translating evidence (SHIFT-Evidence). Through grounded theory and empirical auto-ethnography analysis on data collected over a five-year period across 22 quality improvement projects, these authors spotlighted the constant, adaptive nature of change and the surfacing behaviour of complex systems. Reed et al. (2018) highlighted tensions in three principles:

- (1) [E]mbedding evidence-based practices against local constraints ('acting scientifically and pragmatically'),
- (2) the importance of recognising and appreciating the complexity of systemic issues ('embracing complexity'), and
- (3) the need to facilitate commitment and engagement from important stakeholders ('engaging and empowering'). (p. 1)

This argument is strongly supported by Khoza-Shangase (2022) within the South African context, motivating for increased focus on preventive audiology, and by Kanji and Khoza-Shangase (2021) when arguing for a paradigm shift in the provision of EHDl in South Africa.

### ■ 1.3. Challenges faced by African health systems and potential solutions

Globally, health systems are documented to have faced significant challenges, including urbanisation and behavioural changes that have influenced the incidence of chronic diseases, persistently increased frequencies of infectious diseases and increasing rates of traumatic injuries, as well as pedestrian and motor vehicle accidents and violence (Durrani 2016; Fenny et al. 2018; Maphumulo & Bhengu 2019). Oleribe et al. (2019) asserted that health care systems in Africa commonly deteriorate as a result of underfinancing and disrepair, and this has contributed towards African health care experiencing significant challenges across the six WHO core components or 'building blocks' of health care systems, as depicted in Figure 1.3: '(1) service delivery, (2) health workforce, (3) health information systems, (4) access to essential medicines, (5) financing and (6) leadership/governance' (WHO 2010, p. vi).

Over and above the six building blocks, the WHO outlines general health system goals or outcomes as 'improving health and health equity, in ways that are responsive, financially fair, and make the best, or most efficient, use of available resources' (WHO 2007, p.2). Consequently, the performance of health care systems is determined through the assessment of aspects such as



Source: Adapted from the WHO (2010:vi).

**FIGURE 1.3:** Health systems building blocks.

access, patient safety and experience, cost, quality and equity within these core components (Ahluwalia et al. 2017).

Major challenges and approaches to alleviate health care service challenges in Africa were isolated by Oleribe et al. (2019) in an investigation performed as part of an African Epidemiological Association Meeting in Maputo, Mozambique, in which 11 African countries, Cuba, Portugal and the United Kingdom participated. The first three leading challenges that affect every initiative and programme, including ear-and-hearing health care, were insufficient human resources for health care, deficient budgetary allocation to health care, and poor management and leadership in health care. These challenges lead to health care systems in Africa that are predominantly in impracticable conditions with extremely inferior health outcomes, including poor quality of life indicators influenced by poor rehabilitative services (Oleribe et al. 2019). These findings are similar to those from several other investigations that sought to establish challenges for the health care system in Africa (Azevedo 2017; Benatar 2013; Coovadia et al. 2009; Maphumulo & Bhengu 2019; Oleribe et al. 2016, 2018). Oleribe et al. (2019) argued that challenges identified in their study explain greater than two-thirds of the perceived challenges in the African health care sector and that, as far as the

six WHO key components of the health care system are concerned, these identified leading challenges congregate around health care leadership and governance, financing, health care service delivery and health care workforce (Oleribe et al. 2019). The author of this chapter argues that the rest of the six components could be just as badly affected but may not have been the leading challenges; therefore, they must not be undermined during the prioritisation of these key identified challenges in planning. These components are health information systems and access to essential medicines or interventions.

The leading solutions suggested in Oleribe et al.'s (2019) study included health care workers' (HCWs) capacity-building and training, escalating budgetary allocation to health care and activism, and lobbying for political commitment and support. Oleribe et al. (2019) concluded that radical solutions that take advantage of advances in innovations are required in the African underdeveloped health care systems for better health outcomes. Such solutions would include, for example, (1) public-private partnerships, where multinational companies from high-income countries (HICs) benefitting from resources extracted from Africa could be inspired to invest some of the profits back into health care for the communities from which they draw their workforce for their businesses; and (2) prioritisation of leadership and management, budget allocation and human resources for health.

As illustrated by Oleribe et al. (2019), evidence from the African context reveals that most African countries fail to meet the basic requirements for good health care systems in accordance with the WHO (2010) framework. Marais and Petersen (2015), Mack et al. (2015) and Petersen et al. (2017) reported on human resource and poor governance challenges, needs and potential strategies and opportunities associated with the integration of services in resource-limited nations. Examples of these challenges, also presented by Oleribe et al. (2019), include the following:

- Lack of implementation of relevant programmes and policies and governments reneging on agreements between themselves and the various HCWs or unions, leading to recurrent service provision refusal where HCWs refuse to provide health care services to patients, in countries like Nigeria (Oleribe et al. 2016, 2018).
- Industrial action by HCWs (strikes and protests) that are commonly reported in countries like Nigeria and Zimbabwe (Adeloye et al. 2017; Daniel et al. 2017; Essien 2018; Oleribe et al. 2016, 2018; Orenyi, Paul & Joseph 2018).
- Inefficient health care systems in African countries leading to medical tourism where Africans go overseas to access various forms of treatment (Abubakar et al. 2018).
- Financial barriers precluding people from accessing health care, specifically high medical aid rates (Adua et al. 2017; Petersen et al. 2017; Romdhane et al. 2015; Uzochukwu et al. 2015). This leads to the most

economically vulnerable societies suffering the most burden of diseases and experiencing increased levels of financially debilitating health care expenditure in many sub-Saharan African countries (Etienne et al. 2010; Fenny et al. 2018).

- Human resources shortages, specifically capacity versus demand challenges, with 'brain drain' of African health care practitioners emigrating to the Middle East, Europe and North America (Adua et al. 2017; Oleribe et al. 2016, 2018). In South Africa, physician shortages and unfilled posts in the public health care sector significantly impair health care efficiency throughout the country. Britnell (2015) reported that the vacancy rate for doctors is 56%, while for nurses, it is 46% in South Africa. Mayosi and Benatar (2014) declared that community health, including community workers and nurses, is beginning to occupy a new role in the advancement of health care as well as making this accessible to more South Africans. The author of this chapter argues that, coupled with telepractice as a service delivery model, nurses and community workers (CHWs) can significantly contribute towards the universal ear-and-hearing health care in South Africa as well within the African continent as a whole.

One of the possible solutions for the identified challenges is for African public health policymakers, working in close collaboration with HCWs, to approve and endorse national guidelines for health care system development that are aligned to the WHO framework. This approach is important for uniformity as well as sustainability, where buy-in from HCWs workers will be assured. Another solution involves the adoption of creative solutions, including public-private partnerships where private companies provide part of their profits to subsidise medical aid funding for their employees as well as their families and communities where the companies are based, through their corporate social responsibility schemes. Implementation of social health insurance schemes to address the lack of financial risk protection has been reported in countries such as Rwanda, Nigeria, Ethiopia, Ghana, Kenya and Tanzania (Adua et al. 2017; Fenny et al. 2018; Romdhane et al. 2015; Uzochukwu et al. 2015). Plans to implement the National Health Insurance plan (NHI) in South Africa are another possible solution within the South African context. The South African Health Department aims to achieve universal health care coverage (UHC) through the implementation of the NHI, which has the goal of confronting the absolute divide in health care between the wealthy and the poor (Keeton 2010). Currently, numerous challenges have been identified towards the achievement of UHC in the near future in South Africa, hence the NHI Bill (RSA 2019).

Another possible solution to the African identified challenges involves advocacy for political commitment and support, better management and improved leadership, capacity-building and continuous training for HCWs, and raising budget allocation to health care – all of which fall under leadership



and governance, health care workforce and health care financing when classified under the six WHO building blocks of health care systems. Oleribe et al. (2019) concluded that these solutions highlight that the answer to the chief challenges in African health care systems is found mainly in these three components, which means that they must receive increased focus and be placed on key priority lists for action by policymakers and those tasked with the implementation of policies if better and more effective health care systems that yield better health care outcomes and health indices are to be achieved in the African context. The audiology community within these contexts needs to be in full understanding of these realities and must ensure that they advocate for ear-and-hearing health care to form part of the plans.

Specific to the South African context, Stuckler, Basu and Mckee (2011) asserted that the delivery of quality health care is a constitutional obligation, and this is why the South African government has, over the years, introduced a number of initiatives and programmes aimed at improving the access, quality, safety and efficiency of health care delivery for all users (Mogashoa & Pelsler 2014), with significant amendments in health legislation and policy to safeguard compliance in delivering quality care (Moyakhe 2014). In 2000, the WHO (2000) ranked South Africa's health care system 160th on the eight measures used to rank countries.

Malakoane et al. (2020) argue that the current health care challenges in South Africa exist despite the South African government having made efforts to change the situation for the better. Van Rensburg and Engelbrecht (2012) maintain that since the advent of democracy, the country has put policies, charters, plans and strategies in place to improve public health system service delivery and strengthen its performance. Moreover, the WHO building blocks approach to assessing health care system performance has been adopted by the government departments at the national and provincial levels (Department of Health [DoH] 2013). Maphumulo and Bhengu (2019) maintained that, despite the numerous quality improvement programmes that the country has started, reformed, changed and then evaluated, the essential level of quality health care service delivery that is required in South Africa has not been achieved. Therefore, they highlight that the South African government has an obligation to make certain that the implementation of National Core Standards facilitates the delivery of the desired health outcomes for the South African population.

Malakoane et al. (2020) claimed that South Africa's public health programme outcomes and performance have remained inferior while the burden of disease has multiplied. Begg et al. (2018) asserted that notwithstanding all the strategies and plans as well as policy and regulatory interventions, and despite a well-defined programme for quality health care and considerable annual spending allocation, South African public health care system limitations continue to jeopardise the lives and health of South Africans and have led to

significant loss of confidence among patients, employees and other stakeholders.

Malakoane et al. (2020) illustrated the shortcomings that continue to plague the South African health care system in a case study of one of the Free State province. From their multimethod situation appraisal, using the WHO building blocks as a priori themes where emerging subthemes were later identified, findings revealed the following important major challenges in this province: (1) under *service delivery*, 'fragmentation of health care services' was highlighted; (2) under *health workforce*, 'staff shortages' were found; (3) under *health financing*, 'financial/cash-flow problems' were identified; (4) under *leadership and governance*, 'risk to patient care' was documented; (5) under *medical products/technologies*, 'dysfunctional communication technology' was identified; and (6) under *information*, 'poor information management' was highlighted (Malakoane et al. 2020, p.1). The overall key challenges identified in this study entailed fragmentation of services. The authors believed that to effect the strengthening of health systems in this context, a focus on improving integration is required while attending to financial and human shortcomings. For successful and sustainable preventive audiology implementation within the South African context, Sebothoma and Khoza-Shangase (2022) argued for audiologists to adopt a programmatic approach that allows for better integration of audiological services within the health care-prioritised burdens of disease. This is a significant initial step for South African audiologists towards working within the systems approach paradigm to health care, but it will only yield positive outcomes if there is integration, and fragmentation of services is minimised by ensuring communication between all stakeholders involved in patient care.

The South African programmatic approach to health care is described by Malakoane et al. (2020), who presented how South Africa structures disease-specific programmes within organograms as programmes or directorates that are partly independently controlled through the district health system (DHS). Laskin (1987) argued that this approach has produced 'pseudo-specialisation', where health care programme managers mainly attend to their particular specialities and programmes without interacting or considering any collaborations between their programmes and others, thus narrowing communications across the programmes - the key challenge of fragmentation of services in African health care systems. The inadequate collaborative arrangement of programmes prevents discussion and knowledge sharing among all relevant stakeholders within the health care system. This fragmentation is further worsened by the fact that the South African health care system has two divisions (private and public health care sectors), with the public sector (which provides health care to over 80% of the South African public) being managed by the different provincial

government health care departments. This public health care sector, which provides services through various health care facilities located within each province, is divided into primary, secondary and tertiary levels, all under the accountability of the DoH but directly operated by the various provincial departments (Mahlathi & Dlamini 2015). Malakoane et al. (2020) asserted that the lack of integration of services because of inadequate policy coordination and fragmentation of system operations exacerbates verticalisation and encourages 'bypassing' of prevailing protocols and policies and 'solo' mentality, thereby producing inferior health system performance. These authors reported that, in their study, stakeholders viewed 'bypassing' and 'solo' mentality as significant contributors to poor treatment and disease outcomes. Arguably, this 'solo' mentality tends to be the general practice among South African audiologists, save for some referrals between themselves and otorhinolaryngologists.

The current state of South African health care is fragmented and fails to sufficiently meet the health care needs of all its citizens in a holistic delivery system. Conmy (2018) asserted that the system is ill-equipped to manage catastrophic health disasters, as evidenced in some latest catastrophic public health predicaments that have occurred in South Africa. For example, in the first few months of 2018, over and above a countrywide water shortage, South Africa experienced a listeriosis outbreak in packaged meat, which exposed some health care challenges. The recent coronavirus disease 2019 (COVID-19) pandemic has also exposed the inadequacies and inefficiencies in the South African health care system (Boffa et al. 2020; Khoza-Shangase et al. 2021b; Mbunge 2020; Nyasulu & Pandya 2020). Nyasulu and Pandya (2020) found that the advent of the COVID-19 pandemic has had a direct effect on the South African health care system, negatively impacting its ability to function as resources directed at curbing the pandemic inevitably became depleted. Specific challenges linked to COVID-19 were found to include the absence of supplies (with the unavailability of personal protective equipment [PPE] being a major challenge), suspension of services, diversion of the health workforce, decreased health-seeking behaviour and deterioration in data monitoring, as well as funding crises (Nyasulu & Pandya 2020).

Maphumulo and Bhengu (2019) presented similar challenges to those by Malakoane et al. (2020) for the South African health care context, where they discuss seven issues plaguing the South African health care system: (1 & 2) prolonged waiting time because of human resources scarcity; (3) adverse events; (4) inadequate infection control and poor hygiene measures; (5) escalated litigation as a result of preventable mistakes, where litigation has significantly amplified both in the magnitude of the damages and frequency (Malherbe 2013); (6) scarcity of resources in equipment and medicines; and (7) inefficient record-keeping. All these challenges have a direct impact on the provision of ear-and-hearing health care services for the

majority of the South African population that accesses health care in state hospitals where these challenges are reported to exist.

Chisholm and Evans (2010) stressed that, in the South African context, improving the public health system's efficiency is urgently required for the country to be able to achieve the desired UHC. Such improvement should address the quadruple burden of disease that the country is facing, which includes (1) the high maternal and child mortality, that is, approximately 1% of the global burden; (2) the rising non-communicable diseases, which are approximately 1% of the global burden; (3) the increased levels of violence and injuries, contributing about 1.3% to the global burden; and (4) the HIV-TB dual epidemic, which is about 17% of the global burden (Mayosi et al. 2009). Maphumulo and Bhengu (2019) argued that such improvements will also repair the loss of trust that South Africans have in the health care system because of the lack of attention to improving quality care, reflected by reduced delays in the delivery of care, fewer mistakes, enhanced efficiency, raised market share and decreased cost.

In their study on challenges of quality improvement in the South African health care system post-apartheid, Maphumulo and Bhengu (2019) found the following challenges:

1. **Unequal distribution of resources:** Evidence suggests that approximately 84% of South Africans utilise the public health care sector, with only 16% of South Africans belonging to medical aid schemes allowing them access to the private health care sector for their health care needs (Naidoo 2012). The DoH (2014) documented that the 16% on medical aid schemes expend more than 50% of the entire health care expenditure, while the remaining 84% of the population rely on the resource-constrained public sector. This unequal distribution of resources also extends to human resources, with the DoH reporting that 80% of medical specialists are located in the private sector, where they service 16% of the population.
2. **Leadership and management crisis:** Inadequate leadership and poor management in health care managers and leaders who are lacking in vision and philosophy in how they run health care facilities have been reported, as well as inadequate and unclear goal setting in health care (Pillay-Van Wyk et al. 2016). Siddle (2011) also argued that poor leadership is seen in how misconduct is tolerated in this sector, with the lack of performance management and monitoring strategies to facilitate service delivery goals found.
3. **Increased disease burden:** South Africa's quadruple burden of disease continues to be a challenge that the health care system is struggling to successfully combat. Maphumulo and Bhengu (2019) affirmed that South Africa currently confronts a quadruple burden of disease comprising high maternal and child mortality, an increasing burden of non-communicable diseases (such as cancer, cardiovascular diseases, chronic respiratory

conditions and diabetes), high levels of injuries and violence, as well as the human immunodeficiency virus (HIV) and acquired immunodeficiency syndrome (AIDS) epidemic that is co-occurring with a high burden of TB (Conmy 2018; Malakoane et al. 2020; Mayosi et al. 2012; Pillay-Van Wyk et al. 2016). The disease burden HIV has placed on the South African health care system cannot be separated from the burden it has placed on the country's economy. South Africa has the largest HIV and AIDS epidemic in the world (Joint United Nations Programme on HIV/AIDS [UNAIDS] 2020). Conmy (2018) maintained that South Africa's current health care focus is significantly different from that of other LMICs because of this persistent epidemic and that the country has been under pressure to focus on lowering the incidence and prevalence of this epidemic. This has seen the country shifting 6.5% of South Africa's health care expenditure, diverting the focus away from health care system reform (Central Intelligence Agency 2018).

4. **Health care-associated infections (HAIs):** Over and above the quadruple burden of disease, the South African public health care sector is reported to be significantly affected by another leading cause of mortality and morbidity in the form of HAIs (Dramowski & Whitelaw 2017). Dramowski and Whitelaw (2017) reported that HAIs are diagnosed in one in every seven patients admitted to South African public hospitals, with poor infection prevention and control measures being listed as the cause of this burden of disease.
5. **Pull and push factors:** Migration and urbanisation have been listed as influencing push and pull factors that create challenges to the South African health care system (Maharaj 2004). The continuous influx of citizens into the cities for various reasons (Ngomane 2010) and the immigration of undocumented immigrants from neighbouring countries for economic and political reasons (Mokoele 2012) all have a direct impact on South Africa's health care system's quality improvement.
6. **Protracted headway in restructuring the health care system:** The implementation of the NHI Bill (2019), aimed at restructuring the health care system to achieve UHC for the South African population, is delayed (Conmy 2018); upgrading of infrastructure in health care facilities across the country is reported not to be progressing at an expected and required pace (Heywood 2014). Ruiters and Van Niekerk (2012) reported on this 2009 initiative by the DoH as a form of social health insurance presented as an NHI plan, which is aimed at reducing disease burden, improving overall health and making health care more affordable and accessible for all South Africans. Conmy (2018) argued that the NHI plan is a form of social health insurance in that it imposes contributions from employees and employers to partly fund the health care system, but lack of financial support, proper governance and action has stagnated this progressive policy in the implementation phase.

All of these challenges have direct implications for ear-and-hearing health care service provision in the South African context. As far as the NHI is concerned, in a recent Health Professions Council of South Africa's (HPCSA) SLH Professions Newsletter, Khoza-Shangase (2020) argued that the NHI will facilitate universal ear-and-hearing health care coverage for the South African population and that its conceptualisation fully supports preventive audiology, hence the need for a paradigm shift among South African audiologists. One of the aims of the NHI is to achieve 'a healthier nation, where people will live longer and suffer less illness', an aim that is in line with rehabilitation goals, where audiology is located - with preventive health care as the standard. Another aim of the NHI is to prevent illness and to make certain that individuals access treatment early to avert complications. This aim, once more, is well aligned with the goals of early ear-and-hearing disease or disorder intervention. Additionally, to enhance access to services, the NHI plans to have family health teams in all neighbourhoods offering home-based care and preventive health care services and would be contextually relevant and responsive for audiology. Lastly, the NHI aims to facilitate the growth of PHC services, which is a model of care that promotes UHC and, therefore, universal ear-and-hearing health care coverage. The expansion of PHC services, which have a wider reach (including rural communities), has recognisable advantages for increasing access to audiology service provision. This has implications for the utilisation of task-shifting within tele-audiology service delivery models to address the capacity versus demand challenges around the availability of audiologists for the population requiring ear-and-hearing health care in South Africa. Until the NHI has been implemented and the South African health care system challenges presented in this chapter have been addressed, the South African audiology community is confronted with challenges and complexities that influence their ability to provide optimal ear-and-hearing health care, leading to positive outcomes for all patients requiring their services.

This edited book is a sequel to another book by the current editor titled *Preventive audiology: An African perspective*. While in the process of editing that book, the editor identified that there existed a lacuna of contemporary, contextually relevant publications on complexities and challenges faced by the field of audiology within the African context in implementing preventive audiology. This book delves into these complexities for various areas in audiology, with the authors paying careful attention to contextual factors dictated by the WHO's six building blocks of health care systems, within the South African context, while bearing in mind the South African re-engineered PHC strategy. All chapters deliberate on evidence-based perspectives grounded in an African context on specific areas of preventive audiology, with deliberate and preferential reliance on locally relevant evidence that allows for accurate reflection of complexities and challenges in ear-and-hearing health care delivery within the African context.



Firstly, complexities in EHDI implementation are covered, including deliberations around the implementation of therapeutic approaches and family-centred EHDI services within the African context. Secondly, complexities with the assessment and management of some auditory pathologies such as middle ear pathologies, ototoxicity and vestibulotoxicity and ONIHL are carefully ventilated. Thirdly, complexities with the implementation of specific intervention strategies are deliberated on, specifically, CIs for HCPs as well as the use of ICT in the form of machine learning systems (MLSs) for the management of ONIHL. Lastly, complexities brought about by context are presented, such as linguistic and cultural diversity as well as traditional and alternative health care, on preventive audiology within the South African context. All these chapters have a goal of ensuring that increased efforts are directed towards the provision of clinical services that are driven by contextually relevant and responsive evidence.

## ■ 1.4. Conclusion

Audiology does not function as an island. Within the African context, with all the challenges to health care delivery discussed in this chapter, the role and value of preventive audiology that is well integrated into the whole health care system cannot be underestimated. It is paramount to ensure that preventive audiology initiatives and programmes form part of health care quality delivery intervention strategies. Complexities and challenges in health care delivery have a direct impact on ear-and-hearing health care delivery, hence the importance of audiologists lobbying for audiology-specific challenges to be included in health care policies and regulations, as well as budgeting strategies for human resources, infrastructure and equipment.

Khoza-Shangase (2021) argued that unidentified and unaddressed hearing loss has serious consequences for the individuals affected, their families and the state, from the cradle to the grave. As highlighted by Yoshinaga-Itano (2004), the negative impact of unidentified and unaddressed hearing impairment on a developing child includes significant deleterious effects on language abilities and skills, which may result in language delays of at least two to four years, with consequent social and economic ramifications in areas such as education, employment and integration into the family and society – all of which negatively impact on the individual's quality of life (Moeller 2000; Maluleke, Khoza-Shangase & Kanji 2019 2021; Olusanya 2005; Olusanya & Newton 2007; Rossetti 2004; Yoshinaga-Itano 2004). Furthermore, the lack of effective HCPs that reduce or eliminate NIHL, as well as toxicity monitoring programmes for drug-induced hearing loss, also has significant implications for the individuals affected, the families and communities they come from, and the companies that adults with ONIHL and ototoxicity work for and the state. Such implications include various other negative effects on the affected

individual, such as annoyance (Lusk et al. 2016), impaired cognitive performance and sleep disturbances, as well as leading to the onset of conditions such as hypertension and cardiovascular diseases (Dale et al. 2015), over and above hearing loss and communication impairment (Ding, Yan & Liu 2019; Khoza-Shangase 2017, 2020; Khoza-Shangase et al. 2020b; Moroe et al. 2018; Ntlhakana, Khoza-Shangase & Nelson 2020a; Ntlhakana, Nelson & Khoza-Shangase 2020b).

A majority of the cases of hearing loss, as well as its deleterious consequences, can be prevented or minimised through the implementation of effective preventive measures within a well-coordinated, accessible and efficient health care system, a fact that justifies increased efforts towards strategies aimed at improving quality outcomes of the African health care system, in line with the WHO's (2012) stipulations and a complex systems theory approach. Audiologists within the African context must mobilise to ensure that ear-and-hearing health care forms part of the strategic planning, implementation and monitoring of the health care system for effective universal ear-and-hearing health care coverage to be attained.





# Implementation of early hearing detection and intervention in South Africa

**Katijah Khoza-Shangase**

Department of Audiology, Faculty of Humanities,  
School of Human and Community Development,  
University of the Witwatersrand,  
Johannesburg, South Africa

## ■ 2.1. Introduction

The World Health Organization (WHO) (2002) recommended in the year 2000 that:

[A] policy for universal neonatal screening be adopted in all countries and communities with available rehabilitation services and that the policy be extended to other countries and communities as rehabilitation services are established. (n.p.)

Nevertheless, numerous challenges to the implementation of EHDl exist, particularly in low- and middle-income countries (LMICs) such as South Africa. The World Bank (2005) asserted that:

[E]vidence supports the view that investing in early childhood has large impacts on children's health and readiness to learn and can bring important economic returns later in life - Often greater than investments in formal education and training. (n.p.)

**How to cite:** Khoza-Shangase, K 2022, 'Implementation of early hearing detection and intervention in South Africa', eds. K Khoza-Shangase, *Complexities and challenges in preventive audiology: An African perspective*, AOSIS Books, Cape Town, pp. 23-40. <https://doi.org/10.4102/aosis.2022.BK311.02>

In line with this statement, EHDI programmes have been the gold standard of preventive audiology initiatives in the field of early childhood development internationally (Kanji & Khoza-Shangase 2019). Early hearing detection and intervention programmes detect, diagnose and provide intervention plans for newborns and infants with disabling hearing impairment as timeously as possible (HPCSA 2018). The HPCSA (2018) stated that EHDI programmes ensure cost-effective and ideal solutions that facilitate positive effects for infants and children with hearing impairment. This approach enables these children to function optimally, grow to their full potential and consequently be able to offer full contribution to and participation in society and the country's economy (Yoshinaga-Itano 2003). Without EHDI, inequalities that develop because of developmental restrictions linked to hearing impairment (Ching et al. 2013; Kennedy et al. 2005; Maluleke, Khoza-Shangase & Kanji 2019a, 2019b; Yoshinaga-Itano 2004) add to the socio-economic inequalities that pre-exist in LMICs (Ataguba, Akazili & McIntyre 2011; Ataguba & Alaba 2012; Nwosu & Oyenubi 2021).

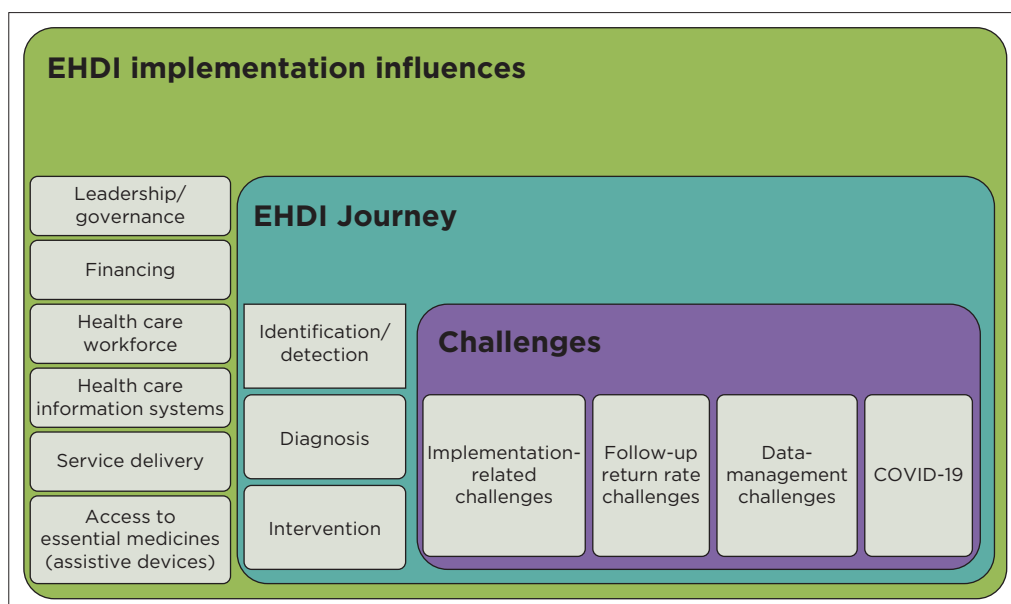
The HPCSA (2018), therefore, advocated for comprehensive and well-integrated EHDI programmes as the paradigm of care for newborns and infants with hearing impairment in South Africa. This Council advocated for EHDI programmes that are:

1. managed through integrated district and provincial service delivery systems
2. encompassing all pertinent governmental and non-governmental organisations (NGOs) and private stakeholders
3. collaborative in nature where intersectoral collaboration occurs, including government departments such as education, health and social development at all levels of care, as well as the private sector (Department of Social Development 2006; HPCSA n.d.)
4. family-centred and culturally congruent within a community-based model of service delivery (Khoza-Shangase & Mophosho 2018; Louw & Avenant 2002; Sass-Lehrer 2014; Swanepoel, Hugo & Louw 2005).

The author of this chapter believes that successful and sustainable implementation of EHDI within the South African context requires a systems theory approach (Kannampallil et al. 2011), where there exists a requirement that stakeholders involved in the programme view it as a whole system, with all its complexity and interdependence, thus shifting the focus from the individual to the health care organisation as a whole (Greenhalgh & Papoutsi 2018; Kannampallil et al. 2011; Plsek & Greenhalgh 2001). Thus, in reviewing the challenges and complexities in the implementation of EHDI in South Africa, this chapter was guided by the WHO (2010) framework of describing health systems, which comprises six 'building blocks': (1) leadership or governance, (2) financing, (3) access to essential medicines, (4) health information systems,

(5) health workforce and (6) service delivery, as illustrated in Figure 2.1. This framework allows for a holistic appraisal of the whole EHDI programme.

Existing evidence demonstrates that where early intervention (EI) for infants with hearing impairment is provided within the first six months of life, speech, language and cognitive development outcomes of hearing-impaired children become comparable with their normally hearing peers (Ching et al. 2013; Kennedy et al. 2005; Störbeck & Young 2016; Swanepoel & Störbeck 2008; Yoshinaga-Itano 2004). The predictive outcomes of EHDI are affected by numerous factors, including comorbid conditions, age, type of amplification, parental and or family involvement and education, therapeutic approaches and service delivery models, quality of intervention services and so on (Casoojee et al. 2021; Ching et al. 2013; Fitzpatrick et al. 2007; HPCSA 2018; Khoza-Shangase & Harbinson 2015; Korver et al. 2010; Maluleke, Khoza-Shangase & Kanji 2020; Pimperton & Kennedy 2012; Wake et al. 2005). Yoshinaga-Itano and Gravel (2001) maintained that universal hearing impairment screening programmes boast long-term economic benefits with regard to decreased costs for social welfare and specialised education, with enhanced lifetime productivity for hearing-impaired individuals. Therefore, universal newborn hearing screening (UNHS) is globally endorsed as the favoured option for preventive audiology strategies in public and private health care (Joint Committee on Infant



Key: EHDI, early hearing detection and intervention.

**FIGURE 2.1:** Complexities and challenges in the implementation of EHDI.

Hearing [JCIH] 2019; Olusanya, Luxon & Wirz 2005) with Bezuidenhout et al. (2018) and Khoza-Shangase, Kanji and Ismail (2021a) recommending targeted newborn hearing screening (TNHS) using contextualised risk factors as an interim measure in LMICs where limited resources do not allow for UNHS. Internationally, countries should strive to attain the gold standard for EHDI programmes, expressed through the 1:3:6 principle. This principle declares that screening for hearing impairment must occur by one-month-old, diagnosis attained by three-months-old and intervention be initiated by six-months-old (JCIH 2019).

Within the South African context, the HPCSA (2018) adapted the 1:3:6 principle, taking careful cognisance of contextual evidence as well as contextual realities. Contextualising the 1:3:6 principle in the South African context, where a number of babies will not be screened in hospital-based programmes, the following timeframes have been suggested by the HPCSA (2018, p. 8):

- Initial screening should occur before one-month-old and by no later than six-weeks-old for programmes associated with immunisation visits.
- Diagnostic audiological and relevant or necessary medical assessments should be underway before three-months-old and diagnosis established by no later than four-months-old.
- Where the diagnosis of hearing impairment has been confirmed, enrolment in and reception of intervention should be instituted before six-months-old and by no later than eight-months-old. This should be provided by health care professionals who have experience in infant hearing impairment.
- For those infants who pass the initial screening but present with risk factors for late-onset or progressive hearing loss, ongoing monitoring by caregivers and primary care providers should occur. Thus, caregiver and parental awareness around risks, as well as communication developmental milestones, should be raised.
- Caregivers and or primary care providers' level of awareness should be raised, and they should be urged to monitor their children's communication developmental milestones closely. Moreover, they should be encouraged to flag any concerns immediately with the health care providers.
- EHDI programmes in place should enable this process to facilitate timely and efficient access to the recommended services from detection to intervention.

The effectiveness of any EHDI programme is demonstrated by its ability to achieve all the overall set goals and specific objectives. Generally, this includes widespread screening, detection of a hearing impairment, establishment of the nature and degree of that hearing impairment, and provision of efficient development intervention (Campbell & Hyde 2010), all within the 1:3:6 principle (JCIH 2019) – or the modified South African timelines. For effective, efficient

and sustainable EHDI programmes within the South African context, it is important to deliberate on complexities and challenges that might influence opportunities for hearing-impaired South African children.

Regardless of location, Campbell and Hyde (2010) asserted that EHDI programmes confront a similar challenge globally. This challenge entails maintenance of programme efficacy, equity and effectiveness with an inadequate number of service sites and within a diverse population – population density and geographic coverage diversity. With evidence of 17 babies in South Africa being born with hearing impairment daily (Moodley & Störbeck 2015), sufficient justification for the exploration of challenges to the implementation of EHDI in this context exists, hence the current chapter.

## ■ 2.2. Early hearing detection and intervention programmes' implementation-related challenges: From detection to intervention

Olusanya (2015) presented neonatal screening challenges in resource-poor countries that impact ideal initiation, development and widespread endorsement of newborn hearing screening (NHS) services in these contexts. The author of this chapter argues that these challenges influence the entire EHDI process in LMICs, not just neonatal screening. These challenges include:

1. failure to acknowledge infant hearing impairment as a significant health condition (Khoza-Shangase & Kanji 2021)
2. financial resources constraints for NHS services (Jacob et al. 2020; Khan & Joseph 2020)
3. absence of suitable risk-based selective screening (Bhutani et al. 2013; Fitzgibbons, Beswick & Driscoll 2021; Kanji 2016; Kanji & Khoza-Shangase 2019; Olusanya et al. 2014a)
4. unsuitable environments and conditions for hearing tests (Aurélio & Tochetto 2010; Bezuidenhout et al. 2018, 2021; Jewel et al. 2013; John et al. 2009; Ramesh et al. 2012)
5. high costs of intervention services (Adedeji et al. 2015; Chundu et al. 2013; Krishnamoorthy, Samy & Shoman 2014; McPherson 2011; Olusanya et al. 2014b)
6. difficulties with voluntary approval of NHS services in LMICs.

The aforementioned difficulties with voluntary approval of NHS services in LMICs include:

1. sociocultural reticence towards hearing-impaired individuals (Byford & Veenstra 2004; De Andrade & Ross 2005; Ehlert & Coetzer 2020; Khoza-Shangase 2021; Moodley & Störbeck 2015; Stephens, Stephens & Von Eisenhart-Rothe 2000)

2. insufficient information from health care providers (John et al. 2009; Kanji & Krabbenhoft 2018; Khoza-Shangase 2019; Olusanya & Akinyemi 2009; Scheepers, Swanepoel & Le Roux 2014)
3. financial and logistical constraints (Khoza-Shangase 2019; Scheepers et al. 2014).

These are overall challenges in LMICs, although some have also been reported in high-income countries (HICs) as well.

In the United States (USA), White (2003) listed numerous challenges that are similar to those in LMICs. The scarcity of qualified paediatric audiologists, limited knowledge among PHC providers about EHDI issues and insufficient reimbursement for screening and diagnosis were reported as the most serious obstacles towards effective implementation of EHDI programmes in the USA. Lack of buy-in or political will by hospital administrators was also listed as an obstacle, although it appeared lower in the obstacles ranking used in this study. Challenges have been recognised in coordinating EHDI programmes, including difficulties associated with screening, diagnosis, EI, connections to medical home providers, data management and tracking, as well as family support programmes, although substantial progress has been made in addressing these. Approximately 10 years later in the same context, Spivak et al. (2009) found that the lack of national standards for the calibration of otoacoustic emissions (OAEs) or automated auditory brainstem response (AABR) instrumentation and uniform performance standards were still challenges. Moreover, Campbell and Hyde (2010) advanced that two major challenges that they maintain act as barriers for families to access EHDI programmes, and these are cultural and geographical variables.

As far as cultural variables are concerned, Campbell and Hyde (2010) reported the following:

1. distrust of public services
2. stigma, where the families are concerned about the potential effect that an identified disability will have on their status or identity
3. inability to understand the EHDI programme process
4. language barriers
5. diversity in cultural viewpoints or levels of awareness about the consequences of hearing loss among families.

As far as geographic variables are concerned, these authors listed the following:

1. Hearing-impaired children and families in remote or rural areas having to travel long distances and to various places to access services.
2. Hearing-impaired children and families having to face travelling in severe weather conditions to access bigger institutions.

3. Needing to travel long distances for EHDl services, while parents or caregivers have to take time off work and incur travel and childcare costs, all negatively impacting the families' financial resources.
4. Limited public transport and families not having private transportation (Krumm, Ribera & Schmiedge 2005; Krumm et al. 2008; Smith et al. 2007; Young et al. 2005).

As recently as 2020, Deng, Gaffney and Grosse (2020) found what they deemed to be interesting challenges in the USA, such as some key factors that served as barriers to the EHDl implementation in the 20 years prior to the review. This conclusion is despite the recognised timely completion of hearing screening that is reported to have been consistently realised for most newborns in that period. Current evidence in the USA indicates that over 95% of neonates and infants now undergo hearing screening prior to the age of one-month-old, which is a 75% increase from their 1999 statistics (Deng et al. 2020). Grosse et al. (2017) and Subbiah et al. (2018) reported that with the annual early identification of over 6 000 infants who are hearing-impaired in the USA, more children (with their families) can achieve enhanced language development outcomes as well as improved overall well-being. This success in hearing screening in the USA is, however, not mirrored by the early provision of follow-up diagnostic and intervention services for these children. Generally, it is documented that in the period 2016–2017, among the documented cases in the USA, less than 50% of infants with *refer* findings on screening had received diagnosis by three-months-old as recommended by the JCIH, and less than 50% of those with a diagnosis of hearing impairment had commenced intervention by six-months-old (Deng et al. 2020; Grosse et al. 2017; Subbiah et al. 2018). Reasons that were proffered for these outcomes are surprising for an HIC, but are very valuable for LMICs to learn from.

As presented by Deng et al. (2020), these challenges to the implementation of EHDl in the USA in the past 20-odd years can be grouped under the following:

- **Social determinants of health challenges:** Socio-economic, racial and geographic inequalities in the delivery of diagnostic and intervention services have been found to continue to exist within many states in the USA (Bush et al. 2014; Deng, Finitzo & Aryal 2018; Lantos et al. 2018). This has been reported to exert significantly more impact on families residing in rural, remote areas and or in those with limited financial resources from lower socio-economic classes.
- **Leadership and administrative challenges:** The absence of effective follow-up return rate strategies and cutbacks in resource allocations to some programmes, as well as variations in state laws, regulations or policies, has been found to present challenges to EHDl programmes.
- **Information systems challenges:** Disparities in the capabilities and infrastructure of the EHDl information systems from state to state negatively



influence some state programmes' ability to correctly detect, collect, match, report and analyse data on all births, with some states being documented to still significantly depend on ancient technologies such as fax and post to gather and report EHDI data.

- **Challenges with non-uniformity in data definitions:** Reported results seem to still be influenced by variations in data definitions among state programmes, making it difficult for Centers for Disease Control and Prevention (CDC) to monitor performance (Alam et al. 2016; Mason et al. 2008).
- **Challenge with the application of systematic evaluation and quality assurance programmes:** Some state EHDI programmes have been reported to not have had the resources or time yet to implement these evaluative programmes.

A close inspection of these current challenges from an HIC reveals important aspects of EHDI programme implementation that could form part of planning in LMICs to ensure that the challenges currently experienced in these contexts are resolved and future programme efficiency and sustainability assured.

Krishnan and Donaldson (2013) explored the challenges and complexities of NHS implementation in LMICs and found that a scarcity of qualified personnel, limited funding, inadequate infrastructure, lack of awareness of early identification of hearing impairment, insufficient support services for intervention and stigma associated with hearing intervention served as barriers to EHDI. These are very similar to challenges in HICs. Swanepoel and Almec (2008) maintained that parental attitudes and knowledge about infant hearing impairment are key to positive EHDI programmes' outcomes, especially in LMICs. In their study on maternal views on infant hearing loss and EHDI in South Africa, these authors demonstrated the necessity for improved maternal awareness around infant hearing loss and their willingness to engage in EHDI programmes.

In another study focusing on UNHS implementation and identification of associated risk factors in a tertiary academic hospital in an LMIC, Jacob et al. (2020) identified several challenges, including non-compliance with follow-up and infrastructural challenges. One of the key findings these authors highlighted is the disadvantage of chasing 'universal' screening where there are limited resources, instead of focusing on 'at risk' neonates. These authors concluded that (Jacob et al. 2020):

[7]he possibility of compromising 'at-risk' neonates, who are significantly more prone to hearing loss, both neonatal and delayed onset, is an additional grave reality which needs deep consideration in this Herculean task of attaining 'universality'. (p. 1)

Bezuidenhout et al. (2018) argued that unless the challenges to EHDI implementation in LMICs are carefully categorised and addressed, the known

benefits of EHDl will remain elusive. In their investigation of challenges encountered during the implementation of UNHS at a secondary-level public hospital in Johannesburg, South Africa, these authors found that a very small percentage (17.9%) of neonates born in that hospital were identified for screening, with only 4.4% undergoing screening via distortion-product otoacoustic emissions (DPOAEs). Of the small number of neonates screened, the majority (74.4%) were screened in the first 24 h of life. Where repeat screening was required, a small fraction of the neonates returned for follow-up. In another study on the outcomes of NHS in an academic secondary-level hospital in South Africa, Bezuidenhout et al. (2021) found that the time of screening is a challenge to the implementation of EHDl in that context. This has been found in other South African studies as well, where discharge within 6 h of birth prevented a number of neonates from being screened because the births could occur outside the working hours of audiologists, and when screening occurred, the presence of vernix in the ear precluded reliable OAE findings (Bezuidenhout et al. 2018; Kanji et al. 2018; Khoza-Shangase & Harbinson 2015; Khoza-Shangase & Kanji 2021; Petrocchi-Bartal, Khoza-Shangase & Kanji 2021).

Challenges that were identified in the implementation of UNHS within this South African context by Bezuidenhout et al. (2018) included (1) capacity versus demand challenges as far as audiologists' availability to conduct screening was concerned, (2) increased rate of false positive test findings, (3) the excessively high rates of loss to follow-up and (4) two adaptable factors, that is, high ambient noise levels and vernix caseosa in the outer ear canal. These authors suggested that for any efficient implementation of universal hearing screening protocols, prudent planning to alleviate the identified prevailing challenges will yield positive EHDl initiative outcomes in these contexts.

Petrocchi-Bartal and Khoza-Shangase (2014, 2016), Kanji (2016) and Khoza-Shangase et al. (2017) explored the practicability of NHS implementation at various health care levels within the South African context. Findings from this LMIC context revealed challenges with a lack of systematic, formal and standardised EHDl implementation at all levels of health care (primary, secondary and tertiary) because of numerous reasons, including human resource constraints, budgetary limitations, lack of equipment, and insufficient ear-and-hearing loss awareness.

As recently as 2021, Khoza-Shangase, Moroe and Neille (2021b) found that there remains a lack of standardised screening protocol use, with budget allocation limitations for EHDl in South Africa. In this study, where current practices employed by audiologists in EHDl in the South African health care context were investigated, Khoza-Shangase et al. (2021) found gaps in the implementation of EHDl. These gaps include a lack of UNHS,

with the TNHS approach being adopted by only half of the sample. Furthermore, findings from this study indicated that human resource challenges had a significant influence on the dearth of efficient NHS programmes, although a large majority of the audiologists (60%) did not believe in task-shifting NHS to people other than audiologists. This is a serious challenge requiring a re-imagining practice think tank among South African audiologists if access to ear-and-hearing health care is to become universal (Kanji & Khoza-Shangase 2021).

Khan and Joseph (2020) believed that inadequate awareness, limited screening infrastructure and poor resources serve as barriers to the use of nurses for task-shifting in EHDI programmes, stressing the importance of education and training as well as contextualised risk factors for hearing impairment forming part of this training. These authors argued that this position is important, particularly because nurses at the PHC level are the most easily accessible HCWs within the South African context. Within the South African private health care sector, which is generally better resourced than the public sector, Meyer and Swanepoel (2011) still found challenges with the implementation of EHDI. In this sector, only 53% of obstetric units offer some form of NHS, with UNHS only offered by 14% of units. This study found that the major challenge to successful screening implementation in this sector was the exclusion of NHS from maternity birthing packages at the health care facilities – a challenge that can be argued to be similar to the lack of EHDI mandating in the public sector.

Challenges to the EHDI process beyond screening and diagnosis, as reported by caregivers from an LMIC context, have included inadequate availability of health care facilities and appropriate schools for their hearing-impaired children, long distances between the limited available services and where the families live, substantial costs associated with the services (e.g. boarding school facilities costs and medical expenses), reduced knowledge and skills of educators and professionals about hearing impairment, contradictory opinions from various professionals about the diagnosis and management of the child's hearing impairment, as well as minimal community awareness about hearing impairment and services that are available for hearing-impaired children and their families (Khoza-Shangase 2019).

On parent-reported challenges, Muñoz et al. (2015) found information sharing with parents to be a difficulty experienced. Parents reported that although the volume of information they obtained was overwhelming, a large majority (84%) preferred being provided with this information at the beginning, rather than it being spread over a long period of time. Furthermore, information sharing around hearing aid acceptance, use and care was reported to be insufficient by parents. Difficulties with hearing aid management, including daily care and use, as well as emotional adjustment to it, were highlighted.

These findings raise implications around the methods, and possibly language, adopted when conducting hearing aid orientation. Muñoz et al. (2015) concluded that their findings demonstrate the value of supporting parents beyond not only covering technical aspects of hearing assessment and amplification function but also offering support around parents' emotions, thoughts and feelings during the EHDI process.

Review of the EHDI programmes' implementation-related challenges from detection to intervention presented reveals numerous similarities between LMICs and HICs, with opportunities for LMICs to learn from HICs in their efforts to achieve their contextually responsive 1:3:6 principle.

## ■ 2.3. Challenges with follow-up return rate

Spivak et al. (2009) investigated if the USA is achieving the target of fitting hearing aids by six-months-old and isolated challenges to meeting this target. These authors found that the achievement of this goal was not influenced by the high return rate for follow-up (91%) in the sample because in their study, despite the high return rate, only 39% of infants were fitted by six-months-old. In this study, infants with unilateral hearing loss were found to be at particular risk of being lost to follow-up. Dilip, Narayanan and Roshni (2020) also reported on follow-up challenges affecting screening and diagnostic processes, with a lack of skilled professionals posing a challenge to EHDI.

Loss to follow-up has been recognised as a major obstacle to EHDI for many programmes to some degree (Hyde 2005; JCIH 2019; Liu et al. 2008; Mason et al. 2008). The HPCSA (2018) stated that follow-up is vital to the success of EHDI as it allows for the following: (1) diagnostic assessment and confirmation of the presence of a hearing loss, (2) evaluation of candidacy for assistive technology options and or amplification devices and (3) rapid referral to early communication intervention (ECI) services. Campbell and Hyde (2010) described the several stages in the EHDI process when loss to follow-up can occur: (1) infants may be discharged from birthing centres prior to being screened, (2) infants referred from screening may be lost to follow-up for repeat screening or diagnostic assessment, (3) infants diagnosed with hearing impairment may not return for intervention and (4) families lose contact with EHDI programmes at different phases during the intervention process.

Kanji and Krabbenhoft (2018) investigated the challenge of follow-up in a South African sample of high-risk neonates. Findings from this study revealed that the most significant perceived challenges were socio-economic, demographic and interpersonal in nature. Distance from the health facility was the most significant factor that negatively influenced the return rate. Findings from this study also revealed facilitating factors that EHDI programme coordinators from LMICs should take careful cognisance of to

improve implementation within these contexts. These facilitating factors were (1) access to positively responsive audiologists, (2) open lines of communication between audiologists and caregivers and (3) utilisation of follow-up appointment reminders. These authors concluded that when deliberating around strategies to improve follow-up return rate, audiologists need to also consider the influence that professional-to-patient interactions and communication have on the EHDI process, as also recommended by Scheepers et al. (2014). In other South African studies, influences of linguistic and cultural diversity, where incongruence between the majority white English or Afrikaans-speaking audiologists and the black African language-speaking population exist, had a role in follow-up return rates (Ehlert & Coetzer 2020; Kanji & Khoza-Shangase 2018; Watermeyer et al. 2012). The influence of language and culture has also been reported in HICs like the USA, where Thomson and Yoshinaga-Itano (2018) recommended that strategies to guarantee follow-up should include providing information in the parents' native language and developing resources in indigenous languages in written form.

Scheepers et al. (2014) also reported that the most common explanations for follow-up default within a South African sample were: (1) reasons related to costs, (2) caregivers' lack of knowledge of NHS and of initial hearing screening results, (3) caregivers forgetting to return for the follow-up appointment and (4) caregivers' lack of awareness of the recommended follow-up appointment. Kanji and Khoza-Shangase (2018) found a return rate of 66.5% for the repeat screening, and this lessened to under 50% for follow-up diagnostic assessment. Factors that influenced the return rate in this South African study included a change of residential location and maternal age. Mothers who returned with their newborns for diagnostic assessment were significantly older than those who did not return, as demonstrated by the significantly higher mean age in this group. In other studies from other LMICs, such as Malaysia and Nigeria, follow-up was reported to be influenced by similar factors, including lack of public awareness of childhood hearing impairment and the value of EI, cultural beliefs around hearing impairment and health-seeking behaviours, stigma associated with hearing impairment and disability, place of birth and or delivery, poor communication between caregivers and screening staff about the value of a follow-up, limitations in the scheduling protocol for the provision of follow-up appointments and accessibility to services, as well as screening not forming part of an integrated childcare system (Ehlert & Coetzer 2020; Mukari, Tan & Abdullah 2006; Olusanya 2009; Olusanya & Akinoyemi 2009).

The challenge of poor follow-up return rates reported in both LMICs and HICs raises important implications for the suitable and well-timed diagnosis of hearing impairment and its consequent intervention. Although Kanji and Krabbenhoft (2018) believed that LMICs experience a significantly lower follow-

up return rate than HICs, reviewed evidence seems to indicate similar challenges in these contexts. Todd (2006) reported follow-up return rates of 58% and 100% in two health facilities in the USA, whereas Lagos in Nigeria reported a return rate of 16% (Olusanya, Wirz & Luxon 2008) and South Africa reported a return rate of 31.4% (Kanji, Khoza-Shangase & Ballot 2010). These return rates are all below the ideal 70% or higher as recommended by the HPCSA (2018). Kanji et al. (2010) suggested that attempts to increase the return rate in South Africa should be stepped up. These efforts may include the involvement of nurses and other health care providers in EHDI processes, as well as parental counselling and education. Furthermore, aligning follow-up care with the routine neonatal follow-up clinic day in provincial hospitals where such services are available may improve the return rate. Additionally, incorporating audiology follow-up in these routine neonatal clinics or at immunisation clinics closer to patients' residences will facilitate the return rate.

Without careful attendance to the identified challenges to follow-up, no EHDI programme will succeed, as such a programme must be continuous for the outcomes to be positive. Addressing challenges identified in this section requires intersectoral collaboration beyond the DoH, such as the Transport, Social Development and Communications departments. This is particularly crucial at this stage, where infrastructural and human resource developments do not seem to be achievable in the near future to allow for EHDI programmes to be available in sites and locations closer to where patients and their families reside.

## ■ 2.4. Challenges with early hearing detection and intervention programmes data management (capturing, standardisation and reporting)

Mason et al. (2008) illustrated the value of standardised reporting and data definitions for EHDI programmes collecting information on NHS and follow-up, as well as the kinds of information best collected in a standardised manner. This is one of the major challenges plaguing EHDI implementation globally, but worse so in LMICs where the use of information and communications technology (ICT) still lags. These authors demonstrated the possible impact of non-standardised definitions and data classifications on frequencies of hearing screening, audiologic follow-up and hearing impairment, where (1) the hearing screening rate was less than expected, (2) only 61% of children screened and referred for follow-up were followed-up, (3) only 49% of these children were tested and (4) only 1.5 per 1000 children were recorded with a hearing impairment, despite a true prevalence of 3.7 per 1000 births. These findings highlight the importance of proper record-keeping as well as complete reporting by audiologists to EHDI programmes. Incomplete, inaccurate and

insufficient reporting has implications for follow-up, as well as accurate calculation of performance measures, thus presenting significant implications for advocacy for EHDI programmes development in any country.

Mason et al. (2008) argued that lack of documentation and standardisation of measures can produce overstatement of 'loss to follow-up', failure to appraise the number of children receiving recommended services and incapacity to evaluate progress towards national goals. Meinen-Derr et al. (2017) reported on the lack of an integrated system connecting educational records, hearing screening, EI and vital records in the state of Ohio in the USA. These authors believed that a more integrated system linking EHDI services and outcomes data could meet the needs of a variety of stakeholders, thus maximising benefits from EHDI programmes. From their study, it was evident that data are stored in a way that does not contribute towards efficient planning, implementation and monitoring of EHDI services, with challenges of this data linkage including (1) different and incongruent data systems, (2) numerous and diverse institutional, legal and operational requirements and (3) access and use of different types of data governed by different laws and regulations.

Within the South African context, Moodley and Störbeck (2017) argued that an appropriate data management system allows for efficient data collection, storage, analysis and interpretation, to direct EHDI programmes' future planning, implementation and evaluation. In their study on data management in the South African EHDI context, these authors found that South Africa does not have a uniform national data management system and does not have access to a dependable and reliable shared system within the private or public health care sectors. Almost half of the sample (44%) utilised a paper-based record-keeping system, with evidence demonstrating that none of the institutions that formed part of the study were utilising data management systems that facilitated data sharing with other medical professionals. These authors concluded that without an efficient data management system, tracking of the referral and intervention pathway from screening to diagnosis to intervention for quality assurance cannot be performed. This is also supported by Khoza-Shangase (2021), who argued that success in the implementation of any programme also significantly relies on a proper data management system that will allow for tracking of identified infants as well as coordinated referral pathways, particularly within a *migration-aware* health care system, which South Africa encourages. A migration-aware health care system calls for a response to migration and health that acknowledges that people move internally within South Africa (South African Health Review [SAHR] 2017), and this has implications for EHDI nationally. Any system that is adopted should consider all challenges associated with ICT use, such as computer literacy training of users, time and personnel allocation for data capturing, and hardware required.



## ■ 2.5. COVID-19-related early hearing detection and intervention programmes' complexities, challenges and opportunities

COVID-19 has presented challenges and opportunities for EHDI globally. The opportunities relate to service delivery models (tele-audiology) that have become innovative, thus allowing increased access as well as enhanced family-centred early intervention (FCEI), as advocated by Maluleke, Chiwutsi and Khoza-Shangase (2021). Martin, Nicholson and Hall (2012) stressed the importance of family support and challenged health care professionals in EHDI programmes to change family support from theory to practices that are evidence-based and conscious of the dynamic and unique nature of individual families, with Maluleke et al. (2021) highlighting that this family support must be linguistically and culturally appropriate and competent within the African context.

Capitalising on the opportunities and finding innovative ways to address the challenges presented by COVID-19 to EHDI programmes is key to ensuring continued development and sustainability of care provided to hearing-impaired children, from identification to intervention, including schooling. Internationally, Yoshinaga-Itano (2020) reported that COVID-19 has presented significant challenges to birthing hospitals, UNHS/EHDI and diagnostic audiology services across the USA. These challenges include (1) families fearing taking their newborns outside their homes to health care facilities for screening, diagnosis or intervention, (2) challenges with parents accessing in-person counselling services, with limited access to and availability of online services and (3) uncertainties around follow-up visits.

One of the key challenges Yoshinaga-Itano (2020) described is the risk of increasing depression in new mothers because of the lack of access to services for their hearing-impaired child. This author asserted that fear of a disability diagnosis can intensify the probability of depression among mothers, particularly during this COVID-19 era when they are unable to get a definitive, timely answer regarding their child's hearing function. This depression occurs amid other psychosocial challenges that many families are going through because of COVID-19, including severe anxieties about employment and job losses, housing and food insecurities, as well as losses of family members to this pandemic. It is, therefore, important that EHDI services continue as seamlessly as possible, through the use of innovative service delivery models such as telepractice, which must include telecounselling. Yoshinaga-Itano (2020) stressed the importance of solidifying the family-to-family support aspect in the 1:3:6 EHDI system during this time, an aspect that HI HOPES (Home Intervention Hearing and Language Opportunities Parent Education Services) advocates and engages in within the South African context



(Störbeck & Young 2016). HI HOPES is a community-based EI organisation that provides care, support and information to families of deaf and hard-of-hearing babies to support their development. Campbell and Hyde (2010) believed that eEHDI, where ICT is used in EHDI programmes, can play a significant role in developing comprehensive intra-programme networks that can resolve the challenge around distances to health care facilities, improve access to services and facilitate the achievement of critical programme goals.

Campbell and Hyde (2010) deliberated on opportunities offered by ICT to address some of the EHDI implementation challenges via eEHDI. In their examination of the role of telemedicine and telehealth as an adjunct to EHDI programmes, these authors found that some of the structural, financial and personal barriers (Smith et al. 2007) that negatively influence families' access to EHDI services can be remediated through the unique opportunities offered by ICT.

Although telepractice (eEHDI) presents significant opportunities for programme success and sustainability, challenges with this model of service delivery do exist. Khoza-Shangase (2021) presented a number of challenges that may influence eEHDI within the South African context, and these include:

1. limited evidence regarding training and education of health care students in the use and implementation of telehealth (Edirippulige, Armfield & Smith 2012; Govender & Mars 2018; Khoza-Shangase et al. 2021)
2. computer competence and literacy of potential users (Carter, Hudyma & Horrigan 2010; Lamb & Shea 2006; Picot 2000)
3. availability of network connectivity
4. understanding and adherence to ethical and legal prescripts around its use (Grogan-Johnson et al. 2015; Lamb & Shea 2006; Naudé & Bornman 2021; Picot 2000)
5. grasp of the standards and procedures that facilitate best practice by the para-practitioners and practitioners in instances where task-shifting is employed (Grol & Grimshaw 2003)
6. data management involving online storage, retrieval and transmission of data (Grogan-Johnson et al. 2015)
7. potential impacts of CLD on its use (Khoza-Shangase & Mophosho 2018, 2021).

With the COVID-19 vaccine drive appearing to yield positive outcomes globally, challenges presented by this pandemic should be seen as opportunities presented to re-imagine future service delivery models beyond COVID-19. These models have the potential to address several challenges, including capacity versus demand challenges, family-centred intervention limitations, as well as access to remote and or rurally placed patients to practitioners and programmes.

## ■ 2.6. Conclusion

Overcoming the challenges presented in this chapter and achieving effective and sustainable EHDI programmes in LMICs like South Africa will require deliberate and concentrated efforts from all relevant stakeholders, including families, governmental and non-governmental agencies, hospitals and all relevant health care practitioners, particularly audiologists and paediatricians, task-shifting cadres, research institutions and others. Within the South African context:

- Firstly, it is critical that EHDI becomes mandated. Olusanya (2015) lamented how in HICs, NHS is routinely provided as a mandatory and essential intervention, and not so in the large majority of LMICs, where over 80% of the burden and incidence of permanent early-onset or congenital hearing loss is found. It is only with governmental mandates and political will from the health ministry that all stages of EHDI, within the preventive health care model of the country, can be successfully and sustainably implemented. In a study to evaluate the effects of policy changes on loss to follow-up rates and the ability to achieve EHDI goals, Krishnan and Van Hyfte (2014) found that policy changes yielded positive outcomes, where fewer infants were lost to follow-up and infants were diagnosed earlier with a hearing impairment, although this was still not within the benchmark of one-month-old. Having EHDI mandated will have significant implications for resource allocation, human resources development and placement, efficient information systems procurement, administrative support provision and so on – as all these challenges are linked to state resources and treasury budget allocation. Such mandating of EHDI will ensure that the significance of early identification of hearing-impaired children is highlighted among administrators and health care providers, which will aid in the implementation of best practice.
- Secondly, prevention and promotion initiatives around hearing impairment need to be increased and enhanced, and this must include families with children at risk, to make sure that they take ownership of EHDI programmes.
- Thirdly, EHDI data should form part of national population-based public health surveillance systems. This system should be electronic, to allow for continuity of care for all babies, especially those diagnosed with hearing impairment. Opportunities brought about by the Fourth Industrial Revolution in terms of advancements in health information technologies for data exchange and analysis should be seized, and this includes the adoption of eEHDI (Campbell & Hyde 2010) as part of hybrid service delivery models that allow for access to remote areas. As a lesson from the USA, surveillance systems used for EHDI should be standard and uniform,

with nationally recognised quality measures, functional standards and data definitions to allow for case management, reporting, follow-up and tracking (Deng et al. 2020).

- Fourthly, within resource-constrained settings, Khoza-Shangase (2021) believed that growing a contextually relevant knowledge base in LMICs is important to ensure that challenges identified are addressed in context. For example, South Africa continues to grow its evidence base in EHDI in the availability of EI services, alternative platforms for screening and in parents' reasons for refusing screening; however, this evidence tends to be in certain pockets of society and is not easily generalisable. Therefore, research must be conducted nationally and not only in the two to three provinces (Gauteng, Western Cape and KwaZulu-Natal) that are usually investigated (Moodley & Störbeck 2015). Kanji (2016) also reported that, in contrast to HICs, there is a clear paucity of outcome studies from LMICs such as South Africa that back the efficacy of EHDI and that this could be because of the well-documented absence of nationally integrated EHDI programmes. Khoza-Shangase (2021) stressed that contextually relevant research into UNHS development, diagnosis and intervention in both private and public health care sectors in South Africa will produce the much-needed evidence on all aspects of EHDI in an LMIC context, which will make EHDI implementation in South Africa contextually relevant and contextually responsive and responsible.
- Finally, standard and uniform implementation of the HPCSA (2018) EHDI guidelines should form part of the government mandate to ensure that nationally endorsed batteries of tests and procedures for diagnosing hearing impairment are adhered to, to facilitate accurate reporting. This must be the same in both the public and private health care sectors. Khoza-Shangase et al. (2021) argued that for EHDI to be successful and sustainable within the South African context: (1) disparities between private and public health care sector resources allocations must be addressed, (2) contextually responsive strategic planning needs to occur and (3) concerted and deliberate efforts towards translation of knowledge, policies and guidelines into practice must be attended to by the South African audiology community.

Implementation of the aforementioned recommendations must consider all perspectives presented in this chapter as solutions to the complexities and challenges identified might differ depending on the perspective adopted. The involvement of all stakeholders will ensure that all perspectives are considered.

# Complexities and challenges with implementation of communication therapeutic approaches to early intervention in audiology in the African context

**Aisha Casoojee**

Department of Audiology, Faculty of Humanities,  
School of Human and Community Development,  
University of the Witwatersrand,  
Johannesburg, South Africa

**Katijah Khoza-Shangase**

Department of Audiology, Faculty of Humanities,  
School of Human and Community Development,  
University of the Witwatersrand,  
Johannesburg, South Africa

## ■ 3.1. Introduction

In keeping with the principles of EHDI, audiologists provide communication intervention through a wide range of therapeutic approaches for children with hearing impairment. Audiologists are the primary individuals responsible for the evaluation and fitting of amplification devices, as well as for the provision

**How to cite:** Casoojee, A & Khoza-Shangase, K 2022, 'Complexities and challenges with implementation of communication therapeutic approaches to early intervention in audiology in the African context', eds. K Khoza-Shangase, *Complexities and challenges in preventive audiology: An African perspective*, AOSIS Books, Cape Town, pp. 41-54. <https://doi.org/10.4102/aosis.2022.BK311.03>

of intervention services to children with hearing impairment and their families. The application of communication therapeutic approaches (CTAs) in audiology has been a challenge globally, but more so in Africa for various reasons, including social and health care system complexities (Abuor 2016; Khoza-Shangase 2019; Madu 2016). The success of the available and documented CTAs is contingent on these challenges being confronted with concerted efforts during the implementation of EHDI protocols for effective and efficacious clinical practice. This chapter explores challenges impacting on the implementation of CTAs for EI in audiology, paying specific focus on the African context.

One of the key goals of any EHDI programme is to maximise the language skills and literacy development in children with hearing impairment (Joint Committee on Infant Hearing [JCIH] 2019). For EHDI programmes to achieve these outcomes, collaboration by an interdisciplinary team of providers (Sapp & Welsh 2019) working in close concert with families (Maluleke, Khoza-Shangase & Kanji 2021a) is imperative. Audiologists are essential members of the EHDI team, performing confirmatory diagnostic testing and fitting amplification devices, as well as enrolling infants with hearing impairment into ECI programmes (Sapp & Welsh 2019). Audiologists further employ various CTAs in their intervention as part of communication development strategies for children with hearing impairment (Casoojee, Kanji & Khoza-Shangase 2021).

Although medical teams are cognisant of the importance of referring children with suspected hearing impairment to an audiologist, of concern is the low rate of referrals of otitis media (OM) and risk factors related to hearing impairment in African countries, including Rwanda, South Africa, Nigeria, Ethiopia and Tanzania (Khoza-Shangase, Barratt & Jonosky 2010; Khoza-Shangase, Kanji & Ismail 2021a; Mukara et al. 2017; Simões et al. 2016). Khoza-Shangase et al. (2010) argued that this poor collaboration between medical and audiological teams is one of the factors contributing to the delay in ECI, leading to the insufficient mitigation of the negative consequences of untreated hearing impairment. Despite this collaboration challenge, Khoza-Shangase et al. (2010) and Khoza-Shangase, Kanji and Ismail (2021a) found that professionals working in the South African context do view ECI programmes as vital and relevant to children's optimal development. These ECI programmes are said to succeed if they adhere to universally endorsed principles of ECI, which include that intervention must be (1) family-centred, with sensitivity and responsiveness to culture and language; (2) developmentally supportive, with a goal to stimulate children's involvement in their natural setting; (3) well-coordinated, comprehensive and team-based; and (4) aligned with evidence-based practice (American Speech-Language-Hearing Association [ASHA] 2008; South African Speech-Language Hearing Association [SASLHA] 2011).

The JCIH (2019) highlighted that for successful EHDI outcomes, which include the targeted ECI outcomes, EHDI programmes must adhere to the 1:3:6 principle. The 1:3:6 principle refers to the guidelines that state that NHS be conducted before one-month-old, diagnostic audiological evaluation be completed before three-months-old for infants that do not pass their hearing screening and enrolment into an EI programme be implemented by no later than six-months-old for children diagnosed with hearing impairment (HPCSA 2018). The HPCSA position statement of 2018 recommends the adjusted 1:4:8 principle for the South African context, which prescribes that NHS be conducted prior to one-month-old, the diagnostic audiological evaluation be completed prior to four-months-old for infants that do not pass their hearing screening and enrolment into an EI programme be implemented by a maximum of eight-months-old to provide children with hearing impairment the opportunity to develop an effective communication system (HPCSA 2018; Smith et al. 2017). The HPCSA has adjusted these benchmarks, bearing in mind contextual realities such as immunisation visits at PHC clinics to enhance effective follow-up return for intervention, which remains a substantial challenge, even in high-income countries (HICs) (HPCSA 2018; JCIH 2019).

Olusanya (2015) provided an overview of contextual factors hindering the optimal introduction, development and widespread promotion of neonatal hearing screening programmes in low- and middle-income countries (LMICs), including Côte d'Ivoire, Nigeria and Egypt. The awareness and acknowledgement of contextual factors that may influence adherence to the 1:3:6 benchmark are important, and these factors include (1) resource constraints such as limited financial stability, family support and effective communication; (2) family systems; (3) unique coping styles; (4) challenges associated with medically unstable or fragile infants; and (5) linguistic and cultural diversity issues (ASHA 2008; Aurélio & Tochetto 2010; Bezuidenhout et al. 2018; Campbell & Hyde 2010; Ching et al. 2013; Deng, Finitzo & Aryal 2018; Jacob et al. 2020; Kanji & Khoza-Shangase 2019; Khoza-Shangase et al. 2021a; Matkin 1998). These (and more) challenges and complexities to EHDI implementation are the focus of Chapter 2, including challenges brought about by the advent of the COVID-19.

## ■ 3.2. Communication therapeutic approaches

Research data indicate that hearing impairment's most discernible impact on a child is in speech and language acquisition, communication, learning and social functioning (ASHA 2015; Lang-Roth 2014). Failure to detect congenital or early-onset hearing impairment fosters a cascade of adverse consequences that include poor academic outcomes and consequently fewer employment opportunities, personal or social maladjustments, as well as emotional difficulties (World Health Organization [WHO] 2016). International research

describes how hearing impairment affects identity and relationships, as people with hearing impairment have trouble having spontaneous social interactions and thereby maintaining social relationships (Olsson, Dag & Kullberg 2021; Tjørnhøj-Thomsen & Philipsen 2021). A hearing impairment further results in exclusion at school and work, cultural barriers and political allegiance (Olsson et al. 2021). These maladjustments are consequent to the lack of an accessible language and not solely because of hearing impairment (Knors & Marschark 2014; Lederberg, Schick & Spencer 2013). Olsson et al. (2021) illustrated the positive effects on individuals' lives when they are part of a group that is able to communicate with the rest of the hearing population. The need for language development to facilitate natural, meaningful and abundant interchanges, regardless of the specific communication mode, is therefore highlighted (Gravel & O'Gara 2003). Consequently, intervention practices in the form of CTAs are pivotal in the global development of a hearing-impaired child (Casoojee et al. 2021).

These intervention practices incorporate communication methods that range from the more visual-gestural approaches, such as sign language, total communication or cued speech, to the more auditory approaches (i.e. utilisation of natural gestures, speechreading or visual cues with amplification), such as the oral-aural approach and auditory verbal therapy (AVT), incorporating listening and spoken language (LSL) principles (Auditory Verbal UK 2018; Casoojee et al. 2021). Lim and Simser (2005) argued that with the consistent advancements and innovation in hearing technology and early detection and intervention approaches, the expectations of hearing-impaired children have changed with regard to outcomes in their listening skills, their development of spoken language and their academic and social performance. However, Gullberg, De Bot and Volterra (2008) suggested that language acquisition, be it signed or spoken, is dependent on the hearing family members' sensitivity to their hearing-impaired child's communication needs. Kluwin and Gaustad (1991) suggested that EHDI programmes should include family training components, targeting the primary caregiver (mostly mothers), as their knowledge around communication determines the mode of communication selected for their hearing-impaired child. The selection of the mode of communication by the hearing-impaired child's primary caregiver 'is a critical decision in the life of that family, because it will condition how the family will be able to function in the future' (Kluwin & Gaustad 1991, p. 28). Kluwin and Gaustad (1991) justified the training focus on mothers by underscoring that mothers take the lead in deciding the mode of communication for the family. This decision is influenced by (1) the mother or primary caregiver's educational level, (2) the hearing-impaired child's mode of preschool education and (3) the hearing-impaired child's severity of hearing impairment (Kluwin & Gaustad 1991). Scarinci et al. (2018) added that five factors related to the



family as a whole have a major influence on the caregiver's choice of communication mode, and these factors are family strengths, beliefs, characteristics, access to information and family-centred practice.

While Moeller (2000) highlighted that family involvement in the communication intervention process accounts for the greatest variance in language outcome scores of children with hearing impairment, Scarinci et al. (2018) and Garrido-Nag and McCann (2020) detailed the following factors as influential in family involvement:

- Family characteristics, such as structure and demographics, socio-economic circumstances and work schedules.
- Family beliefs around hearing impairment and intervention, language, literacy and social skill acquisition.
- Family-centred practices that ensure alignment of intervention services with the family's goals, as well as consistency in learning and using a communication approach.
- Family strengths, which include the level of participation in intervention sessions, opportunities for language learning and communication in the home.
- Family access to information and resources such as availability of EI programmes, as well as the availability of certified auditory verbal therapists, auditory-oral therapists, sign language interpreters and so on.

Some studies have demonstrated therapeutic approaches that incorporate family support as a component of EHDI form the backbone of a successful intervention process, providing numerous strengths and opportunities that have a positive effect on the hearing-impaired child's speech and language development (Akçakaya & Tavşancıl 2016; Butler 2012; Lew et al. 2014; Maluleke et al. 2021a; Nelson, Bradham & Houston 2011).

Globally, published evidence that supports the appropriateness of any one CTA is constrained by the absence of control and or comparison groups in the studies investigating the efficacy of CTAs (Casoojee et al. 2021; Gravel & O'Gara 2003). Despite this lacuna, with EHDI and technological developments such as cochlear implants, children with profound hearing impairment are enrolled in LSL communication approaches (Niparko et al. 2010). Alberg, Wilson and Roush (2006) reported that parents choose the spoken language options for their hearing-impaired children more than 85% of the time. Fitzpatrick (2012) reported that more than 90% of families at the Ontario Infant Hearing Program in Canada chose an LSL communication option. Similar findings are reported by Sugar and Goldberg (2015), where more than 88% of families chose an LSL outcome for their children in Ohio, United States (US). This evidence is important as it affirms that when hearing-impaired children receive appropriate EI services delivered by well-trained and experienced professionals utilising their chosen communication approach, they exhibit typical developmental



milestones in speech, language and scholastic outcomes (Houston & Stredler-Brown 2012).

With progress in biomedical technology, children with severe to profound hearing impairment are learning to listen through cochlear implants and accomplish better speech perception, speech production and language skills, particularly when timely fitting and monitoring of amplification devices is provided (Dettman et al. 2016). Research indicates that to enhance speech perception and consequent speech production precision and language acquisition, cochlear implant provision prior to 12-months-old for children with severe to profound hearing impairment is crucial (Dettman et al. 2016; Punch & Hyde 2011). Ching et al. (2009) also observed that children implanted at younger than twelve-months-old developed normal language skills at a pace similar to normal-hearing children, with hearing-impaired children implanted later presenting at two standard deviations below the normative mean. Similar findings are reported where children fitted with hearing aids and those with cochlear implants were compared, with similar open-set speech recognition abilities or speech production skills, even though children fitted with hearing aids achieved higher scores in the areas of reading comprehension, phonological memory, receptive vocabulary and language (Fitzpatrick et al. 2012).

In an Australian study where language outcomes were examined in paediatric cochlear implant users in three different communication programmes (auditory-oral, sign and spoken language and AVT), findings indicated no significant differences in language outcomes across the three groups (Yanbay et al. 2014). In this study, two factors were found to significantly influence language outcomes, and these were family involvement and age at diagnosis of hearing impairment. These findings affirm that irrespective of the type of CTA adopted, early diagnosis of the hearing impairment and high level of family involvement determine language outcomes, thus emphasising the significance of early diagnosis and the value of family involvement in EHDI outcomes (Ching et al. 2009; Geers 2006; Maluleke et al. 2021a; Punch & Hyde 2011). A family-centred approach promotes partnerships with families, resulting in strengthened follow-through, better participation in ECI activities and programmes, as well as enhanced outcomes for children with hearing impairment (Maluleke et al. 2021a; Sass-Lehrer 2004). The factors influencing a family's decision when choosing a CTA for their hearing-impaired infant are important to determine. As EI professionals, audiologists play a significant role in providing families support when making decisions during the course of each child's communication journey (Scarinci et al. 2018); therefore, their understanding of these factors is key to successful communication outcomes from ECI. Scarinci et al. (2018) argued that the family unit is pivotal to decision-making and has crucial clinical implications relating to audiologists' provision of family-centred care as part of EHDI programmes.

### ■ 3.3. Factors influencing the choice of communication therapeutic approaches

Auditory deprivation during the first three years of life has been consistently documented as the key influencing factor during this critical period for optimal language development (Banda et al. 2018; Motasaddi-Zarandy et al. 2009; Northern & Downs 1991; Pimperton & Kennedy 2012; Schwartz 2017). The age of onset, the age of detection of hearing impairment and the degree of hearing impairment are critical factors in determining the impact that the hearing impairment will have on the child's language and communication skills (Kanji & Casoojee 2021). Therefore, the age of identification of a hearing impairment typically drives the age at which communication intervention begins (Schwartz 2017) and consequently influences the choice of communication intervention adopted. This is driven by parental and or family decision about the communication choices for their hearing-impaired child (Ching et al. 2018).

Ching et al. (2018) investigated factors that influence parents' choice of communication mode in the early education phase of their hearing-impaired child's development. Results from this study revealed four important influencing factors: (1) parents use knowledge and experience they have gained from a variety of sources to make a choice; (2) parents choose based on the outcomes they prefer for their hearing-impaired child; (3) parents consider what the hearing-impaired child prefers and is adept in; and (4) parents' worries and anxieties influence their decisions. These results highlight the importance of parental education and counselling that includes the provision of consistent and continual, impartial, descriptive information, as well as information that affords them the ability to make informed decisions (Kluwin & Gaustad 1991; Maluleke, Khoza-Shangase & Kanji 2021b). Novaes et al. (2012) underlined that family expectations about the future of their child, as well as family involvement and quality of parental participation in the ECI programme, are also essential aspects to deliberate on in the choice of communication adoption and intervention thereof.

Access to and consistent use of amplification has been found to be another important factor in determining the choice of communication approach adopted (Dettman et al. 2016; Punch & Hyde 2011; Yanbay et al. 2014). Auditory approaches to communication intervention for children with hearing impairment significantly rely on a child's access to the acoustic features of speech, thus highlighting the value of fitting of children with state-of-the-art hearing technologies like cochlear implants (Casoojee et al. 2021; Dettman et al. 2016). In South Africa, cochlear implants are not widely available within the public health care sector, which services over 80% of the population, and although advances in hearing aid technology have been documented, unfortunately, within this context, the costs remain exorbitant (Casoojee et al. 2021; Hlayisi & Ramma 2019; Orji et al. 2020). Results of several studies prove that the early use of hearing amplification devices leads to language outcomes

of children with hearing impairment to be within the normal range and comparable to their typically developing normally hearing peers (Ching et al. 2017; Cupples et al. 2018; Dettman et al. 2016; Fulcher et al. 2015; Lew et al. 2014). Novaes et al. (2012), in their investigation of associations between language and amplification use with various other factors,<sup>1</sup> found that constant utilisation of amplification was the sole factor, with a significant association to language and hearing skills. Where parents were not satisfied with the EHDI process, inadequate auditory capacity, even with amplification use, was found. Children with inconsistent hearing aid use and limited parental involvement exhibited poor auditory skills and speech production when compared with expected test scores. Over and above parental involvement as an influencing factor, Garrido-Nag and McCann (2020) raised other factors impeding the use of amplification devices, and these include financial constraints in acquiring assistive device technology, cochlear implant candidacy and expectations regarding the benefits of the amplification device. Within African resource-constrained contexts, budgets allocated to public health care are usually inadequate, resulting in audiologists in this sector having to prioritise what limited resources they have when tackling the needs of the hearing-impaired (Rutherford & Peterson 2019). Addressing these disparities to access amplification devices within the African context poses an even greater challenge (WHO 2017).

Another challenging factor in the choice of communication adopted within the South African context is the challenge created by linguistic and cultural issues that face communication interventionists, with language having a direct implication on service delivery from diagnosis to intervention (Estabrooks, MacIver-Lux & Rhoades 2016; Garrido-Nag & McCann 2020; Kanji & Casoojee 2021; Khoza-Shangase et al. 2021a; Maluleke, Khoza-Shangase & Kanji 2021c). The language used in the home, based on whether one or both parents are Deaf, may influence the decision of the communication intervention approach (Scarinci et al. 2018). The authors of this chapter suggest that additional factors to be considered regarding the home language are the use of spoken language, visual (sign language), bilingual (the use of two languages) or multilingual (combination of spoken and visual). Unfortunately, a global dearth of research exists describing the caregivers' experiences from culturally and linguistically diverse backgrounds regarding CTAs (Chang 2017; Garrido-Nag & McCann 2020; Guiberson 2013; Hyde, Punch & Komesaroff 2010). This is a significant gap in evidence that has serious implications for contexts such as South Africa, where linguistic and cultural diversity have been argued to have a big impact on SLH therapy service provision, not only because of the diversity of

---

1. Including functional hearing, age when amplification was fitted, communication skills, family expectations regarding the language development of their hearing impaired children, as well as family involvement in the first three years of life.

the population but also because of the incongruence between the language and culture of the majority of audiologists (who are mainly Western and English- and or Afrikaans-speaking) and the majority of the patients they see (who are black African and do not speak English and or Afrikaans as their home language) (Abrahams et al. 2019, 2021; Balton, Uys & Alant 2019; Barratt, Khoza-Shangase & Msimang 2012; Kathard, Pillay & Samuel 1997; Kathard & Pillay 2013; Khoza-Shangase & Mophosho 2018, 2021; Maluleke et al. 2021a; Mdlalo, Flack & Joubert 2016; Mdlalo, Flack & Joubert 2019; Moonsamy et al. 2017; Mophosho 2018; Pillay 1997; Pascoe & Norman 2011; Pillay & Kathard 2015). In their study, Hartley et al. (2009) concluded that intervention approaches must be aligned with the culture of the individual and the culture of the community that they come from. These conclusions have relevance in the provision of CTAs in the African context. Chapter 10 delves into more detail about the complexities surrounding linguistic and cultural diversity in the provision of audiology services.

All the aforementioned factors and their consequent challenges have significant implications on the choice of communication approach; on the CTAs adopted globally; however, additional complexities and challenges exist within the African context.

### ■ 3.4. Complexities and challenges with choice of communication therapeutic approaches in Africa

Insufficient evidence on early detection exists within the African context, with the gaps more pronounced in research into the intervention approaches and related outcomes in this context (Kanji 2016; Khoza-Shangase & Kanji 2021; Moodley & Storbeck 2015). There are numerous reasons for this gap in evidence, key to which is the lack of intervention services in Africa (Kanji 2021). This lack of intervention is influenced by factors under all six of the core components that describe health care systems as defined by the WHO (2010). These are challenges around (1) capacity versus demand (health care workforce), (2) service delivery, (3) access to essential medicines – and in this case, audiology equipment and assistive devices, (4) health information systems, (5) financing and (6) leadership and governance. Chapter 2 has comprehensively covered these challenges and how they influence the entire EHDl process from detection to intervention and beyond.

The WHO (2018) reported that 34 million children require intervention to address their disabling hearing impairment globally. With 80% of people with disabling hearing impairment residing in LMICs, and with sub-Saharan African regions among the most affected areas, it stands to reason that majority of hearing-impaired children requiring intervention reside in LMICs. The USA's CDC reports that 6 500 infants are born with a permanent hearing impairment

among the 98% of newborns screened in the USA (CDC 2017). Such data are not available for the African context. The HPCSA (2018) claimed that this lack of data is generally because of the failure to adhere to basic EHDI protocols, such as a lack of UNHS implementation in the continent. Lack of such data has a significant impact on the entire EHDI process, including the availability of appropriate and sufficient communication and educational intervention programmes for the hearing-impaired child, including continuity of care for the hearing-impaired child in their academic career (Khoza-Shangase 2021b; Maluleke, Khoza-Shangase & Kanji 2019).

In Cameroon, in sub-Saharan Africa, Wonkam et al. (2013) found the mean age when the diagnosis of hearing impairment occurred was 3.3 years ( $\pm 1.2$  years), which is significantly delayed from the international benchmark of three-months-old according to the 1:3:6 principle. These authors credited this late presentation to a lack of neonatal hearing screening in that country, as well as to inadequate parental awareness of suspicion-raising signs of hearing impairment and poor access to health care generally. Some data on hearing impairment in South Africa indicate a median age of identification of hearing impairment at 28-months-old (Storbeck & Young 2016), while Khoza-Shangase and Michal (2014) found that children with hearing impairment were generally identified at 23.65 months, fitted with hearing aids 7.11 months following diagnosis and were only enrolled into intervention programmes at approximately 31.2 months - all indicating significant delay from the recommended guidelines for optimum benefit from intervention. Ching et al. (2013) conducted an Australian study that directly compared the speech and language outcomes of hearing-impaired children identified early versus those identified later. Outcomes in hearing-impaired children identified later were well below population norms. Factors contributing to the overall outcomes included (1) amplification device, (2) CTA (communication mode at home and EI, modifications to communication mode at intervention and language use at home), (3) maternal education and (4) socio-economic status of the family (Ching et al. 2013). The World Health Organization (2008) acknowledged the significant impact of late-identified hearing impairment on the lives of children in the long term, specifically in LMICs because of the subsequent financial burden linked to it, hence the importance of effective and efficacious ECI programmes within these contexts. Studies conducted by Lin et al. (2011), Hoffman et al. (2010), Zhan, Cruickshanks and Klein (2010) and Exeter et al. (2015) showed that in many African countries, the rate of hearing impairment is increasing, with two-thirds of this hearing-impaired population residing in LMICs (Labaeka et al. 2018). So too is the increase in the rates of other infections that are known risk factors for neonatal hearing impairment (WHO 2018). With the incidence of new epidemics, congenital cytomegalovirus, neonatal jaundice, exposure to HIV or AIDS, the side effects of Ebola infections and the Zika virus, an increased risk of hearing impairment exists which raises significant implications for ECI of the hearing-impaired

child amid the burden of disease (Billieux, Smith & Nath 2016; Dollard, Grosse & Ross 2007; Glantz 2016; Kanji & Khoza-Shangase 2012; Khoza-Shangase 2021c; Khoza-Shangase & Anastasiou 2020; Khoza-Shangase & Turnbull 2009; WHO 2018).

Khoza-Shangase and Turnbull (2009) found the estimated prevalence of abnormal hearing screening results in paediatric patients enrolled in an HIV and AIDS clinic in South Africa to be 26%, with abnormal findings occurring at various stages of the disease. Additionally, in this study, OM was found to be prevalent in 23% of the children and was raised as the most common possible cause of hearing loss. Similar findings, but in a larger sample size, were recently documented from the same context. Khoza-Shangase and Anastasiou (2020) reported that almost half (43%) of South African children with HIV or AIDS presented with otological manifestations, with otorrhea and OM being the most frequent symptoms. Wonkam et al. (2013) reported genetic causes, putative environmental causes and consanguineous families as risk factors for hearing impairment. Kanji (2019) and Fitzgibbons et al. (2021) argued that understanding contextual risk factors of hearing impairment has vital implications for audiologists in the planning of communication intervention services, while Kanji and Khoza-Shangase (2019) introduced the notion of *quadruple influence on risk factors*, which they coined in line with the South African quadruple burden of disease (WHO 2019). Kanji and Khoza-Shangase (2019) argued that, in the South African context, risk factors for childhood hearing impairment are influenced by factors such as human, medical and technological advancements, as well as burden of disease. The authors of this chapter believe that these factors also influence the ECI process and the outcomes of communication approaches chosen, particularly in an unequal society, which can be extended to the entire African continent.

Inequities and disparities in health care and economics are factors impeding the successful implementation of EHDI programmes in African countries (Engelman 2014; Khoza-Shangase 2021a). Inequalities within the African context often disadvantage families in accessing health care, including both structural and procedural access, that is, physical access, funding, transport and communication barriers, as well as attitudes and beliefs of health care providers (Maluleke et al. 2021b; Orrie & Motsosi 2018). Late-identified hearing impairment poses additional financial stress to the resource-constrained African health care systems, as it is estimated that the cost of severe-profound hearing impairment to society is approximately \$300,000 over the lifetime of the hearing-impaired individual (Hear-It.org 2021). A mathematical modelling study by Baltussen and Smith (2009) regarding the cost-effectiveness of programmes and measures to remediate hearing impairment in sub-Saharan Africa found that substantial health gains of up to \$32m disability-adjusted life years (DALYs) are saved in sub-Saharan Africa when available effective interventions are implemented. This, however, requires resource recruitment



efforts at an international as well as local level, yet preventive audiology in the form of hearing impairment control interventions is only considered more cost-effective when related to the economic attractiveness of alternative interventions in health (Baltussen & Smith 2009; Yoshinaga-Itano & Gravel 2001). Furthermore, state-of-the-art hearing technologies in Africa and CTAs primarily delivered by the private health care sector in countries like South Africa often come at a high financial cost to the patient and their family, as they are not entirely funded nor readily available in the public health care sector (Scheepers et al. 2014). According to the WHO (2018), fewer than one in 40 people who need hearing aids have them, and this has significant implications for ECI. Storbeck and Young (2016) lamented that because of restricted resources in Africa, most hearing-impaired babies have no chance of accessing EI; therefore, they consequently suffer the negative impact on communication outcomes. Maluleke (2022) deliberated on the economic evaluation of EHDI programmes in South Africa, putting EHDI on the political advocacy and resource allocation agenda so that maximum benefits can be gained for children with hearing impairment.

Given Africa's cultural diversity and its incongruence with the mostly Western-influenced health care approaches and systems, the challenges introduced by linguistic and cultural diversity to ECI presented earlier in this chapter are more pronounced. For positive outcomes, CTAs need to reflect culturally and linguistically responsive practices to facilitate family engagement that demonstrates and incorporates the patients' beliefs, interests and cultures, which includes their behaviour and interaction styles (Estabrooks et al. 2016). Evidence from global health indicates positive outcomes of interventions if language and culture are considered in the conception and implementation of intervention programmes (Flood & Rohloff 2018; Khoza-Shangase & Mophosho 2018, 2021). Therefore, it is crucial that audiologists become culturally and linguistically competent and embrace and incorporate cultural and linguistic sensitivity and competence in their therapeutic approaches, as data indicate that insufficient cultural responsiveness creates a barrier to optimal outcomes despite the early identification of hearing impairment (Paul & Roth 2011).

Crowe, McLeod and Ching (2012) asserted that being considerate of the linguistic and cultural diversity of hearing-impaired children provides direction to the assessment, intervention and educational services provided to both hearing-impaired children and their families. In their study describing demographic characteristics, oral language use and communication mode of three-year-old hearing-impaired children and their caregivers, these authors highlighted the value of the development of culturally and linguistically appropriate resources, as well as the provision of EI services to the families of hearing-impaired children, which acknowledge the influence of these factors towards adherence to and outcomes of intervention. Because of the lack of

contextually relevant and contextually responsive evidence, the influence of Africa's CLD on ECI in hearing-impaired children is not known, with Khoza-Shangase and Mophosho (2021) strongly arguing for a paradigm shift in how this challenge is addressed in the African context. It is well established that intervention is more valid and efficacious when it is relevant and culturally acceptable (Pascoe & Norman 2011).

Furthermore, the beliefs and perceptions of the family and community towards the causes and effects of hearing impairment are critical to the ECI process, as they can be crucial to the outcomes of the CTA adopted (Ehlert & Coetzer 2020). The South African study by Ehlert and Coetzer (2020) advocates for the implementation of EHDI programmes regardless of the existence of cultural beliefs that propose superstitions as causes of hearing impairment, as well as the consequent use of traditional medicine. The authors of this chapter argue for the acknowledgement and incorporation of cultural beliefs and practices, where appropriate, in ECI programmes planning and implementation, particularly because evidence demonstrates that parental beliefs and perceptions influence the outcomes of the therapeutic approach adopted (Majid et al. 2017). It is, therefore, important for African audiologists to explore the challenges encountered in the African context while rendering communication interventions with the aim of improving their quality of care and addressing the capacity versus demand challenges so that more children with hearing impairment can have access to evidence-based ECI services (Harmer 1999; Orrie & Motsosi 2018). Chapter 10 comprehensively deliberates on complexities presented by context, particularly linguistic and cultural diversity challenges in preventive audiology in South Africa, with ECI being part of tertiary preventive audiology.

### ■ 3.5. Conclusion

Complexities and challenges with the implementation of CTAs for EI in audiology in the African context cover all the WHO's (2010) building blocks of health care. Challenges confronting ECI of hearing-impaired children relating to policy, budgeting, resources (including human resources), burden of disease and social determinants of health, as well as linguistic and cultural diversity quandaries require addressing before proven positive benefits of intervention can be enjoyed by this population. Kaipa and Danser (2016) found that with AVT, (1) hearing-impaired children beyond three-years-old can develop age-appropriate expressive and receptive language skills to be on par with their normally hearing peers; (2) auditory and speech perception development that leads to appropriate and accurate word recognition occurs even in the presence of background noise; and (3) hearing-impaired children can be successfully mainstreamed. These are important benefits that LMICs should strive for to meet the United Nations' Sustainable Development



Goals, comprising of a collection of 17 global goals that are interlinked and conceived to attain an enhanced and more sustainable future for all (Jatana & Currie 2020). For Africa to achieve this, research into ECI investigating the influences of identified challenges and complexities on CTAs and their outcomes is critical. Such evidence will facilitate evidence-based best practice, informed by contextual relevance and responsiveness.

# Complexities with family-centred early hearing detection and intervention services in Africa

**Ntsako P. Maluleke<sup>a,b</sup>**

<sup>a</sup>Department of Speech-Language Pathology and Audiology,  
Faculty of Health Sciences, School of Healthcare Sciences,  
Sefako Makgatho Health Sciences University,  
Pretoria, South Africa

<sup>b</sup>Department of Audiology, Faculty of Humanities,  
School of Human and Community Development,  
University of the Witwatersrand,  
Johannesburg, South Africa

**Katijah Khoza-Shangase**

Department of Audiology, Faculty of Humanities,  
School of Human and Community Development,  
University of the Witwatersrand,  
Johannesburg, South Africa

## ■ 4.1. Introduction

Universal newborn hearing screening programmes have been proven to be beneficial for children with infant or childhood hearing impairment, as they provide a platform for EHDI programmes. Early hearing detection and intervention programmes are aimed at achieving speech, language, cognitive

**How to cite:** Maluleke, NP & Khoza-Shangase, K 2022, 'Complexities with family-centred early hearing detection and intervention services in Africa', eds. K Khoza-Shangase, *Complexities and challenges in preventive audiology: An African perspective*, AOSIS Books, Cape Town, pp. 55–69. <https://doi.org/10.4102/aosis.2022.BK311.04>

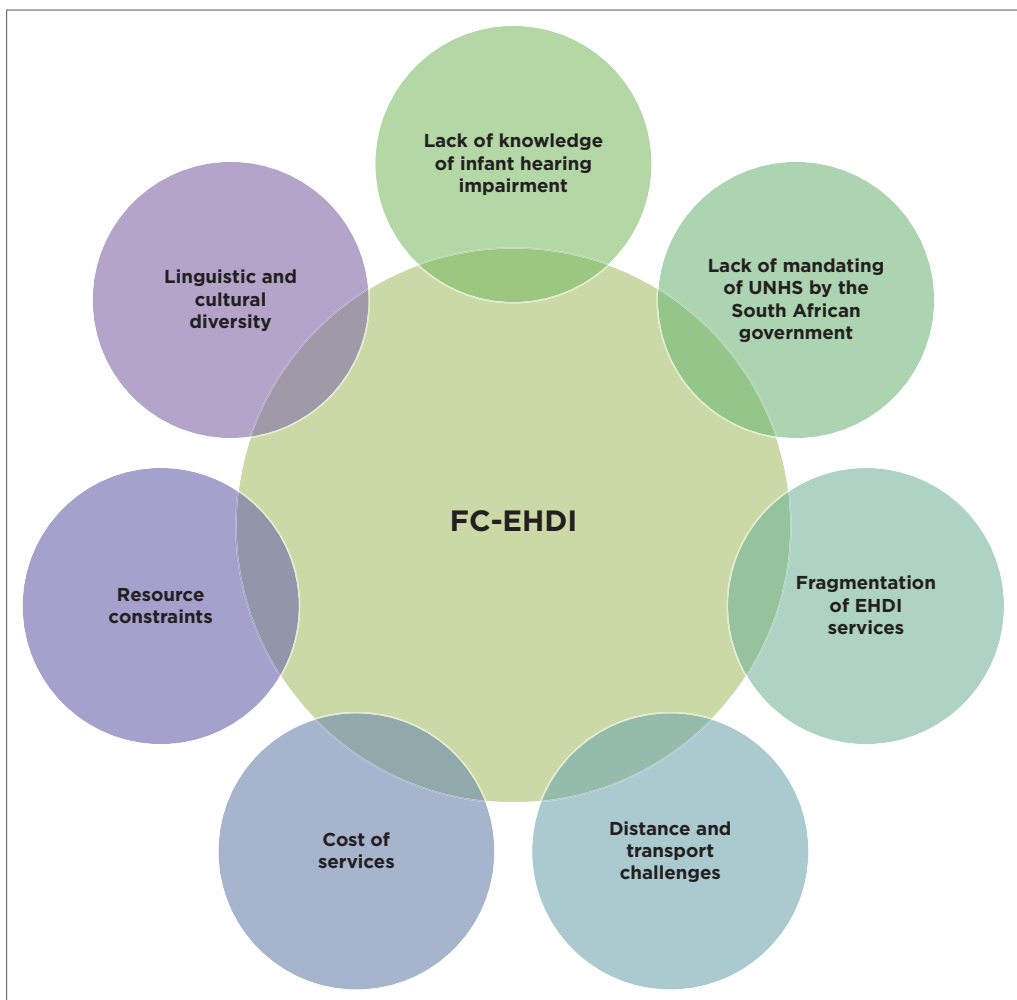
and psychosocial development for hearing-impaired children that is comparable to peers with typical hearing (Kanji 2018; Maluleke, Khoza-Shangase & Kanji 2019; Yoshinaga-Itano 2004). Hearing detection and intervention programmes have become standard practice in high-income countries (HICs); however, this differs from low- and middle-income countries (LMICs), such as most countries in the African continent, where efforts for widespread implementation of these services have been confronted by various challenges (Kanji 2021; Khoza-Shangase & Kanji 2021; Moodley & Storbeck 2015).

For the sub-Saharan Africa region, comprising 49 countries with an anticipated rapidly growing population when compared to other regions of the world between 2015 and 2050 (Simkins 2019), key factors that could be contributing to the EHDI implementation challenges include: (1) inadequate health care systems and their management, (2) insufficient health care human resources leading to capacity versus demand challenges, (3) lack of or inadequate health care infrastructure and (4) financial resources challenges for health care, which often fall on the already-impooverished patients with poor social determinants of health (Ataguba, Day & McIntyre 2015; Olugbenga 2017). The fact that Goals 4 to 6 of the Millennium Development Goals that are directly related to health (Pillay & Barron 2014) have been reported to be the poorest globally (United Nations 2015) illustrates how much of a challenge implementation of EHDI would be in this context. With an infant mortality rate reported to be the highest in this region, and with the HIV and AIDS epidemic remaining as high as it is, implementation of EHDI has a significant number of health care priorities to compete with (Allinder & Fleischman 2019; Avert 2019; UNAIDS 2019). With the burden of disease in Africa increasingly including both chronic communicable and non-communicable diseases, from the historical predominant acute and infectious diseases, such as TB, malaria and measles (Agyepong et al. 2017; World Health Organization [WHO] 2022), hearing loss and its management become less and less of a priority over life-threatening conditions (Kanji 2021; Krishnan & Donaldson 2013).

The various prevailing challenges and complexities that hinder the implementation of family-centred EHDI (FC-EHDI) services, with South Africa used as a focus point, are the focus of this chapter. These include a lack of knowledge of infant hearing impairment (Khoza-Shangase 2019; Maluleke, Khoza-Shangase & Kanji 2018), lack of mandating of UNHS by the South African government (Fitzgibbons et al. 2021; Khan & Joseph 2020; Maluleke et al. 2018), fragmentation of EHDI services (Khan & Joseph 2020), distance and transport challenges (Khan & Joseph 2020; Khoza-Shangase 2019), cost of services (Maluleke, Khoza-Shangase & Kanji 2021a) and resource constraints (Bezuidenhout et al. 2021; Khoza-Shangase & Michal 2014), as well as challenges related to the linguistic and cultural diversity of the South African

population (Khoza-Shangase & Mophosho 2018, 2021; Maluleke et al. 2021a). These complexities, as depicted in Figure 4.1, are deliberated on in this chapter, with recommendations proffered on how they can be addressed within the South African context, although these recommendations may be applicable to the rest of the African continent.

Internationally, UNHS programmes have changed the management of infant and childhood hearing impairment, as illustrated by the age of identification that has become substantially earlier, with a measurable positive impact on EI (Butler et al. 2015; Kanji 2021; Kanji & Khoza-Shangase 2021a;



Key: EHDI, early hearing detection and intervention; FC-EHDI, family-centred early hearing detection and intervention; UNHS, universal newborn hearing screening.

**FIGURE 4.1:** Complexities and challenges hindering the national implementation of FC-EHDI.

Nikolopoulos 2015; Patel et al. 2011; Petersen & Ramma 2015). This impact includes elimination or minimisation of the negative effects of the hearing impairment on the child's language, speech and scholastic performance, as well as general development (Mackey et al. 2021; Nikolopoulos 2015), thus indicating positive strides towards adherence to EHDI principles. Adherence to the EHDI principles is the goal of any efficacious intervention programme (Khoza-Shangase et al. 2017). Within the South African context, these goals include the detection of hearing impairment by one-month-old, diagnosis at no later than four-months-old, as well as the implementation of EI at no later than eight-months-old (HPCSA 2018). Furthermore, in its latest position statement, the HPCSA recommends that EI services for hearing-impaired infants and children must be culturally congruent and family-centred within a community-based service delivery model (HPCSA 2018).

Family-centred early intervention is a family-professional collaboration that positions the child's needs in the context of their family (MacKean, Thurston & Scott 2005; Maluleke et al. 2021a) to optimise the child's developmental outcomes (Iversen et al. 2003) FCEI is the preferred approach in paediatric care (Vetcho et al. 2020), where families and caregivers are maximally involved in their child's care (Moeller et al. 2013), and within the African context, this approach has demonstrably been successfully adopted in the management of paediatric HIV and AIDS (Hosegood & Madhavan 2010; Leeper et al. 2010; Luyirika et al. 2013). Contrary to direct child therapy, where the focus is just on the child, FCEI's purpose is to provide education and support to the family and caregivers of the child with a hearing impairment (Maluleke et al. 2021a; McCarthy, Leigh & Arthur-Kelly 2019; Moeller et al. 2013). Over the past three decades, a shift towards accentuating the value of the child's family playing a more active role in intervention programmes has been observed to be accelerating (Maluleke et al. 2021a; Maluleke, Chiwutsi & Khoza-Shangase 2021b; Manus et al. 2021). Family-centred early intervention is increasingly seen as a cardinal feature of best practice for hearing-impaired children (McCarthy et al. 2019; Woods et al. 2011).

Family-centred early intervention represents a paradigm shift from child-focused interventions to a service delivery model that aims to strengthen family interactions (Maluleke et al. 2021b; Woods et al. 2011). Numerous studies have demonstrated positive effects on child development outcomes through strengthening the family role and responsibility by affording caregivers their rightful place as decision-makers, advocates and partners with EI professionals (Alyami et al. 2016; Ingber & Dromi 2009; Jackson et al. 2010; Khoza-Shangase 2022; Sass-Lehrer et al. 2016). This family-professional partnership stimulates self-efficacy in caregivers and may lead to higher rates of participation, follow-through and adherence to EHDI services (Khoza-Shangase 2019).

Establishing FC-EHDI within the South African context can mitigate some of the complexities and inequities associated with access to health care and specifically to EHDI programmes (Maluleke et al. 2021a; Nkonki et al. 2011). The principles of FC-EHDI are discussed extensively in Maluleke et al. (2021a, 2021b). Although these principles are uncomplicated, the process of implementation confronts numerous challenges and complexities within the South African context. The next section presents these as reflected in Figure 4.1.

### ■ 4.1.1. Lack of knowledge of infant hearing impairment

Hearing impairment is reported to be the most prevalent congenital disability in LMICs and has been dubbed a silent epidemic because of its invisibility (Kanji & Kara 2013; Kaspar et al. 2017; Petersen & Ramma 2015). The adverse effects of unidentified or late-detected hearing impairment on speech, language, academic achievement and quality of life are extensively reported (Khan & Joseph 2020; Maluleke et al. 2019; Maluleke, Khoza-Shangase & Kanji 2021c). However, there is still a lack of knowledge of infant hearing impairment, risk factors as depicted in Box 4.1 (HPCSA 2018) and the consequent speech and language delays among caregivers and HCWs working in paediatric care (Maluleke et al. 2018). Health care workers' and caregivers' lack of knowledge of infant hearing impairment presents a complexity with regard to early detection of hearing impairment (Khoza-Shangase, Kanji & Ismail 2021), leading to late-identified hearing impairment (Maluleke et al. 2018).

In Maluleke et al.'s (2018) study, HCWs failed to refer children who presented with risk factors for hearing impairment for hearing screening. Similarly, in Khoza-Shangase's (2019) study, 48% of the caregivers conveyed that HCWs were not sufficiently knowledgeable about or understanding of their hearing-impaired child's hearing difficulties. Furthermore, 55.2% of nurses in Khan and Joseph's (2020) study reported that they were not knowledgeable about the risk factors for hearing impairment. Health care workers' lack of knowledge of infant and childhood hearing impairment was also reported in India, another LMIC, where caregivers reported having to 'wander around looking for the right people' following a referral for a hearing evaluation for their child (Merugumala et al. 2017). These findings are not only limited to LMICs, but comparable results have been documented in HICs such as the United States, where findings in Elpers et al.'s (2016) study revealed that HCWs did not accelerate hearing health care and disregarded caregivers' concerns about their infant's hearing impairment. Furthermore, in that context, HCWs were reportedly unaware of available EI programmes, which resulted in children not receiving timely intervention services.

**BOX 4.1:** Risk factors for infant and childhood hearing impairment.

- a) \*Parental or caregiver concern regarding hearing, speech, language and or developmental delay.
- b) \*Family history of permanent childhood hearing loss (first cousin or closer to baby).
- c) All infants with or without risk factors requiring neonatal intensive care for *greater than five days*, including any of the following: \*Extracorporeal membrane oxygenation, assisted ventilation, exposure to ototoxic medications (gentamycin and tobramycin) or loop diuretics (furosemide/lasix). In addition, regardless of the length of stay: hyperbilirubinemia requiring exchange transfusion.
- d) *In utero* infections such as \*cytomegalovirus, herpes, toxoplasmosis and rubella.
- e) Craniofacial anomalies involving the pinna, ear canal, ear tags, ear pits and temporal bone anomalies.
- f) Physical findings, such as white forelock, that are associated with a syndrome known to include a sensorineural or permanent conductive hearing loss.
- g) \*Syndromes associated with hearing loss or \*progressive/late-onset hearing loss, such as neurofibromatosis, osteopetrosis and Usher syndrome; other frequently identified syndromes include Waardenburg, Alport, Pendred, and Jervell and Lange-Nielsen.
- h) \*Neurodegenerative disorders, such as Hunter syndrome, or sensory motor neuropathies, such as Friedreich's ataxia and Charcot-Marie-Tooth syndrome.
- i) \*Culture-positive postnatal infections associated with sensorineural hearing loss, including bacterial and viral (especially herpes viruses and varicella) meningitis.
- j) \*Head trauma, especially basal skull/temporal bone fracture that requires hospitalisation.
- k) \*Chemotherapy.
- l) \*Maternal and infant HIV infection.
- m) \*Recurrent or persistent otitis media with effusion for at least three months.

**For a screening protocol targeting bilateral hearing loss:**

\*Infants with a unilateral *refer* result are at risk for progressive bilateral hearing loss.

**\*Denotes the risk factors that are of greater concern for delayed onset/progressive hearing loss**

*Compiled from the JCIH (2007, 2008) with additional risk indicators based on SA contextual infections and screening protocols targeting bilateral hearing loss.*

Source: HPCSA (2018).

Health care workers' lack of knowledge of infant hearing impairment is worrisome and highlights the need for FC-EHDI programmes to be mandated in South Africa and other LMICs (Maluleke et al. 2021a). Mandatory EHDI, starting with compulsory UNHS programmes, will facilitate education and support of all HCWs involved in paediatric care about hearing impairment in this population. Therefore, potential opportunities exist for productive and collaborative transdisciplinary teamwork when ensuring adequate knowledge of childhood hearing impairment by HCWs involved in paediatric management, which safeguards best practice (Maluleke et al. 2018, 2020a; Scheepers, Swanepoel & Roux 2014). Furthermore, because HCWs have an important role in the implementation of multidisciplinary, comprehensive EHDI programmes that include UNHS, diagnosis, family-centred care and EI (Khan & Joseph 2020), such caregivers' and HCWs' knowledge has far-reaching implications within

the South African context. As far as caregivers are concerned, as co-drivers of FC-EHDI, caregivers knowledgeable about infant hearing impairment will aid them in becoming more amenable to accessing EHDI services (Khan, Joseph & Adhikari 2018; Khoza-Shangase 2019). Furthermore, raised caregiver awareness of childhood hearing impairment may facilitate earlier suspicions of the hearing impairment, thus prompting earlier identification of the impairment (Maluleke et al. 2018).

Lack of caregiver and HCW knowledge pertaining to infant and childhood hearing impairment has been highlighted in several South African studies. In Maluleke et al.'s (2018) study, caregivers only suspected that their child might present with a hearing impairment later than twelve-months-old and as delayed as four-years-old, long after the critical period of language development has passed. In Khoza-Shangase's (2019) study, HCWs' inadequate awareness and limited knowledge of hearing impairment were found, with significant implications for EHDI programme efficacy. In Khan and Joseph's (2020) study, 71.1% of nurses reported that contemporary approaches to caregiver education regarding hearing screening and intervention were not effective.

Maluleke et al. (2018) highlighted the significance of ensuring caregiver knowledge and participation in all stages of the EHDI process, with caregiver education being expanded to incorporate risk factors for hearing impairment as well as developmental milestones. Broadening caregiver education can be achieved by expanding the education provided to caregivers during antenatal care and at immunisation clinics (Khan & Joseph 2020; Maluleke et al. 2021a). Khan and Joseph (2020) advised that information given to caregivers as part of the caregiver education initiatives should not only help them appreciate the relevance of hearing screening results but also should create an interest in the ear-and-hearing health care of their child. Moreover, the degree of accurate understanding and recall of information provided to caregivers has important implications for adherence and commitment to intervention proposals, as well as follow-up on treatment options (Maluleke et al. 2021a; Watermeyer, Kanji & Sarvan 2017). This reviewed evidence raises implications for research into caregivers' preferred mode of receiving information, particularly in populations where there are documented low literacy levels and linguistic and cultural diversity challenges, as found in South Africa (Maluleke et al. 2021a; Statistics South Africa [StatsSA] 1998).

## ■ 4.1.2. Universal newborn hearing screening is not mandated

Since 2007, when the HPCSA released its first position statement endorsing UNHS as the ideal approach to achieve EHDI goals, South Africa has made great progress towards increasing awareness of the need for EHDI



(Bezuidenhout et al. 2018, 2021; De Kock, Swanepoel & Hall 2016; Kanji et al. 2018; Petrocchi-Bartal & Khoza-Shangase 2014, 2016). However, UNHS is still not mandated within this context (Khoza-Shangase 2021a). One of the reasons provided for the lack of mandated EHDI services within this context is the lack of evidence to support its efficacy, which in turn is because of the lack of widespread and integrated EHDI programmes (Kanji 2021). Furthermore, the initial position statement issued by the HPCSA was primarily based on guidelines from HICs, which were not all applicable to the South African context (Kanji 2016).

Subsequent to the HPCSA's 2007 position statement, research within the South African context has mainly focused on arguments for UNHS (Khoza-Shangase et al. 2017; Moodley & Storbeck 2015). Studies have been limited to investigations on risk factors associated with hearing impairment (Kanji & Khoza-Shangase 2012, 2021b; Khan et al. 2018), audiological services for diagnosis and intervention for paediatrics in the South African health care sector (Khoza-Shangase, Barratt & Jonosky 2010; Meyer & Swanepoel 2011), NHS services in both the private and public health care sectors (Butler et al. 2015; Petrocchi-Bartal & Khoza-Shangase 2014, 2016), ages at diagnosis and commencement of EI (Maluleke et al. 2018), efficacy of community-based infant hearing screening programmes (Friderichs, Swanepoel & Hall 2012; Khoza-Shangase & Harbinson 2015) and hearing screening protocols and measures followed at various levels of health care in the country (Kanji, Khoza-Shangase & Ballot 2010; Petrocchi-Bartal & Khoza-Shangase 2014, 2016). These studies mainly concentrated on the justification of early hearing detection services and on the development of contextually practicable models of service delivery.

These studies, and other published evidence related to EHDI, have recognised the impracticalities of implementing HIC models of service delivery within the South African context; however, they fall short in terms of demonstrating the efficacy of EHDI services within this context (Kanji 2016, 2021). In accordance with the findings demonstrating the impracticalities of

**TABLE 4.1:** Adapted early hearing detection and intervention time frames for the South Africa context.

<b>What</b>	<b>How</b>	<b>Who</b>
<b>Screening</b> (< 4-6 weeks)	OAE	Trained screeners
	AABR	Audiologists to manage/train/screen
<b>Diagnosis</b> (< 3-4 months)	Diagnostic audiologic assessment	Audiologists
	Otological assessment	Otorhinolaryngologists
<b>Intervention</b> (< 6-8 months)	Amplification (hearing aids/cochlear implants)	Audiologists/otorhinolaryngologists
	Early intervention (family-centred/communication modes/language)	Speech-language therapists/early interventionists/audiologists/parent guidance facilitators, etc.

Key: AABR, automated auditory brainstem response; OAE, otoacoustic emission.

Source: HPCSA (2018).

implementing models from HICs in LMICs, the guidelines and targets for time frames for screening and diagnosis (Table 4.1) were subsequently adapted for the South African context (HPCSA 2018). However, because of the persistent lack of efficacy studies within this context as well as resource constraints, UNHS remains unmandated (Khoza-Shangase 2021a). The continued absence of legislative support for UNHS also presents a complexity for FC-EHDI.

Because of EHDI not being legislated in South Africa, available reports reveal that hearing impairment is identified at ages ranging between 15.3- and 44.5-months-old (Scheepers et al. 2014; Störbeck & Young 2016); ages at amplification in the form of hearing aid fitting range between 28- and 39-months-old, and initial enrolment into EI services occurs between 17- and 49-months-old (Maluleke et al. 2018; Meyer & Swanepoel 2011). Furthermore, infant hearing impairment identification still remains mainly passive in nature through caregivers raising concerns about observed atypical behaviours, delays in speech and language development or OM complications (Petrocchi-Bartal & Khoza-Shangase 2014; Störbeck & Young 2016).

The complexities surrounding the lack of mandating are observed differently in the two different health care sectors in South Africa. The South African health care system consists of a public health care sector and a private health care sector, with the public health care sector being state-run, funded by taxpayers and servicing approximately 85% of the South African population, while the private health care sector (i.e. personal or medical aid-funded) catering for the rest of the population (Meyer & Swanepoel 2011; Scheepers et al. 2014; Theunissen & Swanepoel 2008). Only 27% of public sector hospitals offer NHS when compared to 53% of private sector hospitals (Scheepers et al. 2014). Consequently, more than 90% of infants born in South Africa will not receive EHDI services (Theunissen & Swanepoel 2008). While the lack of NHS in the public sector is attributed to insufficient workforce and equipment, in the private sector, NHS services are reported to be negatively impacted by the fact that they are dependent on individual private audiologists' initiatives and not sector-driven. Reliance on individual private audiologists' efforts has resulted in these services being provided in an unregulated, non-systematic and unstructured manner nationally (Bezuidenhout et al. 2018, 2021; Scheepers et al. 2014; Swanepoel 2009).

Undeniably, the main benefit of UNHS is the timely identification, diagnosis and subsequent EI for children with hearing impairment (Lasisi et al. 2014). With the body of international evidence, one of the lessons that can be learned from HICs that have successfully rolled out EHDI programmes is that political support and promulgated legislation are required to ensure systematic planning and implementation of widespread EHDI services at various levels of service delivery in any country (Kanji & Khoza-Shangase 2021a; Maluleke et al. 2018; Petersen & Ramma 2015; Petrocchi-Bartal & Khoza-Shangase 2016).

### ■ 4.1.3. Services are fragmented

Because of the previously discussed lack of systematic implementation of EHDI services within the South African context, available services are limited and often fragmented in nature. Fragmented services present complexities to efficient, comprehensive and successful implementation to be able to achieve positive outcomes. In a study by Maluleke et al. (submitted) which investigated caregivers' experiences of the EHDI process from detection to intervention in South Africa, caregivers reported being referred to various HCWs and having to attend numerous assessment appointments before receiving a diagnosis for the child's hearing impairment. Consequently, the commencement of EI services was subsequently delayed. In addition to fragmented services pertaining to the identification of the hearing impairment, caregivers in Maluleke et al.'s (submitted) study also reported receiving EHDI services in as many as three different locations that were far apart, with different HCWs and with socio-economic challenges, thus presenting significant challenges to access.

With limited collaboration between the many diverse HCWs that are involved in the provision of services to hearing-impaired infants and children, services will continue to be fragmented, resulting in misinformation, miscommunication, contradictory advice and unnecessary delays for hearing-impaired children and their families (Khan & Joseph 2020). The success and effectiveness of EHDI services are contingent upon EHDI team members collaborating in an interdisciplinary team approach to health care delivery that includes nurses, audiologists, otorhinolaryngologists, speech-language therapists, paediatricians, community HCWs and families (Khan et al. 2018). Khan et al. (2018) argued that this interdisciplinary team approach of amalgamating the essential resources as well as shared skills and knowledge can only advance hearing health and communication outcomes of hearing-impaired children.

Fragmented implementation of EHDI services renders the available EHDI services within the South African context ineffective (Maluleke et al. submitted), subsequently compromising health care services, especially in vulnerable subgroups (Burger & Christian 2020). The existence of fragmented EHDI services can be remedied through the systematic implementation of legislated UNHS programmes, as well as collaborative teamwork among paediatric health care providers - including families in FC-EHDI.

### ■ 4.1.4. Distance and transport challenges

Distance and lack of access to transportation to places where EHDI programmes are run have been identified as some of the physical barriers that negatively affect access to health care and EI, with pronounced effects in rural areas.

Kanji and Khoza-Shangase (2021b) discuss how distance and transport challenges present a complexity for both early identification and EI of infant and childhood hearing impairment within the South African context, with Chapter 1 emphasising the importance of intersectoral collaboration in running such programmes.

Khan and Joseph (2020) identified lack of transport as one of the major challenges related to the implementation of EHDI programmes in South Africa, with Maluleke et al. (submitted) documenting that caregivers reported having to travel long distances to be able to access EHDI services, often using expensive public transport. Similarly, McLaren, Ardington and Leibbrandt (2014) identified the distance to facilities as a barrier to accessing health care, with people from the poorest income brackets being more likely to reside furthest from health care facilities.

After the end of apartheid the South African government sought to improve access to public health care by attending to the distance challenges through strengthening various levels of health care with enhanced PHC (Burger & Christian 2020). However, capacity versus demand challenges in relation to the number of audiologists in the public in comparison to the private health care sector exist (Pillay et al. 2020); thus, reducing distance challenges has not necessarily resulted in an improvement in access to ear-and-hearing health care services such as EHDI, as patients and their families would still need to travel distances to see an audiologist. Furthermore, budget constraints, especially in the public health care sector, have resulted in inadequate equipment, which has implications for the number of visits the patient might have to make and conflates the access challenge, thus impacting the successful implementation of FC-EHDI within the South African context (Khoza-Shangase et al. 2021).

#### ■ 4.1.5. Cost of services

With the dawn of democracy, the South African government had as one of its aims the improvement of access to health care for the poorest and most marginalised subgroups by abolishing user fees for PHC (Burger & Christian 2020). However, affordability still presents a complexity for both identification and intervention in EHDI services. In Maluleke et al.'s (submitted) study, caregivers reported high costs associated with EHDI services, including costs linked to amplification devices and accessories. Furthermore, such costs were only partially covered by medical aid, even for patients who were using private health care, thus requiring out-of-pocket payments. McLaren et al. (2014) highlighted that costs also include money and time costs associated with travelling to health care facilities where intervention services are offered and that these create a considerable barrier for vulnerable sections of the population, particularly in remote and or underserved areas.

South Africa's scheduled implementation of the NHI creates an opportunity to modify health care policies based on the experiences of the end-user regarding the costs associated with accessing health care. Because the NHI will ensure equal access to health care, regardless of financial standing, it is anticipated that its rollout will ensure that access to needed health care services does not place undue financial hardships on households and is well aligned with patients' circumstances (Ataguba & McIntyre 2018).

#### ■ 4.1.6. Resource constraints

Delays in the identification of childhood hearing impairment and lack of FC-EHDI within the South African context have been attributed to the prevalent financial constraints within this context (Khoza-Shangase 2021). South Africa is characterised by a quadruple burden of disease, where there is a growing burden of non-communicable diseases, high maternal and child mortality, high levels of violence and injuries, as well as the HIV and AIDS epidemic that co-exists with TB. Within this context, infant and childhood hearing impairment has obtained reduced political attention and financial support from the DoH because it is viewed as less urgent (Petrocchi-Bartal & Khoza-Shangase 2014). Consequently, a significant portion of the expenditure is frequently expended on curative measures and on the treatment of life-threatening conditions (Khoza-Shangase 2021). Thus, these resource constraints present a significant complexity for the implementation of FC-EHDI within this context.

According to McPherson (2012), the required equipment for UNHS can be relatively expensive in LMICs, and this is evidenced by a shortage of or inadequate hearing screening equipment within South African hospitals and clinics (Bezuidenhout et al. 2018, 2021; Khoza-Shangase et al. 2017; Scheepers et al. 2014). Another significant challenge in implementing widespread EHDI is the aforementioned general lack of personnel (De Kock et al. 2016). A majority of audiologists registered with the HPCSA practise in the private health care sector (Kanji 2016; Pillay et al. 2020). This documented capacity versus demand challenge, as well as the heavy clinical workload faced by audiologists in the public health care sector, has a significant influence on FC-EHDI services (Petrocchi-Bartal & Khoza-Shangase 2014). Most communities reportedly do not have the services of audiologists in close proximity to their areas of residence. Consequently, there is an urgent need for workforce planning, budget allocation and policy formulation for EHDI services, with FC-EHDI being a potentially valuable vehicle to facilitate the achievement of positive outcomes for infants and children with hearing impairment.

### ■ 4.1.7. Language and culture

Within the South African context, the language that is dominant in social, political and educational settings is English (Pascoe et al. 2018). This is regardless of the fact that it is spoken only by 8% of the population as their home language (StatsSA 2018). Over 11 million black South Africans are provided with health care services in English, a language that is not their home language (Mophosho 2018). South Africa is characterised as a multicultural, multilingual country; thus, it is imperative for HCWs to provide services that are culturally and linguistically appropriate to improve health care outcomes (HPCSA 2018; Khan et al. 2018). Language, identity and culture are intricately linked, and thus, the use of English by a majority of South Africans does not respond to the population's identity, culture and needs (Irina 2011; Pascoe et al. 2018). In post-apartheid South Africa, this persistent practice reproduces historical power dynamics that may cause patients to feel less confident to ask for clarification or signify to the HCW when they do not understand some information, with family dynamics and influences in health care significantly impacted (Mophosho 2018).

Global evidence on health outcomes shows that groups that comprise the minority culture have inferior health outcomes when compared to those in the dominant populations (Flood & Rohloff 2018). This phenomenon causes a cycle of marginalisation of the patient and their family from accessing effective health care (Mophosho 2018). Some South African studies have illustrated poor caregiver understanding and recall of information offered by HCWs, as well as a lack of adapting of information giving to align with the communicative needs of the patients (Ehlert & Coetzer 2020; Watermeyer et al. 2017), which are all possibly influenced by linguistic and cultural diversity between the health care providers and the patients they see. Moreover, in this context, the use of interpreters was shown to not necessarily completely address the challenges associated with multilingualism and multiculturalism (Mophosho 2018). Therefore, a multipronged approach is required to address this challenge, and this involves the following: (1) the DoH investing in employing skilled interpreters to assist HCWs (Mophosho 2018); (2) for cultural and linguistic competence, the orientation of all newly-employed HCWs should include basic knowledge on the culture and language(s) of the community they work in (Khoza-Shangase & Mophosho 2021); (3) provision of additional opportunities for clarification for patients and families through the implementation of support group structures (Watermeyer et al. 2017); (4) reviewing and revision of the admission criteria into the university training programmes to increase enrolment of African language-speaking students, as well as curriculum transformation that includes cultural awareness and competence (Khoza-Shangase & Mophosho 2018).

Families serve as a source of a culturally rich setting where children develop and learn; thus, intervention approaches should be easily incorporated into families' daily lives and congruent with their beliefs and practices (Balton, Uys & Alant 2019). Through linguistic and culturally appropriate FC-EHDI services, families and caregivers can be emboldened with appropriate knowledge to enhance their child's developmental outcomes and ensure that EHDI services do not distance the child linguistically and culturally from their families and communities (Iversen et al. 2003; Maluleke et al. 2021a). This is especially imperative in the South African context, where the audiology profession is largely white, female and English- or Afrikaans-speaking (Maluleke et al. 2021a). Chapters 10 and 11 dig deeper into linguistic and cultural diversity complexities and challenges and their influence on preventive audiology, including EHDI.

## ■ 4.2. Conclusion

Various complexities exist which hinder the implementation of FC-EHDI within the African context, with South Africa having been used as a case study. These complexities include a lack of knowledge of infant and childhood hearing impairment, lack of legislative support for UNHS, fragmented services, distance and transport challenges, cost of services and resource constraints, as well as language and culture challenges. These complexities affect early identification, intervention and access to FC-EHDI services for children with hearing impairment. These complexities perpetuate the late identification of hearing impairment that is evident within this context.

Inequity in accessing health care is a global issue and affects the performance of any health care system (Vergunst et al. 2017). South Africa has made great strides to implement widespread FC-EHDI services; however, achievement of the FC-EHDI goals is dependent on strong political will pertaining to mandating UNHS and allocation of funds committed to EHDI. These actions will enable family-centred EHDI programmes to provide children with hearing impairment the opportunity to develop speech, language and cognitive abilities that are comparable to their normally hearing peers.

For accessible and effective family-centred programmes to be implemented within the African context, due consideration of the following factors is warranted:

- Improve support and education of HCWs' knowledge pertaining to infant and childhood hearing impairment.
- Facilitate collaborative and multidisciplinary teamwork among HCWs involved in paediatric care.
- Broaden education given to caregivers during antenatal and immunisation visits to include infant and childhood hearing impairment, risk factors for

hearing impairment and the impact of hearing impairment on speech and language development.

- Explore caregivers' preferences for modes of information sharing.
- Legislative, financial and human resource commitment for UNHS and EHDI.
- Improved access to EHDI services through NHI, within the South African context, donations and crowdfunding.
- Linguistically and culturally relevant EHDI services.
- Multilinguistic and multiculturally competent clinicians.

Sufficient evidence exists for the value of a family-centred approach to health care; thus, the aforementioned challenges require serious deliberation for EHDI initiatives to be successful and sustainable within the African context. The advent of COVID-19 has further highlighted this need, and this is presented in detail in Chapter 2.





# Challenges and complexities with assessment and management of middle ear pathologies in Africa

**Ben Sebothoma**

Department of Audiology, Faculty of Humanities,  
School of Human and Community Development,  
University of the Witwatersrand,  
Johannesburg, South Africa

**Katijah Khoza-Shangase**

Department of Audiology, Faculty of Humanities,  
School of Human and Community Development,  
University of the Witwatersrand,  
Johannesburg, South Africa

## ■ 5.1. Introduction

Research suggests that middle ear pathologies are among the most common and greatest risk factors for the development of hearing loss and communication difficulties (Mulwafu et al. 2017a). Although evidence suggests that prevention of middle ear pathologies is possible through early identification methods and timely intervention (Biagio et al. 2014; Phanguphangu 2017), within the South African context and other LMICs, the achievement of this

**How to cite:** Sebothoma, B & Khoza-Shangase, K 2022, 'Challenges and complexities with assessment and management of middle ear pathologies in Africa', eds. K Khoza-Shangase, *Complexities and challenges in preventive audiology: An African perspective*, AOSIS Books, Cape Town, pp. 71-89. <https://doi.org/10.4102/aosis.2022.BK311.05>

prevention seems to be challenged by numerous complexities in their assessment and management. These complexities appear to be multilayered, therefore requiring a multidimensional approach to resolve. Some of these layers that will be discussed in this chapter include, but are not limited to:

1. the health system, including a programmatic approach to health care in resource-constrained contexts
2. access to health care
3. limited resources and shortage of personnel, as well as lack of funding
4. measures of middle ear function
5. awareness and knowledge of audiology and auditory pathologies
6. poor infrastructure
7. linguistic and cultural diversity challenges
8. political will
9. interactions between all these factors.

The authors of this chapter argue that without addressing these challenges, which occur at various layers of the health care system, prevention of middle ear pathologies will remain elusive and impossible to achieve within the South African context. Therefore, this chapter discusses these complexities and proposes possible solutions on how these can be addressed to achieve the prevention of middle ear pathologies in the South African context and other LMICs.

Mulwafu et al. (2017a) reported that middle ear pathologies are common auditory pathologies in adults and children and are the frequent and greatest risk factor for hearing loss and communication difficulties. Yet, successful identification and management of these pathologies, particularly in LMICs, remains complex and challenging. In 2018, the World Health Organization (WHO) reported that there were approximately 700 million people with middle ear pathologies (World Health Organization 2018a), with LMICs accounting for most of the pathologies. Bluestone (1998) reported that chronic suppurative otitis media (CSOM) is most common in LMICs and in certain high-risk populations in HICs. The World Health Organization (2004) stated that in LMICs, CSOM is a major cause of hearing impairment in children. Because CSOM is caused by persistent acute otorrhea, which in turn is a consequence of acute otitis media (AOM), preventive measures directed towards early detection and intervention of AOM to prevent tympanic membrane perforation are key (Master, Wilkinson & Wagner 2018). Hussain and Pei (2021) stated that tympanic membrane perforation is a global problem resulting from factors such as blast trauma, object penetration and barotrauma, as well as middle ear pathologies. This perforation, if untreated, can lead to conductive hearing loss (CHL), OM, retraction pockets and cholesteatoma, which are all consequences that are preventable. Hussain and Pei (2021) highlighted that millions of patients from LMICs do not have access to proper middle ear disease management.

This is because of operational complexities, lack of surgical resources (Bergmark et al. 2018) and high cost, hence the importance of primary preventive measures in these contexts (Khoza-Shangase 2022)

Biagio et al. (2013) found approximately 20% prevalence of middle ear pathologies in the paediatric population studied in Gauteng province, South Africa. Phanguphangu (2017) reported a much higher prevalence of 61% in school-going children in Limpopo province, South Africa. Literature on the South African adult population also confirmed a higher prevalence of middle ear pathologies (Joubert & Botha 2019; Ramma & Sebothoma 2016). These findings are similar to those in other LMICs such as the Himalayan region of Nepal, where the prevalence of chronic OM is reported to be high in children, with it being the main cause of preventable hearing loss in that region (Maharjan et al. 2020). Kamfwa and Mwanakasale (2016) investigated the trends of common paediatric otorhinolaryngology diseases and how these are related to sociodemographic factors in Zambia and found that of the otorhinolaryngology disorders seen in this population, ear disorders were the most common (47.1%), with these disorders occurring more in patients from lower socio-economic classes than in the upper classes. Similar patterns of middle ear disorders are seen in other African countries such as Cameroon and Nigeria (Bakari et al. 2010; Libwea et al. 2018). These authors concluded that improvement in health education, socio-economic status and conditions of health facilities would significantly reduce the frequency of paediatric otorhinolaryngology diseases in that country.

More recently, in the same country (Zambia), Lukama, Kalinda and Aldous (2019) found that diseases of the ear, nose and throat are common and are a significant cause of morbidity and mortality in that country, with insufficient attention and resources allocated to manage these diseases, as is reported in the rest of the LMICs (Fagan & Jacobs 2009; Institute for Health Metrics and Evaluation 2013; Mulwafu et al. 2017a). These authors reported on the lack of otorhinolaryngology and audiology resources at all levels of hospital care, as seen by deficient infrastructure and inadequate and insufficient human resources and equipment in public hospitals. Similar findings have been reported in other LMICs, where ear, nose and throat burden of disease exist (Cordes, Robbins & Woodson 2018; Lancet 2016; Pearce et al. 2012; WHO 2013). Ministry of Health Zambia (2017) and Lukama et al. (2019) argued that the lack of prioritisation of otorhinolaryngology and ear diseases, including middle ear pathologies, with the lion's share of resources being directed towards infectious and non-communicable diseases in LMICs, has led to high levels of preventable morbidity and mortality in these countries.

Monasta et al. (2012) also reported that OM is the foremost cause of health care visits and drug prescriptions globally, with its consequences being one of the leading causes of preventable hearing loss, particularly in LMICs. The AOM incidence rate is 10.85% cases each year, with 51% of these

occurring in children under the age of five, while the CSOM incidence rate is 4.76% annually, with 22.6% being in the under-five age group and with the prevalence rate of preventable OM-related hearing impairment documented as 30.82 per 10 000. Many people die from complications of middle ear diseases annually, with Monasta et al. (2012) having reported this mortality to be at 21 000 annually.

### ■ 5.1.1. Consequences of untreated middle ear pathologies

Studies have reported that unidentified, untreated or late treatment of middle ear pathologies can lead to numerous negative consequences. Middle ear pathologies such as OM or otitis media with effusion (OME) can cause transient CHL (Tshifularo et al. 2013), which can be treated medically or surgically (Martin & Clark 2019; Vouloumanou et al. 2009). However, if middle ear pathologies such as OME are left untreated, they can lead to permanent hearing loss such as sensory or neural hearing loss or mixed hearing loss (Kolo et al. 2012), as well as auditory processing difficulties (APDs) (Villa & Zachetta 2014). In addition, untreated middle ear pathologies can cause life-threatening conditions such as meningitis (Sharma et al. 2015) and death (Monasta et al. 2012). The consequences of hearing loss from cradle to grave are well documented and are detailed in various chapters of this book.

### ■ 5.1.2. Risk factors for middle ear pathologies

The continued increase of middle ear pathologies in LMICs seems to be associated with multiple risk factors that are mainly predominant in these regions. In a study from Pakistan, Akhtar et al. (2020) established factors contributing to the high prevalence of CSOM in their population. Their findings revealed that low socio-economic status, low educational level (below matric or Grade 12) and residence in rural areas were significant contributing factors to the high prevalence of CSOM in Pakistan. These authors argued that CSOM remains a major public health problem in LMICs when compared to HICs that have better health care resources and better socio-economic status of their populations. This, they asserted, is because of factors such as poverty, malnutrition, illiteracy, lack of health education, as well as people living in substandard and rural areas. Comprehensive preventive health care is, therefore, an urgent requirement (Akhtar et al. 2020; Cordes et al. 2018; Khoza-Shangase 2022), particularly where the burden of diseases that are risk factors for middle ear disease is reportedly high.

For example, as far as the burden of disease is concerned, several studies have found a strong association between middle ear pathologies and HIV (Chandrasekar et al. 2000; Khoza & Ross 2002; Khoza-Shangase &

Anastasiou 2020; Sebothoma & Khoza-Shangase 2018, 2020; Tshifularo et al. 2013). Research on HIV hypothesises that HIV reduces the number of CD4 cells in the body and weakens the human immune system (Vajpayee, Negi & Kurapati 2013), which ultimately allows for opportunistic infections such as viruses and bacteria to attack the body. Middle ear pathologies are, therefore, caused by these opportunistic infections that enter the middle ear system (Van der Westhuizen et al. 2013).

Obasineke et al. (2014) examined the association between middle ear pathologies and the CD4 cell count. The findings of this study suggested that individuals with significantly decreased CD4 cell counts were at a greater risk of acquiring middle ear pathologies and were also more likely to have a more severe type of disease. Van der Westhuizen et al. (2013) also found an association between the severity of middle ear pathologies (e.g. type B tympanograms) and the number of CD4 cells. The aforementioned studies suggest that individuals living with HIV are at an increased risk of presenting with middle ear pathologies when compared to HIV-negative individuals.

The association between HIV and middle ear pathologies is concerning, given that HIV is a pandemic and presents a high burden of disease in LMICs (Atkinson & Mabey 2019; Khoza-Shangase 2020). Recent reports indicate that approximately 40 million people are living with HIV worldwide, of which a majority of the cases come from LMICs such as South Africa (UNAIDS 2020). Although the antiretroviral therapy (ART) programme has been demonstrated to be effective in managing individuals living with HIV, middle ear pathologies seem to persist (De Jong, Luder & Gross 2019; Sebothoma & Khoza-Shangase 2018; Sebothoma et al. 2021a). The existence of HIV, therefore, warrants identification methods that will identify early signs of middle ear pathologies so that timeous intervention can be provided.

Other risk factors for middle ear pathologies include allergies, exposure to second-hand smoke and recurrent upper respiratory tract infections (URTI), among others (Mukara et al. 2017). Murphy (2019) claimed that ear, nose and throat disease risk factors, prevalence and treatment are different between LMICs and HICs, with LMICs suffering the highest burden because of risk factors such as poor preventive health care strategies and limited surgery access in these countries (Bergmark et al. 2018; Master et al. 2018). Murphy (2019) argued that poor outcomes in LMICs are also because of unsustainable health care systems and lack of access to technologies that provide otorhinolaryngological surgery with innovative diagnostic and treatment prospects. This author suggested that LMICs adopt a multifaceted approach to change the outcomes of patients with otorhinolaryngology diseases such as middle ear pathologies, including increased efforts in preventive health care such as public education and awareness initiatives, reduction of high-risk behaviours and prevention of diseases that increase the risk of otorhinolaryngologic diseases (Khoza-Shangase 2022).

The education aspect of intensifying efforts towards preventive health care should include the provision of high-quality otorhinolaryngology training to local health care professionals to facilitate delivery of self-sustaining and low-cost care, mainly at the PHC level through hybrid models of care that include telepractice and the use of trained task-shifting cadres (Khoza-Shangase & Sebothoma 2022; Murphy 2019). Cordes et al. (2018) suggested that ethical challenges of personal health, safety risks, and CLD challenges that impact the provision of otorhinolaryngology, including middle ear disease management, in LMICs should also form part of this education.

As far as the training of task-shifting cadres is concerned, Mulwafu et al. (2017b) found that training improved the knowledge of community HCWs in ear-and-hearing health care in Malawi and afforded them the ability to identify patients with ear-and-hearing disorders; therefore, LMICs could apply this strategy as a method to increase access, as also proposed by Murphy (2019). In Azad Jammu and Kashmir in Pakistan, where otorhinolaryngologic diseases account for about 25% of diseases in adults and up to 50% in children in general practice and otorhinolaryngology practice, a majority of general practitioners (GPs) (72%–96%) reported the need for high-quality training in otorhinolaryngologic diseases, with improvement in undergraduate training as well as otorhinolaryngology continuous medical education programmes (Farooq, Ghani & Hussain 2018).

Advances in modern information and communication technologies (ICTs) have had a positive impact on improving access to, and quality of, health care provision as well as education, as they provide innovative approaches that can facilitate coordination and collaboration of preventive health care efforts (Forde & Gallagher 2020; Grewal, Terauchi & Beg 2020; Howells et al. 2019; Muflih et al. 2020). Hancock, Hoa and Malekzadeh (2018) and Tariq et al. (2018) stated that these developments, including a number of different mobile learning and web-based platforms such as e-learning, open education resources, and mobile or m-learning, are worth considering as efforts increase towards enhancing educational resources for global health in otorhinolaryngology; the authors of this chapter, supported by findings from Khoza-Shangase, Moroe and Neille (2021) systematic review, suggest that these modalities be actively explored in education and training.

Leach et al. (2020) provided a summary of published evidence on OM and associated hearing loss in LMICs. These authors reported that:

1. the prevalence of OM in Africa, Asia and Oceania was, respectively, 8%, 14% and 50%
2. the corresponding prevalence of hearing loss in these regions was 12%, 12% and 26%
3. risk factors for OM in these LMICs included age, gender, exposure to smoke and pollution

4. quality of life studies identified discrimination of persons with OM and hearing loss
5. varied methods of diagnostic approaches were adopted, ranging from the application of the naked eye to tympanometry.

These authors concluded that these findings raise important implications for clinical practice, including increased evidence-based development through research, increased regional representation, standardisation of methods and improved quality reporting, all with the goal of facilitating accurate assessment of disease burden in LMICs.

Fagan (2018) reported on human resource challenges in sub-Saharan Africa, with extreme shortages of ear-and-hearing health care professionals such as otorhinolaryngologists, speech pathologists and audiologists. This author emphasised that the lack of training opportunities and the limited number of otorhinolaryngology services, exacerbated by population growth and ageing, are risk factors for middle ear pathologies in this region. This author also reported that less than 5% of the population in this region has access to timely, safe and affordable surgery, with over 50% (29 of 52) of the African countries having no radiotherapy services, with very significant implications for the management of middle ear diseases.

## ■ 5.2. Available detection/identification and preventive methods for middle ear pathologies

Various available middle ear evaluation measures are clinically used in South Africa and other LMICs to identify the presence or absence of middle ear pathologies (Sebothoma et al. 2021). These measures include objective measures that are commonly used by audiologists and clinical examination measures that are routinely utilised by medical specialists such as otorhinolaryngologists. Objective measures include acoustic immittance measures such as tympanometry, acoustic reflex thresholds and acoustic reflex decay (Gelfand 2017). There are other objective measures that are not necessarily designed for the diagnosis of middle ear pathologies, but because of their sensitivity to any middle ear impedance, they are used indirectly to identify middle ear pathologies. Otoacoustic emissions are commonly utilised towards this end (Campos et al. 2012).

Tympanometry has been used clinically for over four decades and remains the most common and routinely used middle ear measure globally (American Academy of Audiology [AAA] 2012; Emanuel, Henson & Knapp 2012; Kramer & Brown 2019; Sebothoma & Khoza-Shangase 2021). Several studies have indicated that most audiologists always include tympanometry as part of their audiological test battery (Emanuel et al. 2012; MacDonald & Green 2001; Sebothoma & Khoza-Shangase 2021a). A single probe tone, such as 226 Hz,



667 Hz or 1000 Hz, was used commonly in clinical settings to identify middle ear pathologies in both adults and children (British Society of Audiology [BSA] 2013). This type of tympanometry has been widely used because it is easy to perform, is quick to obtain and interpret results and does not require patients to respond to any stimuli (BSA 2013; Erkkola-Anttinen et al. 2014; Martin & Clark 2019).

Literature has also indicated that tympanometry with a single probe tone can be performed by paraprofessionals such as hearing screeners and parents as part of the task-shifting paradigm of service delivery (Erkkola-Anttinen et al. 2014; Martin & Clark 2015). As a result, tympanometry has been used in various settings, such as clinics and schools (Mahomed-Asmail, Swanepoel & Eikelboom 2016b) and in the community (Ramma & Sebothoma 2016). Recently, Sebothoma (2020) also highlighted the need for and value of the inclusion of tympanometry into HCPs such as those implemented in mining industries, because of the documented occurrence of middle ear pathologies in this population. Otorhinolaryngologists also recommend the use of tympanometry as a precursor for the management of middle ear pathology (Rosenfeld et al. 2016).

### ■ 5.2.1. Wideband acoustic immittance

Although tympanometry has been used for a number of years and continues to be used today, evidence exists indicating that tympanometry with a single probe tone has poor sensitivity and specificity, particularly in identifying some less-severe forms of middle ear pathologies, such as those that have minimal or no effect on the mobility of the tympanic membrane (Kaf 2011; Sebothoma & Khoza-Shangase 2018; Sebothoma et al. 2021) and pathologies affecting the ossicular chain (Shahnaz & Polka 1997; Shahnaz et al. 2009; Shahnaz, Feeney & Schairer 2013). Because of these challenges, newer and more advanced tympanometry, such as multifrequency and multicomponent tympanometry and wideband acoustic immittance (WAI), has been proposed (Hunter & Shahnaz 2013; Margolis, Saly & Keefe 1999).

Hunter and Shahnaz (2013) reported that WAI is a potential technique that can effectively and efficiently measure the mechano-acoustic properties of the middle ear system. Wideband acoustic immittance differs from traditional single-probe tone tympanometry in various clinical parameters. Shahnaz (2021) reported that WAI not only measures impedance and admittance but also the amount of absorbance and or reflectance of sound energy. Furthermore, WAI measures middle ear status across a wide range of frequencies. While research indicates that WAI can measure middle ear function from a low-frequency 226 Hz up to 11000 Hz (Margolis et al. 1999), typically WAI is measured from 250 Hz to 8000 Hz (Shahnaz 2021). Lastly, WAI uses broadband stimuli, such as chirps and clicks, as opposed to pure tones that are used in standard tympanometry (Hunter & Shahnaz 2013).

These clinical parameters allow WAI to more accurately identify middle ear pathologies (Ibraheem 2014; Sebothoma et al. 2021; Terzi et al. 2015). For example, several studies have indicated that WAI can accurately identify various middle ear pathologies (Ibraheem 2014; Shahnaz et al. 2009; Terzi et al. 2015) and predict the magnitude of the CHL (Keefe et al. 2012). Studies on sensitivity and specificity have demonstrated that WAI has higher sensitivity and specificity in identifying middle ear pathologies compared to the traditional single-probed tone tympanometry (Hunter et al. 2008; Kaf 2011; Sebothoma et al. 2021). Terzi et al. (2015) reported that the sensitivity of WAI can be as high as 100%, especially when the wideband average is used. Mimosa Acoustics and Interacoustics have made WAI commercially available, and countries such as the United States are gradually making WAI a part of their routine audiological test battery. Although in South Africa and other LMICs, WAI is not yet a routine measure for middle ear pathologies in clinical settings because of a lack of equipment, normative data (Sebothoma et al. 2021), as well as insufficient training in WAI (Sebothoma & Khoza-Shangase 2021), its availability in the market offers promise for early identification and timely intervention of middle ear pathologies within this context. Sebothoma and Khoza-Shangase (2021) found that with sufficient continued professional development training, South African audiologists are willing to use WAI when it is available to improve patient care.

## ■ 5.2.2. Pure tone audiometry

While pure tone audiometry is designed to assess hearing thresholds (Kramer & Brown 2019), the use of pure tone audiometry can provide important information about the status and function of the middle ear. For example, the existence of middle ear pathologies can be determined by the difference or a gap between air and bone conduction thresholds (air-bone gap) (Møller 2012). Although an air-bone gap of  $\geq 10$  dBHL is typically recommended to determine the presence of hearing loss with a conductive element because of middle ear pathology (Kramer & Brown 2019), significant variability has been found in the literature (Sebothoma & Khoza-Shangase 2020). Despite the wide variability in various studies, the principle of the air-a bone gap remains the same, and it continues to be used today to identify the presence of a middle ear conductive element in hearing loss, which provides evidence about the status of the middle ear.

Pure tone audiometry measures that include the use of the air-bone gap to determine the presence or absence of middle ear pathologies are often conducted in sound-treated rooms with minimal ambient noise (Schlauch & Nelson 2015). These noise-controlling chambers can be costly to install; hence, in countries such as South Africa, they may only be found in selected health institutions such as hospitals and not necessarily in spaces where preventive health care is offered, such as in PHC. Although pure tone air conduction

audiometry forms part of screening programmes and can be part of the task-shifting paradigm of service delivery, the inclusion of bone conduction testing to distinguish the nature of hearing loss remains a task exclusive to qualified audiologists. Therefore, with the extreme shortage of audiologists in South Africa, the use of pure tone audiometry for the early detection of middle ear pathologies may be challenging. Furthermore, because pure tone audiometry is a subjective measure, factors influencing patient cooperation and reliability should be considered, including the influence of linguistic diversity on testing procedures (Khoza-Shangase & Mophosho 2018).

### ■ 5.2.3. Otoacoustic emissions

Although OAE measures such as the DPOAEs and TEOAEs are designed to measure the functioning of the outer hair cells (Hall & Dhar 2018), these measures can also be used to obtain important data about the presence or absence of middle ear pathologies (Hunter 2021). Hunter (2021) reported that the presence of middle ear pathologies can reduce the magnitude of OAEs as a result of middle ear impedance. Current hearing screening protocols in South Africa, particularly neonatal and infant hearing screening programmes, use OAEs to make inferences about the status of the middle ear system in infants and neonates (Bezuidenhout et al. 2018, 2021; Kanji & Khoza-Shangase 2018; Kanji, Khoza-Shangase & Moroe 2018). Otoacoustic emissions are routinely used because they are easy to perform and results are simple to interpret, and they are also cost-effective and can be utilised by paraprofessionals such as CHWs, volunteers and so on, in task-shifting to reach as many neonates and infants as possible (Kanji 2021).

While OAEs are useful in identifying middle ear pathologies, there are often challenges associated with their use. In a study of 2120 newborns, Gina et al. (2021) found that OAEs provided more false negative results than the auditory brainstem response (ABR). Their findings suggest that the abnormal results of OAEs may not necessarily be a resultant of hearing impairment and or middle ear pathology but may be a result of other factors such as the ambient noise levels, with these high false negatives resulting in unnecessary and costly referrals as well as stress on the patient. Prieve and Fitzgerald (2015) reported that noise has significant effects on OAEs. Olusanya (2010) also found that the ambient noise in health care sector facilities in LMICs is relatively higher when compared to those reported in HICs, with Neille, George and Khoza-Shangase (2014), Kanji and Khoza-Shangase (2018) and Kanji (2019) confirming this for the South African context. Additionally, OAEs are also prone to technical difficulties (Bezuidenhout et al. 2018) which may increase costs incurred by a health care system that is already overstretched. As a result, the use of OAEs for preventive middle ear pathology initiatives may be challenging to adopt in countries such as South Africa and requires careful planning around the identified challenges.

## ■ 5.2.4. Clinical examination of the middle ear

Some clinical methods are subjective in nature as they require clinicians, predominantly otorhinolaryngologists, and these are other measures used for the identification of middle ear pathologies within the South African context. The commonly used clinical examination methods include pneumatic otoscopy, video otoscopy and otomicroscopy. Research has indicated that clinical examination methods, although recognised as subjective, have higher sensitivity and specificity in identifying middle ear pathologies (Sebothoma & Khoza-Shangase 2018). In a study conducted by Lee and Yeo (2004) comparing three middle ear measures, the sensitivity of pneumatic otoscopy and otomicroscopy in identifying middle ear pathologies was 97.2% and 100%, respectively. Sebothoma and Khoza-Shangase (2018) found that video otoscopy identified more middle ear pathologies than conventional tympanometry with a single probe tone. Consequently, in LMICs such as South Africa, clinical examination methods are considered the 'gold standard' for the identification of middle ear pathologies (Lundberg et al. 2017).

As far as otoscopic assessment and management of middle ear pathologies are concerned, bearing in mind the capacity versus demand challenges in LMICs as well as the need for enhanced diagnostic accuracy, Avrunin et al. (2020) suggested increased use of artificial intelligence (AI). These authors performed investigations aimed at enhancing computer-based image analysis systems in clinical diagnostic procedures to facilitate the use of objective characteristics in the diagnosis of several diseases, including middle ear diseases. These authors also argued for considerations of using digital information processing of the image of the middle ear, captured by a digital camera and analysed through specialised software that allows the accomplishment of the objectivity of instrumental research. The benefit of this approach is the fact that it can be utilised for telemedicine consultations of middle ear diseases, which is of particular relevance in LMICs where there exist capacity versus demands challenges with regard to the availability of ear-and-hearing health care practitioners (Fagan 2012, 2018; Pillay et al. 2020; Saadi, Goldenberg & Goldenberg 2018). Furthermore, this method has current relevance in conditions of self-isolation such as during the novel COVID-19 pandemic (Khoza-Shangase et al. 2021).

Viscaino et al. (2020) were of the same view as Avrunin et al. (2020) in encouraging the use of computer-aided technology for the identification of middle ear diseases. These authors believed that to overcome challenges of misdiagnosis as well as the absence of ear-and-hearing health care professionals, machine learning algorithms such as support-vector machine (SVM), k-nearest neighbour (k-NN) and decision trees to develop the ear condition predictor model should be considered. These, they argued, would

increase access to ear-and-hearing health care and decrease the costs of health care incurred as a result of misdiagnosis and or late diagnosis, particularly in resource-constrained contexts such as LMICs. Viscaino et al. (2020) also argued that the use of such technologies would aid in remote supervising and or training of health care practitioners, such as GPs, who are not sufficiently trained or do not have enough experience in assessing middle ear pathologies. In their study on the computer-aided diagnosis of external and middle ear conditions, these authors found that the machine learning algorithms presented good performance, with SVM and k-NN presenting the best. These findings suggest that this machine learning system can be used by GPs to enhance their diagnosis of middle ear pathologies, which the authors of this chapter believe could also be applicable to audiologists.

Viscaino et al. (2020) asserted that the potential application of AI in the field of medicine has substantially grown, particularly in the last decade. Evidence indicates that AI is increasingly a major role player in medical imaging interpretation as part of implementation and initiatives aimed at early detection, accurate diagnosis and treatment of diseases (De Silva et al. 2018; Giger 2018; Leha et al. 2019). Goggin, Eikelboom and Atlas (2007) earlier highlighted the value of AI's algorithms in enhancing medical tasks and skills, with positive benefits in managing fatigue, distraction, use of outdated diagnostic techniques or physicians' visual impairment as a result of ageing. Although relevant applications of AI have been reported in cancer diagnosis (Cruz & Wishart 2006), metastatic breast cancer detection (Wang et al. 2016), classification of tissues and consequent identification of cardiovascular organs (Mazo, Alegre & Trujillo 2017), rapid identification of radiographic anomalies (Lao et al. 2004), delineation of surgical anatomy (Wei et al. 2005) and classification of malignant tissues in pathologic specimens (Zacharaki et al. 2009), challenges still exist in the use of AI in otorhinolaryngology (Crowson et al. 2020).

However, there are increasing efforts in the use of AI in head and neck oncology to classify malignant tissue based on histopathologic and radiographic features (Halicek et al. 2017; Mahmood et al. 2018; Rosado et al. 2013), inner ear disorders (Bing et al. 2018; Liu et al. 2017), classification of hearing loss phenotypes (Dubno et al. 2013), vocal fold diagnoses (Fang et al. 2019) and prevention of ONIHL (Dimitrieska, Stankovsk & Efremova 2018; Min et al. 2019), with the use of AI tools for external or middle ear diseases still at its inception stages of research (Viscaino et al. 2020).

With external and middle ear diseases being reported to be among the most frequent pathologies seen and treated by GPs, particularly in childhood (Moberly et al. 2018), the current practice of diagnosing middle ear pathologies through case history interview, a physical examination of the ear through the

use of a manual otoscope and audiological measures such as tympanometry or pure tone audiometry (Viscaino et al. 2020) seems insufficient, hence the previously presented recommendations as well. Other measures such as otoendoscopes or otomicroscopes can be used by otorhinolaryngologists to enhance the diagnosis. All these measures are costly to both the patient and the state; therefore, they are not readily available or available in sufficient numbers, particularly in LMICs (Fagan 2018; Sebothoma & Khoza-Shangase 2018, 2019).

The World Health Organization (2004) highlighted that most approaches to middle ear disease management have presented challenges in LMICs because of their questionable efficacy as well as high costs linked to them. An example of the use of parenteral aminoglycosides that require prolonged hospitalisation and are potentially ototoxic in nature is provided to illustrate this point, although significant progress has been made in this aspect, with improved efficacy of antibiotics that are topical in nature, although still expensive. The high costs linked to these measures, therefore, have implications for preventive programmes where mild conditions that can present subclinically are being missed, with only the most complex cases of ear pathologies being examined through these measures (Sebothoma et al. 2021; Viscaino et al. 2020). In LMICs such as South Africa, with staffing capacity versus demand challenges, the situation is worsened, making accurate and reliable diagnosis of middle ear diseases even more difficult (Biagio et al. 2014; Fagan 2012; Fagan & Jacobs 2009; Mulwafu et al. 2017a; Sebothoma & Khoza-Shangase 2018, 2020; Sebothoma et al. 2021).

It is with these challenges in mind that it is believed that the use of the previously presented AI strategies and telepractice can aid in improving the accuracy of diagnosis and reducing the subjectivity involved in the assessment of middle ear pathologies. However, Moberly et al. (2018) cautioned that the ever-growing popularity and use of telemedicine and telediagnosics calls for increased vigilance and application of clinical validation of new devices, such as the use of high-definition digital still images of the tympanic membrane in obtaining sufficient data to allow for accurate diagnosis of middle ear pathologies, as compared to clinical microscopy. In their study, Moberly et al. (2018) found that diagnosing middle ear pathologies was increased with the use of this measure, with diverse reviewers' confidence in diagnosis among types of pathology, as well as among participants, with a condition such as middle ear effusion remaining complex to diagnose when relying only on a still image. A similar caution was raised in Sebothoma et al.'s (2021) study on the utilisation of telepractice in the evaluation of middle ear function in adults living with HIV during the COVID-19 pandemic, where the quality of the video-recording equipment was highlighted as having an influence on the sensitivity and validity of the model used.

### ■ 5.3. Available intervention methods for middle ear pathologies

Middle ear pathologies are among the few auditory pathologies that can be treated effectively with medical intervention (Møller 2012). Treatment protocols for managing middle ear pathologies exist and seem to be efficacious in various clinical settings at various levels of health care (Lieberthal et al. 2013; Rosenfeld et al. 2016). This treatment depends on the nature and severity of the disease, for example, AOM can effectively be treated at the PHC level such as clinics, using various medical regimens that include antibiotics therapy (Liberthal et al. 2013). Otitis media with effusion, which can result from untreated AOM (Liberthal et al. 2013), is treated differently. Rosenfeld et al. (2016) reported that OME treatment can range from observation (watchful waiting) to medical intervention to referral for surgical intervention. Treatment for chronic middle ear pathologies such as CSOM includes surgical intervention. Birman (2006) indicated that CSOM is often treated by the surgical insertion of a ventilation tube, and to some extent, adenectomy is also used. These surgical interventions are mainly available in tertiary and academic hospitals in South Africa. In 2019, Professor Tshifularo and his team from the Department of Otorhinolaryngology at the University of Pretoria, South Africa, pioneered the world's first middle ear transplant using 3D-printed bones. This 3D-printed model is designed to surgically treat patients with abnormal ossicular chains that cause hearing loss with a conductive element. Audiological management, following medical clearance, involves the provision of amplification and continuous hearing function monitoring as a result of the fluctuating nature of CHL, and this can be surgical amplification through bone conduction hearing devices (Barbara et al. 2013).

### ■ 5.4. Complexities with identification and management of middle ear pathologies

Despite the availability of identification measures that have been shown to be sensitive, established efficacies of the intervention methods, existing guidelines on how these measures can be implemented to achieve early identification and intervention of middle ear pathologies, early identification and intervention of these pathologies remains a challenge within the South African context. The authors of this chapter believe that the country's ability to achieve early detection and intervention of middle ear pathologies relies on our understanding of the complexities and challenges that exist as contextual realities.

Firstly, although various South African studies have documented the occurrence of middle ear pathologies in various populations and the estimated



proportions (Biagio et al. 2013; Mahomed-Asmail et al. 2016b; Phanguphangu 2017; Ramma & Sebothoma 2016; Sebothoma & Khoza-Shangase 2018; Sebothoma et al. 2021), the national prevalence and incidence statistics of middle ear pathologies in South Africa are unknown. Available data on the prevalence and incidence of these pathologies come mainly from big cities, with limited information collated from rural areas (Pillay et al. 2020). This lack of data may be a result of the general shortage of ear-and-hearing health care professionals in South Africa (Fagan & Jacobs 2009), with rural areas being the most severely affected regions. The lack of this data precludes appropriate planning around middle ear diseases, including the allocation of required resources. It also makes it challenging for policymakers to establish systematic, effective preventive programmes that extend from identification to intervention.

Secondly, middle ear pathologies within the South African context are also poorly understood, particularly in people with comorbidities (Sebothoma & Khoza-Shangase 2022). For example, while several studies have indicated that comorbidities such as HIV increase the risk of middle ear pathologies (Chandrasekar et al. 2000; Khoza-Shangase & Anastasiou 2020; Obasineke et al. 2014; Sebothoma & Khoza-Shangase 2020; Tshifularo et al. 2013; Van der Westhuizen et al. 2013), there remains limited longitudinal evidence on the onset and development of middle ear pathologies in this population. This kind of data is crucial for the determination of whether monitoring programmes are required for people living with HIV as part of preventive audiology strategies that include early identification and intervention. Given the quadruple burden of disease that South Africa grapples with (WHO 2018b), a clear understanding of middle ear pathologies and contextual risk factors that can be gained in longitudinal design studies is important (Hlayisi et al. 2019; Khoza-Shangase 2020, 2021; Khoza-Shangase & Kanji 2021; Van der Westhuizen et al. 2013).

Thirdly, the complexity of achieving early identification and intervention of middle ear pathologies is also influenced by the capacity versus demand challenges seen in the general shortage of health care professionals. Surveys on ear-and-hearing health care professionals have indicated that the ratio of audiologists and otorhinolaryngologists to the population in South Africa is extremely large, with most practitioners working in large cities and in private practices (Fagan & Jacobs 2009; Mulwafu et al. 2017a). Pillay et al. (2020), using data from the HPCSA's registration department, reported that the Western Cape, Gauteng and KwaZulu-Natal provinces have higher practitioner ratios per 10 000, with poorer provinces having the lowest ratio per 10 000 population. This shortage of ear-and-hearing health care professionals makes it difficult to provide services to the majority of the South African population with middle ear pathologies and those at risk, if the preventive approach is correctly adopted.



The emergence of the COVID-19 outbreak in December 2019 has further weakened and complicated a health care system that is already weak and incapacitated. The spatial analysis study by Mokhele et al. (2021) demonstrated that South Africa lacks the capability to deal with the COVID-19 outbreak. South Africans also lack confidence in the health care system's capability to deal with COVID-19. While research has indicated that technology such as that utilised in telehealth can be used during the COVID-19 pandemic (Sebothoma et al. 2021), the current infrastructural challenges in African countries make it complex to successfully implement these technological advancements for early identification and intervention.

Because of the continued shortage of ear-and-hearing health care professionals in South Africa and the rest of Africa and its influence on early identification and intervention, the use of advances in ICTs in telepractice has been highlighted (Khoza-Shangase & Moroe 2020; Khoza-Shangase et al. 2021; Swanepoel 2015), with the adoption of hybrid methods of service delivery that include task-shifting to increase access across South Africa being recommended (Sebothoma & Khoza-Shangase 2022; Khoza-Shangase et al. 2021). O'Donovan et al. (2019) found that CHWs can play an important role in addressing ear diseases. Biagio et al. (2013) also reported that tasks such as capturing video images or video clips of the outer ear and tympanic membrane, which can be sent asynchronously for analysis and diagnosis by a qualified otorhinolaryngologist, can be done by individuals with no background in health, a sentiment recently expressed by Sebothoma et al. (2021) from the same context.

While technological advancements and task-shifting paradigms offer promise, these modalities do present challenges. For example, Ombuya and Ishmael (2016) pointed out that the challenges of implementing telehealth include financial, administration reluctance to accept change and lack of sufficient literature, as well as Internet connectivity challenges. Khemapech, Sansrimahachai & Toachodee (2019) added that the implementation of telehealth may be affected by infrastructure challenges and concerns including legal, regulatory, security and human resources, as well as digital literacy. Therefore, there is a need for various stakeholders and intersectoral collaboration to effectively implement technology such as teleaudiology in the assessment and management of middle ear pathologies in the South African context.

Task-shifting also presents with challenges that may affect its adoption as part of service delivery models. While the literature provides clear guidelines on how task-shifting should be applied (WHO 2007), it is not clear how volunteers and CHWs taking up the tasks will be incentivised within the South African context or how they will be regulated. Grossman-Kahn et al. (2018) found that communities' lack of understanding of the roles of CHWs may compromise preventive health care. In South Africa, where people, particularly

those in rural areas, do not understand the role of audiologists (Joubert, Sebothoma & Kgare 2017), task-shifting may present with even more challenges pertaining to the scope of practice and adherence. Therefore, there is a need to educate communities about ear-and-hearing health care, with the inclusion of task-shifting and the role of CHWs and other paraprofessionals in preventive health care. Khoza-Shangase and Moroe (2020) raised caution about the importance of regulations and policy challenges, with stringent observance of ethics, human rights and medical law when utilising tele-audiology. The authors of this chapter also believe that similar caution should also be raised around the application of task-shifting.

Furthermore, successful implementation of task-shifting as a paradigm of service delivery may depend on how CHWs and other paraprofessionals are incentivised. Although there is limited budget for health care service in countries such as South Africa, with increasing numbers of unemployed health care professionals further straining the already stretched health system, there must be a strategic plan for financing task-shifting programmes. Sebothoma and Khoza-Shangase (2022) argued that preventive programmes, particularly in audiology, must take advantage of the NHI bill of 2019, whose goal is to ensure UHC in line with the WHO call (Ghebreyesus 2017). Therefore, audiologists and qualified ear-and-hearing health care professionals such as otorhinolaryngologists need to ensure that the implementation of task-shifting, which may include training, equipment and incentives for individuals, is properly planned for within the envisioned NHI.

Fourthly, ear-and-hearing health care forms part of the broader health care system. Yet within the South African context, ear-and-hearing health care has not been included in various existing health programmes. This fragmented approach has resulted in hearing health receiving minimal resource allocation, preventing implementation of effective and sustainable preventive programmes. Sebothoma and Khoza-Shangase (2022) proposed a programmatic approach where hearing health programmes, such as prevention of middle ear pathologies, form part of the broader health programmes, thereby sharing resources and allowing for a systems approach to health care to be adopted. Chapter 1 details this approach and its value in the preventive ear-and-hearing health care. In fact, Sebothoma and Khoza-Shangase (2022) further suggested that hearing care should not only be part of the health programmes but also form part of other existing programmes such as the school health programmes to increase the reach to communities for universal ear-and-hearing coverage goals.

Within the African context, the use of alternative health care, such as traditional healing, further exacerbates the complexity of early identification and intervention of middle ear pathologies. For example, Mbatha et al. (2012) reported that approximately 80% of the South African population consults traditional doctors before accessing Western health care.

Although South African audiologists are willing to collaborate with traditional doctors (Pillay & Seroe 2019), there is little, if any, collaboration between traditional and Western health care, with a lack of evidence on this collaboration. Evidence on global health has highlighted the influence of language and culture in health outcomes (Flood & Rohloff 2018) and, therefore, the value of considering these in the implementation of any programme (Khoza-Shangase & Mophosho 2021). The authors of this chapter believe that without the integration of various health care systems, including traditional, that exist in South Africa, prevention of middle ear pathologies will remain challenging. Chapter 10 deliberates on linguistic and cultural diversity challenges in preventive audiology within the South African context, while Chapter 11 reflects on challenges raised by traditional and alternative health care practices in preventive audiology.

Lastly, prevention of middle ear pathologies can be achieved through health education and awareness programmes (WHO 2019). In South Africa and other LMICs, health education is particularly important, given the widespread use of hazardous methods that may contribute to the development of middle ear pathologies (Ibekwe & Nwaorgu 2011; Joubert et al. 2017). The World Health Organization (2019) reported that education is one of the most important preventive strategies for preventing auditory pathologies, such as middle ear disease. While health education is crucial, the multilingual and multicultural society of South Africa poses a major challenge to preventive health care. For example, South Africa comprises an approximately 81% black African population (StatsSA 2019), with various cultural backgrounds and belief systems. Yet, there are only 15.2% of black African audiologists registered with the HPCSA (Pillay et al. 2020). Khoza-Shangase and Mophosho (2018) stressed the importance of guarding against ignoring cultural, linguistic, health-seeking and health-practising practices and beliefs of the population a health care service is being rendered to during both the conceptualisation and implementation of a health programme. Flood and Rohloff (2018) further argued that programmes not delivered in indigenous languages have a negative influence on the population's rights, autonomy, research ethics and revitalisation of these languages, as well as on programme efficacy. This has implications for programmes aimed at minimising and mitigating middle-ear pathologies within this context.

## ■ 5.5. Conclusion

The high prevalence of middle ear pathologies resulting from multiple prevailing factors within the South African context is a challenge that ear-and-hearing health care professionals must deliberate on. The reality that middle ear pathologies are the major cause of preventable hearing impairment in this country highlights the significance of the ear-and-hearing health care

professionals carefully reflecting on challenges and complexities presented in this chapter for favourable ear-and-hearing health care outcomes. While middle ear pathologies can be identified through various sensitive measures discussed in this chapter and managed timeously to prevent the negative sequelae, challenges to early identification and intervention exist. These challenges and complexities stem from several factors at various levels, requiring evidence-based strategic planning at the DoH level as part of disease planning and prevention programmes. This is because a number of the challenges require political will that facilitates the release of required resources to implement preventive health care at all levels of prevention, with positive cost-curbing outcomes for individuals, families and the whole society, as well as the state. This chapter, therefore, raises important implications for policymakers, audiologists, otorhinolaryngologists, community members and other relevant stakeholders for collaborative efforts towards early identification and intervention of middle ear pathologies in this context.



# Challenges and complexities with assessment and management of ototoxicity in South Africa

**Katijah Khoza-Shangase**

Department of Audiology, Faculty of Humanities,  
School of Human and Community Development,  
University of the Witwatersrand,  
Johannesburg, South Africa

## ■ 6.1. Introduction

Watts (2019) defined ototoxicity as the injury to structures and function of the auditory-vestibular system that is because of exogenous agents such as pharmaceuticals, chemicals and ionising radiation, leading to hearing and or balance disorders. Globally, and increasingly so within the South African context, there continues to be mounting interest in pharmacovigilance and ototoxicity within the research, clinical audiology and medical communities. However, the assessment and management of ototoxicity continue to be confronted by challenges, which are more pronounced in low- and middle-income countries (LMICs) like South Africa (Khoza-Shangase & Masondo 2020, 2021). This chapter comprehensively explores these challenges,

**How to cite:** Khoza-Shangase, K 2022, 'Challenges and complexities with assessment and management of ototoxicity in South Africa', eds. K Khoza-Shangase, *Complexities and challenges in preventive audiology: An African perspective*, AOSIS Books, Cape Town, pp. 91-106. <https://doi.org/10.4102/aosis.2022.BK311.06>

guided by the World Health Organization's (WHO) (2010) framework detailed in Chapter 1, which defines health systems based on six building blocks: (1) leadership or governance, (2) financing, (3) health information systems, (4) access to essential medicines, (5) health workforce and (6) service delivery.

Ganesan et al. (2018) stated that while ototoxic medications have a significant role in contemporary medicine, their ability to cause injury and lead to considerable morbidity requires pharmacovigilance on the part of audiologists and the rest of the health care team involved in the management of patients on ototoxic drugs. This pharmacovigilance comprises early detection of toxicity via prospective ototoxicity monitoring programmes, which facilitate review and reflection of treatment alterations to lessen or avert permanent hearing impairment and vestibular dysfunction. Although numerous ototoxicity monitoring protocols are available, their practicability and viability are uncertain because of numerous factors as well as challenges to implementation, particularly in LMICs (HPCSA 2018; Khoza-Shangase & Masondo 2020, 2021). Ganesan et al. (2018) also highlighted the fact that although prevailing protocols have been demonstrated to be effective, some disparities in practice have been faced because of divergences in proposed protocols internationally.

Evidence indicates that, historically, practice as well as research has concentrated on the ototoxic effects of a range of therapeutic classes of drugs as well as on attempts towards reversibility of the cochlear-vestibular damage that has presented itself in unfavourable drug reactions that include tinnitus, hearing loss and vestibular dysfunction, in isolation or in combination (Khoza-Shangase & Masondo 2020). DiSogra (2019) reported that, in this practice and research development, nutraceuticals and pharmaceuticals – which are botanicals and over-the-counter dietary supplements aimed at otoprotection or at reducing the ototoxic effects of ototoxic drugs – have been more recently studied, with unfortunately no nutraceuticals for tinnitus, vestibular dysfunction or hearing loss having been endorsed by the United States Food and Drug Administration (US FDA) yet.

There are between 200 and 600 medications that are documented to be potentially ototoxic in nature (Cianfrone et al. 2011), with Ganesan et al. (2018) highlighting that with the advancement of the pharmaceutical industry in the international pharmacopeia over the years, an increase in the number of potential ototoxic agents has occurred. Arslan et al. (1999) registered loop diuretics, antimalarials, aminoglycoside antibiotics, macrolide antibiotics and platinum-based chemotherapeutic agents as the frequently prescribed ototoxic drugs, with evidence of ototoxicity linked to antiretroviral drugs also mounting (Fokouo et al. 2015; Khoza-Shangase 2010, 2011, 2014; Simdon et al. 2001; Williams 2001). Landier (2016) stated that the recounted prevalence of ototoxicity in individuals who have been prescribed potentially ototoxic

medications spans from 4% to 90%, and this is dependent on a range of risk factors such as patient population, age, drug(s) used, cumulative dose and method of drug administration.

Ganesan et al. (2018) maintained that although ototoxicity is not a life-threatening condition, regardless of the cause or nature of ototoxicity, its health-related and psychosocial consequences on the affected individual are substantial, with the burden of morbidity significantly worse in the paediatric population. Ototoxicity can lead to negative consequences on health-related quality of life indicators and communication for the individual affected, with significant educational, social and vocational consequences (Knight, Kraemer & Neuwelt 2005). In the paediatric population, even minimal to mild hearing impairment can impact social, cognitive, and speech-language development, with consequent inadequate psychosocial functioning and scholastic performance (Brooks & Knight 2018; De Andrade, Khoza-Shangase & Hajat 2009). The resultant cochleotoxicity, vestibulotoxicity or neurotoxicity requires multidisciplinary assessment and management by a variety of professional disciplines whose goal is to determine causation, prevention and management of the ototoxic effects of the treatment that patients are prescribed. Within preventive audiology, this process involves ototoxicity preventive strategies at primordial, primary, secondary and tertiary levels of prevention, as described by Khoza-Shangase (2022b).

The Association of Faculties of Medicine of Canada (AFMC) (2013) insisted that because of the natural history of hearing impairment from exposure to causal agents through its progression to final outcomes, preventive strategies need not exclude the primordial level of prevention. The author of this chapter believes that LMICs should prioritise this level of prevention in their preventive health care models as this level focuses on the future possible disease before the disease presents itself. It is at this primordial level where factors that are known to increase the future risk of exposure to ototoxicity, such as environmental, economic, social and behavioural risk factors are prevented from developing, including the addressing of health determinants (Khoza-Shangase 2022a). This level of prevention focuses on changing determinants at the systemic level rather than at the personal risk factors level, which is where the primary level of prevention focuses (WHO 2020). Khoza-Shangase (2022a) provides examples of preventive audiology initiatives at this level with those appropriate for ototoxicity prevention. These include: (1) vaccination and immunisation of everyone from infants to the elderly, as well as postexposure prophylaxis or vaccination for individuals exposed to communicable diseases (WHO 2020), all these with the aim of preventing conditions that would require treatment with potentially ototoxic medications; (2) removing and or limiting access to ototoxic medications from treatment regimens where alternative options exist, with an increased role for audiologists in the drug development and approval processes (Khoza-Shangase 2017);



(3) addressing social determinants of health, which the author of this chapter believes should be the cornerstone of all preventive health care programmes and so on.

Primary prevention through risk reduction has as its aim preventing the onset of ototoxicity through targeting the risk at the personal level. AFMC (2013) stated that this would involve behaviour changes or modification of exposures that can cause ototoxicity or growing resistance to the effects of exposure to ototoxic medications, all aimed at avoiding the manifestation of ototoxicity (WHO 2020). In preventive audiology specific to ototoxicity prevention, this approach would incorporate the supplying of information on medical health and behavioural risks on any public platforms, including all media; in HIV and AIDS, TB and cancer clinics; and alongside other health prevention and promotion strategies, consultations and methods to minimise the risk at the personal and community level (Khoza-Shangase 2022b).

After primary prevention of ototoxicity, secondary prevention would entail its early detection, which WHO (2020) argues improves the chances for positive health outcomes. All measures aimed at detecting and retarding the progression of ototoxicity are employed at this level, before it presents clinically and progresses to severe levels where, for example, frequencies involved in speech perception are involved or where permanent vestibular dysfunction is experienced (AFMC 2013). Also implemented at this level are initiatives such as evidence-based screening programmes for early detection of hearing or vestibular impairment or ear disease (ototoxicity screening and monitoring) and preventive drug therapies, as well as other interventions of proven effectiveness when administered or implemented at an early stage of the disease, such as the use of otoprotective agents in ototoxicity. Khoza-Shangase (2022a) argues that because secondary prevention refers to the use of measures that may lead to earlier diagnosis and treatment of health conditions, advocacy for mandating such measures (e.g. government mandating of ototoxicity monitoring as part of TB treatment) is pivotal for both initial implementation and sustainability of such programmes. Furthermore, it is paramount to ensure that sensitive, valid and reliable assessment or screening measures are used in such programmes.

Ganesan et al. (2018) argued that the choice of early ototoxicity identification techniques remains contentious because of these measures being highly susceptible to factors such as reliability, sensitivity and specificity, as well as labour-intensiveness and time consumption for the patient. Specifically, in ototoxicity monitoring programmes, an important part of effective secondary-level prevention of ototoxicity is the utilisation of sensitive measures such as ultrahigh frequency audiometry, DPOAEs (Ganesan et al. 2018; Govender et al. 2020; Khoza-Shangase 2020a; Konrad-Martin et al. 2018), vestibular screening and assessment through a vestibular testing battery for recording vestibulopathy, such as vestibular-evoked myogenic potentials (VEMPs),

videonystagmography (VNG), video head impulse test (vHIT) and caloric testing over and above subjective questionnaire-based evaluations (Ahmed et al. 2016; Ganesan et al. 2018; Halmagyi et al. 2012; Maru & Malky 2018; Vasquez & Mattucci 2003) and so on.

The AFMC (2013) reported that tertiary-level prevention occurs at the state when, in this case, ototoxicity has presented itself and treatment is provided at the acute phase, with the objective being to decrease the deleterious consequences of ototoxicity on the affected individual's function, longevity and quality of life. This level, therefore, involves approaches that minimise the challenges linked with disability from health outcomes (Stucki, Cieza & Melvin 2007), such as contextually relevant and responsive aural rehabilitative programmes with fitting of amplification, as well as ototoxicity monitoring programmes that are collaborative, multidisciplinary and standardised in nature (Khoza-Shangase 2022b; Maluleke, Khoza-Shangase & Kanji 2020).

Guided by Sahu et al. (2014), an ototoxicity monitoring programme can supply the undermentioned advantages: (1) provide information about the safety and quality of the drugs being prescribed, (2) initiate risk-management plans for ototoxicity, (3) prevent the expected ototoxicity and assist in calculating ototoxicity incidence and (4) educate all stakeholders (the health care team, patients, pharmacists, nurses, policymakers, etc.) about ototoxicity effects, while also creating awareness regarding these effects. Ganesan et al. (2018) maintained that one of the central challenges with ototoxicity is a delay in its diagnosis. Because ototoxicity is highly inconsistent and variable and is influenced by numerous factors, including comorbid medical conditions, age and cognition levels, an accurate record of the patient's symptoms, test results and history is critical. It is, therefore, important for health promotion to raise awareness about symptoms such as decreased hearing, ear fullness, tinnitus, oscillopsia and disequilibrium to all stakeholders, including the multidisciplinary team members (oncologist, general practitioner, otorhinolaryngologist, audiologist, clinical pharmacist, nurses) as well as patients and their families.

Murphy and Frigo (1993) and Moore (2001) asserted that the chief goal of monitoring is to reveal the frequency and quality of adverse drug reactions and to distinguish the risk factors that can lead to the adverse reactions. Without adherence to the national guidelines for ototoxicity monitoring (Khoza-Shangase & Masondo 2020, 2021), without a national electronic medical records database, and furthermore, without clear directives from regulatory authorities on reporting, South African audiologists face significant challenges with ototoxicity assessment and management. In audiology, Konrad-Martin et al. (2018) asserted that regularisation of the evaluation and reporting of ototoxic effects is an imperative interdisciplinary subject for debate that must occur, as this is currently an area lagging in clarity and consensus globally.

## ■ 6.2. Exploration of challenges and complexities in ototoxicity assessment and management

### ■ 6.2.1. Adult population

A sequential monitoring programme that is efficacious and has high sensitivity and specificity affords the health care system with the ability to (1) compare the hearing/vestibular evaluation results during the treatment programme, (2) identify any change in hearing function (and vestibular function) early, (3) recognise the need for potential drug therapy modifications, (4) prevent debilitating ototoxic-induced hearing loss (and vestibular dysfunction) if treatment is modified and (5) provide timeous auditory rehabilitation to minimise the adverse effects of ototoxicity on the individual affected (Ganesan et al. 2018).

Within the South African context, Khoza-Shangase and Masondo (2020, 2021) explored current practice for ototoxicity assessment and management in adults and found several key challenges and barriers, some similar to what Govender (2015) found. These challenges indicated limited translation of knowledge into practice by South African audiologists, including the following:

- Although over two-thirds are involved in ototoxicity monitoring and management in their practice, the practices implemented are not congruent with the national HPCSA (2018) nor to international standards on evaluation and management of individuals on ototoxic treatments.
- Validity and reliability of the data utilised to arrive at preventive treatment decisions are negatively influenced by the use of non-standard assessment batteries.
- Baseline assessments are not conducted routinely by most audiologists, for various reasons.
- The frequency of monitoring is uneven and decreased from the proposed standard, thereby impacting on the capacity for early identification and management of ototoxicity within this context.
- There are barriers to the referral pathways that audiologists employ which include the absence of collaborative working relationships between audiologists and the clinical team involved in the management of individuals on ototoxic drugs. Multidisciplinary case management for ototoxicity is difficult within the South African context, with effective multidisciplinary approaches influenced by large caseloads with excessively busy clinicians' schedules, a trust deficit among professionals, limited knowledge in ototoxicity, inadequate inter-clinician communication, referrals to audiologists only made only after the patient has developed a hearing loss and so on.
- Challenges with prevention and promotion methods used, which consist of workshops and printed flyers or handouts mainly in English or Afrikaans,

which is a barrier within the South African context where these two languages are not a home language to over 80% of the population and where literacy remains a challenge for a large majority of the population. The CLD impacts on activities and initiatives aimed at prevention and promotion are not considered within this context (Khoza-Shangase & Mophosho 2018, 2021), where Joubert, Sebothoma and Kgare (2017) highlighted a need for different prevention and promotion material that are suitable for the South African context.

- Accessibility to resources for ototoxicity monitoring programme implementation is a challenge. Ototoxicity takes up an average of 15% of the audiologists' caseload, with over half of the audiologists indicating having long waiting lists inclusive of new cases, and this is worse so for cases requiring repeated measures such as ototoxicity monitoring. This challenge speaks to the well-documented human resource-linked capacity versus demand challenge around ear-and-hearing health care services within the South African context (Fagan 2012, 2018; Fagan & Jacobs 2009; Khoza-Shangase 2021; Moonsamy et al. 2017; Pillay et al. 2020). Availability of equipment is another resource challenge where inadequate budgeting occurs, with equipment repairs and assistive devices procurement receiving minimal budgeting. In a context that is already resource-constrained, numerous challenges impact the success of programmes, such as patients insufficiently monitored, early identification and consequent early preventive measures rendered unfeasible, poor and inadequate planning for repairs of equipment leading to paralysis of services and consequently, patients with hearing impairment not being fitted with assistive devices if and when necessary. Even though the objective of an ototoxicity monitoring programme is to eradicate and or diminish the need for assistive devices, contemporary South African evidence calls for attention to adequate budgeting for assistive devices for this population (Bardien et al. 2009; Fagan 2012; Khoza-Shangase & Stirk 2016).
- Patient-specific challenges to ototoxicity assessment and management include that (1) patients frequently lack awareness of the audiological features of ototoxicity and therefore fail to attend audiological monitoring; (2) patients pay minimal focus to the potential quality of life indicators, with most attention placed on the life-threatening conditions they suffer from; and (3) patients reside long distances from the health care institutions where these services are offered and therefore are unable to access monitoring within the required time frames, particularly if they are outpatients (Nhokwara 2015).
- Language and culture are other influencing challenges in ototoxicity assessment and management within the South African context. Language diversity serves as a barrier to ototoxicity programmes as it negatively impacts counselling. Audiologists utilise untrained interpreters but raise concerns around breaching patients' confidentiality, as trained

interpreters are not available. On the contrary, culture may lead to patients not reporting symptoms earlier because of a fundamental cultural belief that impacts the early detection process, as well as the patients' compliance with the intervention practice. Evidence underscores that patients are less likely to seek medical care and report symptoms as part of preventive services, comply with treatment or adhere to follow-up appointments (Hunter-Adams & Rother 2017; Khoza-Shangase & Mophosho 2018, 2021) if linguistic and cultural barriers are not addressed, and these factors are vital to a successful ototoxicity monitoring programme.

- Challenges with information management practices also have a negative influence on ototoxicity monitoring programmes within this context. A significant challenge is the use of paper to record and store clinical data, with some use of both paper and electronic databases. An electronic data management system more easily and efficiently allows for comparative analysis of repeated measures for early detection of hearing changes. Furthermore, an electronic system considers and takes on board a migration-prone health care system, such as the South African context (Health Systems Trust 2017); thus, if a patient moves from one health care facility in one province to another, their care is not compromised. On the contrary, a system that utilises both paper and electronic systems may increase margins of error and create challenges in the data collection and analysis of an ototoxicity monitoring programme.

These previously presented South African challenges are no different from some reported in the United States by Konrad-Martin et al. (2018). When these researchers reviewed the US national audiology guidelines in relation to 'real-world' OMPs implementation, they found the following challenges:

- Lack of adherence to guidelines.
- Staffing and equipment limitations.
- Ototoxicity monitoring protocols not being standardised, with evidence of utilisation of varied protocols mirroring their varied contexts.
- Service delivery challenges such as baseline assessments skipped or performed after the initial treatment, monitoring tests conducted infrequently or only after cessation of therapy, et cetera.
- Logistics barriers to ototoxicity monitoring such as challenges with reaching and assessing patients because of absent processes that facilitate patients' entry into programmes because of inconsistent referrals, patients' time and scheduling limitations, as well as undesirable audiology clinic location and space limitations.
- Lack of official support from organisations governing medical specialty stakeholders in occupational medical practitioners (OMPs) such as pharmacists, oncologists, infectious disease specialists, pulmonologists and otolaryngologists.

- OMPs guidance required regarding assessment schedules, outcome reporting and establishment of actionable ototoxic modifications and the application of hearing conservation methods appropriate for the mass testing required to facilitate large-scale monitoring endeavours.

Hong et al. (2019) raised an important argument about challenges with ototoxicity related to other individual influencing factors which make the establishment of causal links difficult and therefore challenge the audiologists managing ototoxicity monitoring programmes to be cognisant of these influencing factors. In their study on patients prescribed aminoglycosides for the treatment of multidrug-resistant tuberculosis (MDR-TB) in LMICs like sub-Saharan Africa, Hong et al. (2019) created a framework that investigates the relationships between aminoglycosides-induced hearing loss and pre-treatment conditions. This framework essentially identified that, in this population, noise, ageing, alcohol use, smoking, malnutrition and HIV worsen ototoxicity, with the key individual events documented as (Hong et al. 2019):

(1) [N]ephrotoxicity, pre-existing hearing loss, and hypoalbuminemia that catalyses aminoglycosides accumulation; (2) immunodeficiency and antioxidant deficiency that trigger oxidative stress pathways; and (3) co-administration of mitochondrial toxic drugs that hinder mitochondrial protein synthesis, causing apoptosis. (p. 1385)

These findings highlight the significance of the establishment of individualised ototoxicity interventions for patients undergoing MDR-TB treatment, for example. Such interventions, including booking frequent monitoring, choosing less ototoxic medications, modifying patient nutritional status, limiting or eliminating exposure to noise, avoiding polypharmacy, reducing smoking and alcohol intake and so on, then become key aspects of the ototoxicity assessment and management programme. Within a health care system that does not adopt a systems approach, as presented in Chapter 1, such interactions become challenging to any preventive health care initiative, including an ototoxicity monitoring programmes.

Tangiisuran et al. (2009) reported that the elderly are predominantly at amplified risk of undesirable drug reactions largely produced by physiological changes affecting the pharmacodynamics and pharmacokinetics of several drugs or inadequate amenability because of depression or cognitive impairment and polypharmacy. Polypharmacy is, therefore, an important challenge to consider in any ototoxicity monitoring programme in the elderly. Besides polypharmacy in the elderly, various other factors create challenges with ototoxicity monitoring, where correct identification of ototoxicity can be difficult for those with and around the patient. Tangiisuran et al. (2009) reported that not all nurses, pharmacists, clinicians or patients have the capacity to accurately recognise adverse drug reactions for numerous reasons, including expectations, education and previous experience, and this observation is true for ototoxicity in the South African context (Bardien et al. 2009; De Andrade et al. 2009; Govender et al. 2020; Khoza-Shangase 2013,

2014; Khoza-Shangase & Jina 2013; Khoza-Shangase, Lecheko & Ntlhakana 2020a; Khoza-Shangase & Masondo 2020, 2021; Khoza-Shangase & Stirk 2016; Paken et al. 2016; Phanguphangu & Ramma 2018; Ramma et al. 2019; Wium & Gerber 2016). With ototoxicity in the elderly, this reality is additionally obscured by the presentation of ototoxicity, which is often non-specific and atypical or presents similarly to other common causes of hearing loss such as ONIHL or presbycusis, where the symptoms might be understood as a primary rather than secondary diagnosis that is a result of medication (Khoza-Shangase 2020b, 2020c). Rochon and Gurwitz (1997) cautioned about the challenge caused by this inability to identify adverse drug reactions precisely and differentiate drug-induced symptoms from a conclusive medical diagnosis, in that it leads to the prescription of yet additional drugs to manage the symptoms, which raises adverse drug reactions and drug-drug interactions, referred to as 'the prescribing cascade'. The author of this chapter believes that effective and efficient ototoxicity monitoring programmes would contribute towards minimising this 'prescribing cascade' with obvious positive outcomes for the patient's health as well as the financial implications associated with it.

Morata (2007) underlined that while the ototoxicity of therapeutic drugs has attracted significant focus in audiology for years, ototoxicity of chemicals found in the environment from contaminants in the workplace and in water, food and air has not. Pillay (2020) and Pillay and Manning (2020), within the ONIHL scope of audiology function, advanced the same argument for the South African context. In their analysis of hearing loss and the contemporary South African occupational health law, Pillay and Manning (2020, p. 1) found four important themes that illustrate how ototoxicity of chemicals is neglected even in the laws and regulations, with ONIHL being the case study: (1) separate and unequal regulatory frameworks when it comes to noise exposure and chemicals exposure, (2) monologic foregrounding of noise, to the exclusion of chemical toxicity and its interaction with noise, (3) minimisation of vestibular disorders, which are also significantly impacted by both toxins and (4) dilution of ototoxic agents. These authors maintained that there is a demand to complement occupational health and safety (OHS) law and increase the scope of hearing protection legislation to encompass the complete range of recognised ototoxic hazards, not just ototoxicity of therapeutic drugs. This is particularly important because noise exposure has been documented to interact synergistically with or potentiate several toxins, leading to worsened morbidity outcomes for the individuals affected (Khoza-Shangase 2020b; Morata 2007). Morata (2007) argues that such noise and chemical dynamics make the identification and diagnosis of the ototoxicity effect even more challenging.

Schaal (2019) reported that because noise has traditionally been considered the primary risk factor for hearing loss in industrial environments, the 1996 NIOSH publication 'Preventing Occupational Hearing Loss (OHL) – A Practical



Guide' was a welcome step in the right direction. This document estimated that, in the workplace, an employee may be exposed to at least three hazardous agents simultaneously, and therefore, narrowing OHL to simply 'noise-induced' is inaccurate and inappropriate. Here, again, Schaal (2019) highlighted the reality that exposures to chemicals frequently utilised in occupational settings may also impact hearing independently or in combination with noise exposure. Ototoxicity monitoring programmes that ignore this noise impact on ototoxicity have significant limitations, particularly because noise exposure is ubiquitous.

Watts (2019) and DiSogra (2019) argued that studies to find and develop otorescue agents and otoprotectants to prevent ototoxicity are promising and will convert basic scientific breakthroughs into applications for utilisation in clinical care. Ganesan et al. (2018) believed that with further improvement, approaches including stem cells, adeno-associated virus-mediated delivery of brain-derived neurotrophic factor and cochlear gene therapy that have been thoroughly displayed in animal models may become clinically appropriate in the near future. This, over and above the use of otoprotective agents such as dexamethasone, sodium thiosulfate, n-acetylcysteine, amifostine and amifostine agents, which are still undergoing clinical trials (Gurney et al. 2014; Landier 2016; Marshak et al. 2014; Riga et al. 2013; Van As, Van Den Berg & Van Dalen 2014), is another challenge facing ototoxicity monitoring programmes. Because there are presently no drugs approved by the US FDA for the prevention of drug-induced ototoxicity (Ganesan et al. 2018; Landier 2016), the challenges that confront the assessment and management of ototoxicity need urgent addressing.

Once ototoxicity monitoring has occurred within the South African context, there are no guidelines for the audiologist, even in the recently published HPCSA's (2018) guidelines, as to the postmarketing surveillance findings reporting. Khoza-Shangase (2017) stated that ototoxicity monitoring is essentially postmarketing surveillance of medications, which Vlahović-Palčevski and Mentzer (2011) described as a process where marketed drugs are monitored for side effects after clinical trials. Hartzema et al. (1987) and Spelsberg et al. (2017) also maintained that because a large majority of drugs may not get to the market in the absence of phase III clinical trial approval, postmarketing surveillance studies, such as ototoxicity monitoring, as argued by Khoza-Shangase (2017), are regarded as phase IV studies. Alomar et al. (2020) stressed the importance of postmarketing surveillance and thus reporting of adverse reactions, as they declare that 'the life of a drug truly starts post marketing' (Alomar et al. 2020, p. 3). At postmarketing, pharmacoepidemiology can occur with pharmacovigilance, which is drug safety surveillance that is mainly involved in the 'timely detection' of 'novel' adverse drug reactions that are distinctive in their 'clinical nature, severity and or frequency' (Faillie et al. 2016; Ibrahim et al. 2016; Lafond 2016; Sahu et al. 2014). Sahu et al. (2014) stated that pharmacovigilance plays a substantial



function in the surveillance of adverse drug reactions for drugs used to cure diseases. Thus, it becomes critical for physicians, health care providers, the pharmaceutical industry and the WHO to resolve the associated problem of adverse drug reactions, which can only occur if there is adequate and efficient reporting of these reactions, such as ototoxicity.

Regulatory authorities such as the HPCSA and the South African Health Products Regulatory Authority (SAHPRA) need to communicate reporting protocols for suspected adverse drug reactions, including ototoxicity reporting. Alomar et al. (2020) highlighted that, though beneficial, spontaneous reporting of adverse events programmes encounter numerous restrictions and challenges in diagnosing adverse drug reactions, with bias and under-reporting being the main difficulties. These authors suggested that innovative strategies and online signal detection measures are required to enhance the spontaneous reporting programmes, and the author of this chapter recommends that this online platform be also made accessible to the general public (patients who may be taking these medications but have no access to audiologists, for example, for diagnosis of the symptoms), with increased awareness among health care professionals around ototoxicity. Sharrar and Dieck (2013) claimed that postmarketing surveillance can be performed actively because of technological advancements and ICT that allows for access to electronic medical records. However, these authors stressed that this is only of value if regulatory authorities (such as SAHPRA) and pharmaceutical companies have access to electronic medical records databases and actively seek drug-associated adverse drug reactions – such as ototoxicity. Within the South African context, the health care system is a long way from having a national electronic medical records database that would allow for this process to occur, with a majority of audiology databases still kept in hard copy files across the country. This data capturing, use and storage limitation also influences the South African audiologists' ability to engage in risk-benefit evaluations of ototoxic medications used, in the context where limited less ototoxic alternatives are available (Khoza-Shangase 2017). Khoza-Shangase (2017) stressed the value of carefully reflecting on the risk-benefit of drugs prescribed to treat diseases within LMICs, particularly in the context of mounting evidence showing that ototoxicity monitoring is becoming increasingly and widely conducted within the South African clinical and research communities, regardless of this monitoring being non-strategic, non-standardised, non-comprehensive and non-systematic in nature (Khoza-Shangase & Masondo 2020).

## ■ 6.2.2. Paediatric population

Kanji, Khoza-Shangase and Ballot (2010) stated that, in the paediatric population, neonates in neonatal intensive care units (NICUs) are at increased risk of permanent hearing impairment compared to infants in well mother and baby units. Numerous factors have been linked with this higher prevalence of

hearing impairment, including ototoxic drug prescriptions (such as glycopeptide or aminoglycoside antibiotics) (Garinis et al. 2018). Garinis et al. (2018), in their study on ototoxicity monitoring in neonates, discovered that contemporary audiological monitoring or screening protocols in this population are ill-designed to sufficiently identify the early onset of ototoxicity. This gap in appropriate resources is regardless of the prevalent utilisation of ototoxic medications in this population. Aminoglycosides, which are commonly prescribed in the NICU (Lestner et al. 2016), such as vancomycin (Rubin et al. 2002), gentamicin (Brummett et al. 1990) and neuromuscular blocking agents such as vecuronium bromide and pancuronium bromide, which potentiate the risk of ototoxicity because of aminoglycosides (Cheung et al. 1999; Masumoto et al. 2007), are widely prescribed to neonates (Garinis et al. 2018). All these drugs are documented to be potentiated by ambient sound levels, co-administration with other potential ototoxic compounds and inflammatory status (Garinis et al. 2018; Neille, George & Khoza-Shangase 2014). Investigations are concentrating on determining if ambient sound levels in the NICU can influence aminoglycoside ototoxicity (Zimmerman & Lahav 2013). Gratton and Kamen (1990) and Gratton et al. (1990) reported that cisplatin ototoxicity can also be potentiated by increased levels of prior noise exposure. Additional clinical factors that raise the ototoxic potential of medications have been established, especially for aminoglycosides, and these include inadequate renal function, fever (higher-than-normal body temperature), decreased antioxidant status or poor nutrition, as well as hypoxia (Hoffman et al. 1988; Lautermann, McLaren & Schacht 1995; Lin et al. 2011; Manian, Stone & Alford 1990). All these factors contribute significantly towards challenges in ototoxicity assessment and management in the paediatric population, over and above the fact that, until now, no specific ototoxicity hearing screening and monitoring protocols for neonates and infants have existed (Fligor 2019). In LMICs, like South Africa, this lack of neonatal screening for ototoxicity extends to the lack of UNHS in general, with TNHS occurring only in pockets of the South African health care sector, with the private health care sector that services less than 20% of the population conducting more screening than the public sector (Bezuidenhout et al. 2018; De Kock, Swanepoel & Hall 2016; Kanji 2016; Kanji et al. 2018; Khoza-Shangase 2021; Khoza-Shangase & Harbinson 2015; Khoza-Shangase & Kanji 2021; Khoza-Shangase, Kanji & Ismail 2021; Nikolopoulos 2015).

Specific challenges in monitoring ototoxicity in neonates have been presented by Garinis et al. (2018), including the following:

- Inability to acquire baseline hearing assessment results prior to commencement of therapy with potentially ototoxic medication, as around 80% of neonates are prescribed empiric or prophylactic treatment with ampicillin (a  $\beta$ -lactam) and the aminoglycoside antibiotic gentamicin on admission to the NICU.

- In instances where baseline hearing test findings obtained before the initiation of ototoxic drugs are available, these often do not include results for hearing thresholds above 4 kHz, frequencies that are critical for ototoxicity monitoring, as current NHS protocols exclude these higher frequencies. Current neonatal screening protocols focus on frequencies crucial for speech-language development (ASHA 2016; Knight et al. 2005).
- Protocols for NHS often exclude ABR testing. Without its findings before the initiation of ototoxic treatment, differential diagnosis between ototoxicity and other pre-existing causes secondary to a genetic process or another disease makes the diagnosis of ototoxicity challenging. This challenge makes preventive health care, which includes an alternative treatment regimen or dosing, impossible. The broadband clicks that are utilised during automated ABR (AABR) screening are not sensitive to the high-frequency (> 8 kHz) hearing loss typically initially found in ototoxicity.
- Use of OAEs and ABR testing for ototoxicity monitoring, the only available tools for this population, is labour-intensive, with interpretation challenges in premature infants (< 34 weeks gestational age) because of the still-developing auditory system (Norton et al. 2000).
- The influence of middle ear status on ototoxicity monitoring protocols creates another challenge in the paediatric population, therefore requiring an additional test in the test battery (Hunter et al. 2016). Garinis et al. (2018) recommended that sensitive middle ear measures such as wideband reflectance form part of the test battery, measures that are not readily available within the South African context (Sebothoma & Khoza-Shangase 2021).
- Noise in the NICU generated by medically essential interventions, such as mechanical ventilation, can present electrical or acoustic interference that can disturb AABR or ABR application. This challenge has been recognised to be prevalent in the South African context (Nathan, Tuomi & Müller 2008; Neille et al. 2014; Rakhelja & Lubbe 2016).
- Capacity versus demand challenges with the shortage of audiologists for long-term monitoring.
- Challenges with follow-up and return rate for infants at risk for late-onset hearing loss after completion of ototoxic drug treatment (Kolinsky et al. 2010).
- Lack of informational and educational resources given to professionals and caregivers or parents about the value of follow-up.

Because of the widespread use of ototoxic drugs in the paediatric population, particularly in the NICUs, Garinis et al. (2018) suggested that increased efforts be placed on the establishment of the currently unavailable efficacious OAE and ABR ototoxicity monitoring protocols utilising higher frequency (4 kHz -16 kHz) stimulation that detect the onset of ototoxicity earlier and more efficiently. These authors also proposed that audiologists refine the current

monitoring practices to guarantee diagnostic follow-up, in case the infant presents with progressive hearing loss. Furthermore, these authors recommended investigations into the interaction effects of the combination of factors such as higher levels of ambient sound in the NICU, co-drug administration, neonatal physiology (e.g. inflammation and hyperbilirubinemia), and genetic risk factors – which may all synergistically potentiate the ototoxicity in this population. Lastly, Garinis et al. (2018) called for a mandate and increased funding for research in neonatal drug development aimed at designing effective and safe options for ototoxic medications in this population.

### ■ 6.3. Challenges and complexities in vestibulotoxicity assessment and management

As far as vestibulotoxicity assessment and management are concerned, Ganesan et al. (2018) lamented that although vestibulotoxicity of certain aminoglycosides is well recognised (Ahmed et al. 2012; Rogers & Petersen 2011), the reality that no widely endorsed guidelines for vestibulotoxicity monitoring are available is a challenge for the audiology community. Furthermore, the identification of vestibulotoxicity symptoms is negatively impacted by the fact that the symptoms become apparent only when the patient is mobilised and may therefore often be misdiagnosed to the patient's debilitating condition. The incapacitated status of the patient during monitoring has been listed as one of the difficulties with ototoxicity assessment and management, alongside transport costs to the monitoring centre in the case of outpatients (Ganesan et al. 2018; Nhokwara 2015). The reality is that there is no solo measure that can detect vestibulotoxicity, while screening tests such as the Dizziness Handicap Inventory scales, head impulse test and dynamic visual acuity test are recommended to monitor patients. However, within the South African context, evidence suggests that (1) not all audiologists in practice received formal education or clinical training on vestibular assessment and management from university; (2) a large majority of audiologists lack confidence in performing vestibular assessments and management, and in fact, a large majority of the audiologists (62.5%) do not perform vestibular management; and (3) the frequently performed assessments are peripheral vestibular assessments and oculomotor measures because of lack of high-tech equipment at a majority of the institutions (Khoza-Shangase, Sebothoma & Seedat 2020b; Seedat, Khoza-Shangase & Sebothoma 2018). Furthermore, vestibular diagnostic procedures are often impractical to conduct because patients requiring them may have compromised health status at the time (Rogers & Petersen 2011). Rogers and Petersen (2011) reported that presently, vestibular rehabilitation therapy is the favoured treatment for vestibulotoxicity but that this yields outcomes that are variable – another challenge facing audiologists while implementing ototoxicity monitoring programmes.

## ■ 6.4. Conclusion

Landier (2016) believed that prospective monitoring for ototoxicity is important as it permits for auditory (and vestibular) outcomes to be compared within and across clinical trials, and Khoza-Shangase (2020a) stressed the importance of standardised protocols to allow for such comparative analysis to be possible. Furthermore, this monitoring allows for early detection of vestibulocochlear changes and potential changes to the therapy, as well as the provision of rehabilitation and auditory intervention to enhance the negative sequelae of hearing impairment (and vestibular dysfunction). This chapter carefully and comprehensively reviewed the evidence on challenges and complexities confronted during the assessment and management of ototoxicity across the lifespan, and these challenges deny the South African population these monitoring benefits as part of preventive audiology outcomes. Khoza-Shangase (2022b) stated that implementation of preventive audiology at the different WHO levels of prevention within the South African context calls for audiologists to engage in strategic planning around guidelines, policies and resources, including human resources, as well as the development of a contextually relevant evidence base. All these speak to the WHO's six building blocks of health care systems (WHO 2010). The challenges and complexities of assessment and management of ototoxicity presented in this chapter require careful deliberation by the South African audiology community, as these challenges impede the implementation of the HPCSA (2018) *Audiologic management of patients on treatment that includes ototoxic medications guidelines*. Key to the deliberations should be capacity-building, including that of paraprofessionals who can form part of the task-shifting initiatives to address the paralysing capacity: demand challenges within this context, an important part of efficient preventive health care.

# Exploration of complexities in the management of occupational noise-induced hearing loss in the mining sector in sub-Saharan Africa

**Nomfundo F. Moroe**

Department of Audiology, Faculty of Humanities,  
School of Human and Community Development,  
University of the Witwatersrand,  
Johannesburg, South Africa

**Katijah Khoza-Shangase**

Department of Audiology, Faculty of Humanities,  
School of Human and Community Development,  
University of the Witwatersrand,  
Johannesburg, South Africa

## ■ 7.1. Introduction

Compared to high-income countries (HICs), OHS, particularly ONIHL, has not been addressed sufficiently in low-and-middle-income countries (LMICs) like sub-Saharan Africa. This reality is despite the rapid ongoing industrialisation that has brought with it occupational noise exposure and associated hearing impairment as a public health concern in this part of the

**How to cite:** Moroe, NF & Khoza-Shangase, K 2022, 'Exploration of complexities in the management of occupational noise-induced hearing loss in the mining sector in sub-Saharan Africa', eds. K Khoza-Shangase, *Complexities and challenges in preventive audiology: An African perspective*, AOSIS Books, Cape Town, pp. 107-124. <https://doi.org/10.4102/aosis.2022.BK311.07>

world, this seeming neglect of this important and highly prevalent occupational health condition is also evident in the dearth of objective studies on ONIHL and HCPs in sub-Saharan Africa. The available evidence, for example, on the prevalence of occupational noise, is often provided by the mining sector and power plants, which may be influenced by a conflict of interest in their reporting. This chapter seeks to highlight the impact of ONIHL in sub-Saharan Africa, with a reflection on the complexities surrounding its management.

## ■ 7.2. Occupational noise-induced hearing loss in the mining and mineral sector

The ONIHL is an invisible occupational medical condition that does not readily manifest itself (Lie et al. 2016; Tye-Murray 2009). It is defined as a partial or complete lifelong sensorineural hearing loss caused by exposure to excessive noise levels (above 85 dBA) in the workplace (Nelson et al. 2005; Thorne 2006). Globally, it is the leading work-related disability, the second most prevalent type of acquired hearing loss after presbycotic (age-related) hearing loss (Mostaghaci et al. 2013; Ritzel & McCrary-Quarles 2008) and the 15th most serious health issue (Chia et al. 2007; Fabry et al. 2010; Nelson et al. 2005).

Although hearing loss is not life-threatening (Hong et al. 2013; Le et al. 2017), unmanaged hearing loss has a significant impact on the quality of life and well-being of the affected employees. This is particularly true in sub-Saharan Africa where the prevalence rate is four times that in HICs and poses significant challenges in LMICs (World Health Organization [WHO] 2018). The financial burden of unaddressed hearing loss is worse for LMICs because of pre-existing poverty, environmental risk factors and life-threatening diseases (Stevens et al. 2013).

Within the last decade, ONIHL has been prioritised as a public health concern because of the longer lifespan in the era of increasing industrialisation, thereby adding to the global burden of this condition (Nandi & Dhattrak 2008). Yongbing and Martin (2013) state that ONIHL is a potentially expensive public health challenge, particularly in LMICs. Currently, the incidence of ONIHL is between 16% and 24% globally. This incidence is growing exponentially, considering that in 1995, approximately 120 million (2%) of the global population had some sort of disabling hearing loss (Nelson et al. 2005; Suzuki, Kobayashi & Koga 2012). Nelson et al. (2005) attributed this disabling hearing loss to noise exposure in the workplace, although there is limited data to conclusively draw this conclusion. This figure doubled to 240 million cases in 2003 (Suzuki et al. 2012). In 2005, Nelson et al. (2005) estimated the prevalence of ONIHL to be between 7% and 21% globally. What is certain is that the increase in ONIHL globally



affects LMICs more than HICs (Chadambuka, Mususa & Muteti 2013; Miah, Rubya & Kabir 2014).

The presence of hazardous noise in the workplace potentially results in individuals acquiring a disabling hearing loss, marked by hearing thresholds below 40 dBs (Yadav et al. 2015). Disabling hearing loss is the ‘most prevalent, least recognised and least understood physical disability’ (Dugan 2003, p. 9) and is a major contributor to the global burden of disease for individuals, families, communities and countries (Copley & Frederichs 2010; Hermanus 2007). Acquiring NIHL is associated with adverse effects on the health, safety and financial outlook of the impacted individuals, their families and societies, as well as the state (Moroe & Khoza-Shangase 2018a). For instance, continuous exposure to hazardous occupational noise has the following outcomes:

1. ONIHL leading to the minimisation of opportunities for further employment and or promotion (Kane-Berman 2017b; Khoza-Shangase, Moroe & Edwards 2020).
2. Even a mild hearing loss may be devastating on the safety and work-related injuries for the affected individual (Amjad-Sardrudi et al. 2012).
3. Excessive noise exposure has been linked to increased fatigue and decreased concentration, which ultimately manifests through increased human errors (Amjad-Sardrudi et al. 2012; Picard et al. 2008).
4. Decreased performance and productivity, particularly with tasks dependent on auditory signals or verbal communication (Thorne et al. 2008).
5. Acquiring a communication handicap, which ultimately affects teamwork and group productivity (Momm & Geiecker 2009).

Pillay (2020) argued that every day 6 000 people suffer occupational fatalities, and those who do not die acquire disabling injuries or illnesses. Among this population, hearing loss significantly contributes to disability-adjusted-life-years (DALYs) for 20% of the working population (Pillay 2020). This is particularly pertinent in sub-Saharan Africa, as the World Bank has published a report on occupational health in the mining sector where hearing loss contributed 18% of the burden of injury among ex-mineworkers in Lesotho, Mozambique, South Africa and Swaziland (Pillay 2020). These findings are not alarming considering the historic and persistent poor working conditions for migrant workers, which Pillay (2013) termed 3D jobs - dirty, dangerous and difficult.

The impact of ONIHL on health and well-being cannot be quantified or measured in benchmarks (Hong et al. 2013); however, compensation costs linked to ONIHL are progressively rising. For instance, the International Labour Organization estimates that 4% of global gross domestic production (GDP) is lost because of accidents, diseases and fatalities in the workplace (Tompa et al. 2021). While statistics on the burden of ONIHL in LMICs are not routinely documented, reports indicate that 80% of individuals affected by ONIHL



reside in LMICs, where ONIHL presents a 'much heavier burden than in developed regions of the world' (Chadambuka et al. 2013, p. 899). Thus, ONIHL is considered one of the important public health threats, more so recently with the advent of COVID-19.

Expanding on the work by Zhang (2021) examining occupational risk factors for COVID-19 transmissions in Washington, Shkempi and Neitzel (2022) submitted that occupational noise should also be considered as a potential risk factor for COVID-19 transmission. Shkempi and Neitzel (2022) argued that noise in the workplace causes difficulties in worker communication, particularly in occupations with high noise volumes. Specific to COVID-19 and the required use of hearing protection devices (HPDs), oral communication is severely affected. In the observation of social distancing between workers and the use of masks and face coverings, middle to high voice frequencies are significantly affected. This ultimately affects speech intelligibility and comprehension (Shkempi & Neitzel 2022). Failure to observe the COVID-19 regulations increases the risk of COVID-19 transmission among workers. In essence, these authors believed that ONIHL is a risk factor for COVID-19 transmission. This is an important issue for consideration as efforts to mitigate the spread of COVID-19, while critically important, have not considered the ease and the feasibility of implementing these strategies in occupations where communication is key to safety, productivity and effective performance. Furthermore, understanding occupational noise as a potential risk for COVID-19 transmission is important for raising awareness about the presence and danger of excessive noise, as it is not sufficiently acknowledged nor addressed in LMICs.

### ■ 7.3. Occupational noise-induced hearing loss in sub-Saharan Africa explored

[O]ccupational noise exposure and related hearing impairment is a public health problem in sub-Saharan Africa that has been neglected, despite the increase in ONIHL cases due to rapid ongoing industrialisation. (Nyarubeli et al. 2018, p. 1110)

In a systematic review on the management of ONIHL in African mines, Moroe et al. (2019) suggested that the high prevalence of ONIHL is well known and recognised by the mining industry; however, efforts to curb it remain unsuccessful. This lack of success in minimising or eliminating ONIHL in this continent is argued to be due in part to the lack of contextual evidence that would guide the implementation of preventive measures (Khoza-Shangase 2022). Moroe and Khoza-Shangase (2018b) asserted that establishing locally relevant evidence from mines is often challenging as access to the data is denied by mine management in various ways. These ways include key persons being unwilling to share information regarding the management of ONIHL

and progress made in HCPs at their mines. These authors believed that this barrier could very well be a protective mechanism for mines from possible litigation, although this has a negative impact on their ability to implement best practice in HCPs that is guided by contextually relevant evidence.

Most African countries export substantial amounts of mineral commodities, with mining in countries such as Botswana, the Democratic Republic of Congo, Mozambique and Guinea accounting for more than half of their export revenues (Gajigo, Mutambatsere & Ndiaye. 2012). Subsequently, these countries have enticed new players with an interest in mineral commodities from industries belonging to BRIC nations (Brazil, Russia, India and China) to invest in Africa's mining sector (International Finance Corporation 2014). Perhaps Africa's ability to significantly contribute financially to economic growth indirectly gives the industry organisational autonomy in deciding the extent to which it releases its data on the prevalence of occupational diseases. Nonetheless, the prevalence of ONIHL in Zimbabwe is reported to be 37% (Chadambuka et al. 2013), 47% in Tanzania (Musiba 2020), 73% in South Africa despite the presence of HCPs (Edwards et al. 2011) and 21% in Ghana (Kitcher et al. 2014). In a Tanzanian study, Musiba (2015) found that ONIHL was highest in workers with increased total years of exposure, worse in underground rather than open pit miners, and highest among the youngest age group (20–29 years). However, in Ghana, Amedofu (2002) reported that hazardous noise exposure was present in all surface areas, including the open pit, with only the mess area producing noise levels below 85 dBA. In Amedofu's (2002) study, 23% of the workers had ONIHL, which was also worsened by age and duration of exposure. In Nigeria, while the occupational hazards are widely unknown, the prevalence of sensorineural hearing loss was 65% in 2003 and 87% in 2005 (Ologe et al. 2008). The aforementioned statistics highlight the urgent need to address ONIHL in sub-Saharan Africa, as the impact is greatest in these countries. However, there is a persistent failure to implement sound and effective OHS regulations in these countries. Perhaps this failure is influenced by the historical legacy associated with the colonisation of Africa and the subsequent treatment of black African mineworkers, who are the mine's workforce.

### ■ 7.3.1. Occupational health and safety as a human rights requirement

The authors of this chapter locate OHS regulations within the ambit of human rights. Therefore, in this section, the discussion will focus on the contribution of the human rights framework in the implementation of OHS regulations. The main points of discussion will include the significance of recognising OHS as a human rights issue.

'Man has a fundamental right to freedom, equality and adequate conditions of life in an environment of a quality that permits a life of dignity and well-being' (Sohn 1973, p. 451). This statement captures the declaration of the United Nations Conference on Human Environment held in Stockholm in June 1972 (Sohn 1973). This conference is believed to be the most successful international conference ever held on human rights. The declaration comprises a set of 26 common principles aimed at inspiring and guiding individuals globally in the preservation and promotion of the human environment (Sohn 1973). The 26 common principles address the human impact on the environment, highlighting the need for environmental issues to be addressed publicly and internationally. For this discussion, the focus will be placed on the first principle of the declaration, which states that man has a fundamental right to freedom, equality and adequate conditions of life in an environment of a quality that permits a life of dignity and well-being (Sohn 1973). Against this principle, it can be argued that OHS is a basic and fundamental human right. This position is supported by Tshoose (2014), who locates OHS within the human rights framework as the right to safe and healthy working conditions. In arguing and locating OHS as a human right, Tshoose (2014) firstly defined it as:

[T]he right of individuals to live and work in an environment that is adequate for their health and safety; and not to be exposed to occupational hazards which compromise their fundamental human right. (p. 277)

Tshoose (2014) further posited that when OHS is viewed from the human rights perspective, it empowers individuals to claim an essential element of their existence. Contextualising the right to health, the United Nations General Assembly acknowledges that this right constitutes a range of socio-economic factors which include determinants of health, safety, healthy working conditions and a healthy environment (Tshoose 2014).

To illustrate this within the South African context, Tshoose (2014) drew from the South African Constitution which explicitly states that all people have a right to an environment that is safe, healthy and risk-free. Specifically, this author referred to section 8 of the *OHS Act 85 of 1993* which places a general duty on every employer to provide and maintain, as far as reasonably practical, a safe working environment without risk to the health of the employees (Basson, Le Roux & Strydom 2009; Tshoose 2014). For instance, ONIHL is an occupational disease that threatens the health and well-being of workers exposed to excessive noise; therefore, the mining sector has a responsibility to provide and maintain a healthy working environment where noise as an occupational health hazard is significantly reduced, as there is an understanding that in some occupations, noise cannot be completely eradicated (Moroe et al. 2019; Moroe & Khoza-Shangase 2020a). Evidence suggests that OHS as a human right has been neglected in Africa.

### ■ 7.3.2. Neglect of basic human rights within the mining industry in Africa

Historically, the mining sector has neglected the basic rights of most mineworkers (Jamasmie 2021). Ten years after the adoption of the United Nations Guiding Principle on Business and Human Rights, some African mining companies have failed to convert promises made to communities into action plans (Jamasmie 2021), with their promises' infringements spanning civil, political, economic, social, cultural and environmental areas. Jamasmie (2021) declared that most mining companies tend to reduce human rights to a limited set of issues, thereby downplaying their role in advancing these rights.

The neglect of human rights for mineworkers in Africa can be traced back to the complexities surrounding the political history of mining in Africa and how its legacy has influenced the development of Africa as a continent. The influence of slavery (Adeola 2016) and colonisation in all of Africa (except for Ethiopia and Liberia) during the 'Scramble for Africa' (Nkrumah 1963) cannot be underestimated in how workers, who are mostly black Africans, are treated and their health and safety prioritised. As such, the South African mining sector has been heavily criticised for undermining the human rights of people and indigenous populations at risk (Handelsman 2002).

Occupational health and safety legislations are implemented within the mining sector (Reiprich et al. n.d.) within the Southern African Development Community (SADC) region, which comprises 16 member states: Angola, Botswana, Comoros, Democratic Republic of Congo, Eswatini, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Tanzania, Zambia and Zimbabwe. It should be noted that these OHS regulations are specifically focused on silica and dust as work-related diseases, to the exclusion of ONIHL. According to Reiprich et al. (n.d.), in theory, mineworkers are protected from occupational diseases, specifically dust, as all the countries in the SADC region have implemented OHS legislations in the workplace. Furthermore, according to the legal frameworks, employers are responsible for maintaining the health and well-being of the employees (Reiprich et al. n.d.). With the exception of South Africa and Mozambique, the provision for OHS and regulations on dust control are broad and open to interpretation. Only the South African mining industry has clear regulations and guidelines on occupational hygiene systems. Furthermore, according to the authors, South Africa is the only country that has formulated and documented a process and commitment to achieving zero harm in the mining sector (Reiprich et al. n.d.). Moreover, South Africa is the only country with a mandatory code of practice (CoP) for an occupational health programme on personal exposure to pollutants (Department of Minerals and Energy of South Africa [DME] 2003).

Reportedly, after South Africa, the most comprehensive OHS legislative framework is that of Mozambique, although without clear implementation guidelines and control systems (Reiprich et al. n.d.). Other countries make reference to 'dust' control in their guidelines and provide specific guidelines on aspects such as dust control, ventilation and use of personal protection equipment (Reiprich et al. n.d.). Furthermore, while South Africa, Tanzania, Namibia, Mozambique and Zambia have implemented OHS regulations, there are no guidelines or protocols for monitoring and measuring performance (Reiprich et al. n.d.). Lastly, all countries, except Malawi and Lesotho, prescribe occupational health surveillance in terms of fitness-to-work examinations and periodic medical examinations (Reiprich et al. n.d.).

Like all policies and regulations, there are shortcomings with the OHS regulations currently implemented in the SADC region. Firstly, the authors of this chapter note the silence on ONIHL in these regulations. In the documents, noise is mentioned in passing and in statements such as (Reiprich et al. n.d.):

[7]he large-scale mining industry is also moving from human resource intensive mining to more automated processes, which facilitates the protection of workforces from occupational hazards such as dust, noise and heat. (p. 46)

There is no specific discussion of ONIHL in the mining sector within this region. This omission is concerning because ONIHL is generally neglected and often competes with other occupation-related diseases such as exposure to dust and silica for attention and prioritisation.

Other shortcomings of the regulations and policies reported by Reiprich et al. (n.d.) over and above unclear monitoring and measurement of exposures include the following:

1. Variation in the way OHS legislations are applied in medium-scale mines.
2. Substandard mining operations that remain non-compliant because of poor inspection protocols and lack of authority of inspectors.
3. Although some enterprises have legal mining licences, they do not observe the existing mine health and safety regulations and standards issued by mining, health or labour authorities.
4. Deficiencies in risk assessments.
5. Limited access to technical expertise and equipment utilised to assess hazard monitoring and weak management systems resulting in poor compliance with health and safety standards.
6. Except in South Africa, unions have not sufficiently engaged with health and safety concerns of the workers as they are more concerned with wages.
7. Mineworkers themselves also seem less concerned about their health and more about their remuneration.

Based on this, it is evident that, despite being available, implementation of OHS regulations is not achieving the expected outcomes, which perhaps

echoes the views of Reiprich et al. (n.d.), who stated that OHS is implemented theoretically, with ONIHL in the mining industry neglected.

### ■ 7.3.3. The neglect of occupational noise-induced hearing loss in the mining sector in South Africa

South Africa's mining history has had the most pronounced effects on the economy, politics, health and safety and the general well-being of mineworkers and the mining industry at large (Moroe 2018). According to Benson (2016), the roots of these effects stem from the history of colonialism and the introduction of apartheid in the South African mining industry. Although apartheid was formally legalised in 1948, its roots were established with the arrival of the Europeans in 1952 (Benson 2016; CJPME Foundation 2014), and its effects seem to continue to this day. This claim is supported by the recent observations made by Teke (2017), who laments that, when addressing human rights within the South African context, 'the mining industry in South Africa is a painful contradiction when seen through the eyes of a miner' (Teke 2017, p. 1). This statement rings particularly true for black mineworkers.

Concerning the plight of black South African mineworkers, there is ample historical evidence documenting how the mining industry, despite being aware of the poor OHS regulations in the industry, intentionally ignored the human rights and well-being of black mineworkers. Katz (1994), in his book titled *The White Death*, documented how black African workers (the majority of the workforce) who acquired silicosis, a lung disease caused by inhaling silica dust in gold mines (Nelson 2013), were overlooked and their right to a healthy working environment as purported by the Stockholm Principle was sidelined in favour of white English workers. Black African workers waited until 1993 (Roberts 2009):

[F]or the last racist legislation on the statute books and clauses instituting differentiating provisions on the basis of populations groups, to be removed so that all the de jure provisions of the *Occupational Diseases in Mines and Works Act* - (ODMWA) 78 of 1973 applied equally to them. (p. 18)

Roberts (2009) further lamented:

The fate of black South African migrant miners has [*come*], close to a hundred years later, (is) yet to be fully recorded. Decades upon decades have passed without the graves of South African miners, who have returned to their homes in the labour-sending areas of the country, being counted in any epidemiological reports. A grave is too late for any epidemiological inquiry. (p. 17)

It was only in 2012 that previous and current gold mineworkers successfully filed a class action suit against the South African mining industry about silicosis incurred during their employment (Reuters 2013). Moroe (2018) argued that although the outcome of the class action ruled in favour of black

South African and Lesotho miners, who form most of the claimants, for some miners, this outcome came a bit too late as they had already died before the class action even began. Drawing attention to ONIHL, although its prevalence was high in the mining industry prior to 1994 (Stanton 2003), only one study was conducted in the mining sector, and this study systematically excluded the black mineworkers who were the majority of the workforce (Hessel & Sluis-Cremer 1987). It was only in 1994 that a study was conducted on ONIHL that included black mineworkers (Kahan & Ross 1994). The findings of this study conducted on black workers revealed that these workers had not been informed of the dangers of exposure to excessive noise in the absence of hearing protection. These findings confirm the statement by Simons (1960), who revealed that, pre-1994, black mineworkers were not given instruction on OHS issues as they were seen as incapable of learning. Interestingly, in the ruling of the silicosis class action referred to previously, the mines were penalised by the High Court for failing to provide mineworkers with adequate protection during apartheid rule and even after it ended in 1994 (Reuters 2013). In essence, the mining industry failed to adhere to the Stockholm Principle and the human rights ideals of the mineworkers.

After 1994, not much change has taken place within the mining sector in ensuring that mineworkers are adequately informed regarding noise and its negative impact.

This neglect is reported by Kanji, Khoza-Shangase and Ntlhakana (2019) and demonstrated by Moroe (2020), who conducted a study on how occupational health practitioners, including audiologists, train mineworkers on noise and its impact on their health. The findings revealed that audiologists were not aware of how workers were trained. Perhaps this also explains the currently reported prevalence of ONIHL in the African mining sector.

Furthermore, most African countries have eroded infrastructure with poor industrial development and low technological transfer (Ibrahim & Cheri 2013). This has implications for the rollout of OHS regulations. Annan, Addai and Tulashie (2015) and Kheni, Dainty and Gibb (2008) located the failure or poor implementation of OHS regulations to a lack of resources and infrastructure that facilitates implementation. By extension, Khoza-Shangase (2020) argued that implementing HCPs, particularly engineering controls, may be costly for LMICs industries, considering that ONIHL potentially competes with other health conditions such as HIV and AIDS and TB.

Related to infrastructure and its contribution to human rights and the burden of diseases such as HIV, AIDS and TB, as Khoza-Shangase (2020) alluded to, pre-1994, black mineworkers were subjected to a compound system as a means of accommodation (Kane-Berman 2017; Simons 1960). Reportedly, the compound system was established to prevent black



mineworkers from being absent from work, discourage drunkenness and minimise the risk of theft (Kane-Berman 2017; Moroe 2018). According to Wilson (1972), living conditions in the compounds were unhygienic and unhealthy, and consequently, diseases such as TB, HIV, AIDS and silicosis became rife in the mining sector. After the democratic dispensation, evidence reveals that South Africa is among the countries with the greatest prevalence of HIV, AIDS and TB, with the highest prevalence of these diseases in the mining industry (Khoza-Shangase et al. 2009, 2020b; Stuckler et al. 2011; Stuckler et al. 2013). In 2013, with between 3 000 and 7 000 cases per 100,000 people per year, South African gold mineworkers were listed among those with the highest incidence of TB globally. According to a report by Reddy and Swanepoel (2006), a third of mineworkers acquired HIV within 18 months of being employed at the mines. AngloGold Ashanti West Wits company reports estimated approximately 85% of their workforce were diagnosed with HIV (AngloGold Ashanti 2012). The presence of HIV infection increases the probability of acquiring TB, which is aggravated by poor working and living conditions (Bhunu & Mushayabasa 2012).

According to World Bank, as cited by Cullinan (2018):

[/]n South Africa alone, TB rates within the mining workforce are estimated at 2500 to 3000 cases per 100,000 individuals. This incidence is 10 times the WHO threshold for a health emergency and is also nearly three times the incidence rate in the general population. (p. 1)

In responding to the bittersweet win on the silicosis settlement, one of the claimants from this class action stated (Cullinan 2018):

We weren't given masks and were sent in after they [*the mining companies*] would blast and blast, not even waiting 15 minutes. The doctors say I won't get better, and all I want is to have my voice heard. I don't want future miners to suffer like I do. (p. 1)

Regarding the compensation awarded to the miners, some supporters expressed their views (Cullinan 2018):

As TAC and Sonke Gender Justice, we recognise that no compensation can make up for the loss of loved ones, or the loss of one's health or ability to work. We also note that the amounts that former mineworkers or their surviving family members will be receiving are in no way sufficient compensation. However, we also recognise that insufficient as the settlement may be, it is more than people would have received under the existing compensation framework, and as such we welcome it. (p. 1)

Another piece of evidence shows that black workers were previously disadvantaged in terms of education and skilled labour (Kane-Berman 2017; Smit & Mji 2012). These historical disadvantages and injustices have presented a perpetually devastating outcome, not only for the mineworkers but also for their families, the mining industry and the state at large. In South Africa, according to Menon (2017), unemployment has been at its highest since 2003,



with the highest prevalence (33.1%) among people who have less than a matric level education, making this category 5.4% higher than the national average. Historically, black South African mineworkers had low levels of education and literacy because of past social and economic injustices imposed on black people during the apartheid era. For instance, according to Smit and Mji (2012), the majority of mineworkers are illiterate; consequently, they are limited to manual labour jobs which do not require any form of education. In 1996, approximately 80% of all mineworkers (unskilled) had an education level lower than Grade 7 and were illiterate and innumerate. A decade later, in 2006, 67% of mineworkers still had not obtained a Grade 7 education. Furthermore, a quarter of them had no formal education at all (Smit & Mji 2012).

Arguably, improvements may have occurred in recent years because of the surge of millennials entering the mining industry. Nevertheless, unemployment is still high among graduates in South Africa (Graham & Mlatsheni 2015; Oluwajodu et al. 2015); therefore, low levels of education in the presence of hearing loss and disability have had and continue to lead to adverse consequences for most mineworkers. The historical legacy of ignoring the human rights of workers exposed to excessive noise in the workplace has resulted in complexities in the management of ONIHL within the mining sector.

## ■ 7.4. Complexities in the management of occupational noise-induced hearing loss in sub-Saharan Africa

Unfortunately, available evidence on the prevalence of occupational noise and its impact within the African context is generally reported by industries themselves (John, Sakwari & Mamuya 2018; Musiba 2015; Nyarubeli et al. 2018, 2019). This practice has implications for the validity and reliability of data and calls for independent verification to overcome the conflict of interest effects. This is in line with the suggestions by Khoza-Shangase and Moroe (2020) on having independent stakeholders in evaluating risk versus benefit in the assessment of OHS of workers.

There are numerous complexities in the management of ONIHL in sub-Saharan Africa, including miners' awareness of and attitudes towards noise exposure, the absence of audiologists in occupational health in the mines, significant lag in the use of ICTs for efficient record-keeping, hearing conservation as CIs and the heavy focus on understanding the effectiveness of the interventions rather than on the process used in the implementation of the intervention. These, as reflected in Figure 7.1, are discussed in detail.



Key: HCP, hearing conservation programme; ICT, information and communication technology.

Source: Author's own work.

**FIGURE 7.1:** Complexities in the management of occupational noise-induced hearing loss in the sub-Saharan Africa.

### 7.4.1. Mineworkers' awareness and attitudes towards noise exposure

Kanji et al. (2019) explored the knowledge of South African mineworkers regarding ONIHL. Findings from this study highlighted that although a majority of the mineworkers (97%) were well informed about their exposure to hazardous noise levels and its impact on their hearing function, less than 50% of them consistently used HPDs. In Nigeria, Ologe, Akande and Olajide (2005) examined the attitudes and knowledge of steel-rolling mill workers towards ONIHL and the use of HPDs. These authors found similar results to those by Kanji et al. (2019) in that a high awareness (93%) of the hazards of noise on hearing function and the importance of preventive methods was found; however, there was little consistent use of HPDs (28%).

Contrary to the aforementioned findings, in another earlier South African study, Hansia and Dickinson (2010) found that at least 29% of their sample

were not aware of the impact of hazardous noise on their hearing, while 9% had insufficient knowledge about HPDs and their value in hearing conservation. In this study, the importance of live observations over reported use of HPDs was demonstrated; while 93% of the workers reported consistent use of HPDs, their use was observed in only 50% of the sample. These findings raise implications for promotive and preventive campaigns in this context, with considerations around the influence of language and culture in the training programmes.

Moroe (2020), in a study investigating occupational health practitioners' perspectives on how mineworkers are trained on noise and its impact, found that training and awareness programmes were influenced by factors such as (1) mineworkers subscribing to the notion of 'seeing is believing'; (2) nobody taking responsibility for training mineworkers, with 'not my department!' being a common theme among respondents; (3) linguistic diversity and education levels challenges; and (4) 'compensation pay-outs' being a possible incentive for lack of compliance with HCP strategies among mineworkers. This author suggested that health literacy be prioritised as part of OHS plans, while the authors of this chapter, supported by Khoza-Shangase and Mophosho (2018, 2021), stress that this health literacy should be conceptualised and implemented, bearing in mind the influence of language and culture of the mineworkers and the providers of the training.

#### ■ 7.4.2. The absence of audiologists in hearing conservation programmes' decision-making

Management of ONIHL in African mines is negatively influenced by the absence of audiologists in HCPs in terms of their role in the conceptualisation, planning, implementation and monitoring of HCPs (Moroe & Khoza-Shangase 2018a). In their investigation on the role and involvement of audiologists in the management of ONIHL in South African mines, Moroe and Khoza-Shangase (2018a) found that audiologists did not play a central role but were instead juniorised, misaligned, ill-trained and their role not well known within the industry. These findings raise important implications for ONIHL management in Africa, where health care professionals (including audiologists) are in short supply, and where they are available, their role is minimised and peripherised, as in the South African mining sector. Khoza-Shangase and Moroe (2020), in their deliberation on the role of audiologists within the South African mines, suggested that audiologists should also be involved in risk versus benefit evaluations of HCPs, where ONIHL is managed in a *preventive* manner rather than the current *compensation*-driven approach. These authors argued that audiologists are the only profession who have the appropriate extensive knowledge and are regulated by scope of practice to be able to establish

programmes that are comprehensive and systematic, with ample consideration of all facets of hearing and hearing function in HCPs. Furthermore, audiologists have the capacity and training to assess the value and benefit of HCPs as well as their risks.

### ■ 7.4.3. Lag in the use of information and communication technologies for efficient record-keeping

Another challenge that confronts efforts to manage ONIHL in this region is the significant lag in the use of ICT for efficient record-keeping, record-keeping that facilitates early detection and intervention to enhance preventive audiology and record-keeping that allows independent research that provides evidence for evidence-based best practice. Ntlhakana et al. (2020a) raised the importance of accurate, efficient and useful record-keeping, utilising effective proactive data management systems (PDMS). Currently used PDMS show significant gaps, such as lack of integration of audiometry data with important risk factor data, including the burden of diseases such as TB, HIV and AIDS which have significant impact on ONIHL (Khoza-Shangase 2020a; 2020b; Ntlhakana, Khoza-Shangase & Nelson 2020b; Ntlhakana, Nelson & Khoza-Shangase 2020b; Ntlhakana et al. 2021). Ntlhakana et al. (2021) recommended that South African mines adopt an inclusive integrative data management programme that incorporates the medical surveillance data set of the miners' noise exposure levels, occupations, ages and ototoxic medical treatments. These are important risk indicators for developing ONIHL, particularly within the South African context (Ntlhakana et al. 2020a, 2020b). Khoza-Shangase (2020) highlighted that the burden of diseases on otology and audiology is a critical factor to consider in HCPs, particularly because such disease can cause hearing loss as a primary effect, as a secondary or opportunistic effect or as a side effect of their treatment options, regardless of hazardous noise exposure. This author, therefore, suggested closer monitoring of such employees and individualised HCPs, as these employees with noise exposure and comorbid conditions are at greater risk of ONIHL than other employees. This illustrates the complexity of ONIHL and HCPs, requiring innovative management approaches.

### ■ 7.4.4. Hearing conservation programmes as complex interventions

In recognising the need for alternative approaches to the management of ONIHL within the African context, as the incidence remains high in the presence of HCPs, Moroe (2020) explored the adoption of the complex

interventions approach that encourages realist reviews (RRs) of individual mines to plan and implement HCPs that are contextually relevant and responsive (Khoza-Shangase et al. 2020). Chapter 8 delves into this intervention approach and its challenges within the African context. Khoza-Shangase et al. (2020) argued that over and above this paradigm shift towards CIs in HCPs, it is important to have a collaborative implementation of all pillars with stakeholders who are fully dedicated to the implementation process, as well as timeous implementation of effective measures. These authors emphasised the value of ensuring that this collaborative programme implementation is managed by audiologists for reasons already advanced in this chapter.

Evidence-based interventions (EBIs) such as HCPs are designed with a target population in mind, in this case, workers exposed to excessive noise in the workplace. Current evidence suggests that EBIs do not reach their target population, hence highlighting the evidence-practice gap (Grimshaw et al. 2012). For end-users to benefit from interventions implemented for them, they need to be involved in the development and implementation of the interventions. To date, there is a paucity of research conducted within sub-Saharan Africa indicating the active engagement of workers in the intervention programmes – from planning to monitoring and evaluation. In a systematic review by Moroe et al. (2019), findings revealed only nine articles conducted in this region, with none investigating active engagement of the end-user. Moreover, in another study by Moroe (2020) investigating how mineworkers are trained, findings revealed that personnel involved in the training of the end-user were themselves not aware of how end-users are trained on noise. This attests to the fact that mineworkers, as end-users, are not actively involved in EBIs meant for them, hence the evidence-practice gap in the management of ONIHL.

#### ■ **7.4.5. Focus on the effectiveness of hearing conservation programmes rather than on the implementation process**

Interventions fail to reach their target population because of the heavy focus on understanding the effectiveness of the interventions rather than on the process adopted in the implementation of the intervention (Ooi et al. 2020). Understanding the process, specifically, the implementation strategies – activities used to optimise the adoption, implementation and sustainability of EBIs – can facilitate the uptake of interventions and contribute towards bridging the evidence-practice gap (Powell et al. 2015). Furthermore, using frameworks, models and theories consulted in the development and implementation of EBIs enhances and guides the implementation process,

including the development and design of the strategies to facilitate the uptake of interventions (Nilsen 2015). Stamos et al. (2001) argued that explicit implementation increases the probability of getting EBIs to their target population. To support this argument, in their study, Stamos et al. (2001) found that by attaching a reminder (implementation strategy), the intervention reached 94% of the target population compared to 35% of the control group. This evidence supports the effectiveness of using implementation strategies to reach the target population.

In a current scoping review by the authors, this chapter's preliminary evidence suggests that there are currently no studies in sub-Saharan Africa that actively document the use of implementation strategies in the development and implementation of HCPs. The majority of the studies identified in the scoping review are in HICs where the prevalence of ONIHL is less when compared to LMICs (Chen, Su & Chen 2020). There is a need to be intentionally and deliberately responsive to the international trends in order to provide interventions that reach the target population in ONIHL assessment and management.

## ■ 7.5. Conclusion

Hearing loss has catastrophic implications for LMICs, particularly those in the sub-Saharan Africa. These implications are far-reaching and have implications not only for the person exposed to excessive noise but also for the economy of the country at large. Notwithstanding or downplaying the contribution of colonisation and apartheid in the African mining sector and the complexities surrounding noise and its management, hearing loss is preventable, and drastic measures need to be taken to address ONIHL. Perhaps one of the ways this can be achieved is through embracing OHS regulations, and by extension, the implementation of effective HCPs as a human rights issue, as espoused in the first principle of the Stockholm Declaration. It is imperative that LMICs urgently attend to this, as evidence shows how neglecting human rights has a generational legacy and impact. In implementing OHS and HCPs, the socio-economic factors (which include determinants of health, safety, healthy working conditions and a healthy environment) must be taken cognisance of (Tshoose 2014).

The complexities in the successful implementation of HCPs must be thoroughly interrogated with the intention of facilitating the upholding of the rights of the workforce and providing a working environment that is free of hazards and risks. Also, recognising the complex nature of HCPs themselves and the contextual complexities in implementing them, just like audiologists who are responsible for training workers, the mining industry needs to be contextually and culturally responsive to the needs of the workers

(Khoza-Shangase & Mophosho 2018, 2021). The role of context can never be overemphasised. Granted that the African infrastructure and resources may not be on par with HICs, local industries can learn from international and recent trends, while considering the local context. The goal of implementing HCPs is to protect the workforce; therefore, the mining industry needs to be deliberate in implementing programmes that will reach the target audience. Therefore, there is a call to invest in implementing HCPs, strategies and activities that promote and embrace the human rights of workers in sub-Saharan Africa.

# Complexities with hearing conservation programmes in South African mines: Applying complex interventions theory

**Nomfundo F. Moroe**

Department of Audiology, Faculty of Humanities,  
School of Human and Community Development,  
University of the Witwatersrand,  
Johannesburg, South Africa

**Katijah Khoza-Shangase**

Department of Audiology, Faculty of Humanities,  
School of Human and Community Development,  
University of the Witwatersrand,  
Johannesburg, South Africa

## ■ 8.1. Introduction

Hearing conservation programmes are evidence-based, multi-pillared and multistakeholder CIs aimed at protecting workers from damage caused by exposure to excessive noise in the workplace (Moroe 2018). Evidence from the African context indicates that these interventions are not yielding the

**How to cite:** Moroe, NF & Khoza-Shangase, K 2022, 'Complexities with hearing conservation programmes in South African mines: Applying complex interventions theory', eds. K Khoza-Shangase, *Complexities and challenges in preventive audiology: An African perspective*, AOSIS Books, Cape Town, pp. 125-140. <https://doi.org/10.4102/aosis.2022.BK311.08>



desired outcomes. Khoza-Shangase, Moroe and Edwards (2020) argued that this lack of success is because of numerous factors, one of which is a serious gap in the contextually relevant evidence base that would allow for best practice in interventions to be provided. Reeve et al. (2016) believed that complex problems within health care provision, such as ONIHL, require CIs. It is only with contextually relevant research that efficacious CIs can be provided in context, so gaps in research within the South African mining industry on ONIHL and HCPs compromise the ability to implement CIs efficiently. This chapter, therefore, seeks to deliberate on the reasons behind this failure of HCPs, while exploring CIs as a paradigm with its own challenges within the South African mining context. The chapter introduces the concept of CIs and argues their value in HCPs, utilising local examples to support the notion of HCPs as CIs. The chapter ends by reflecting on the need to conduct RRs in HCPs within South African mines to understand 'what works, for whom, and under what circumstances' (Reynolds et al. 2014).

### ■ 8.1.1. Definition and description of complex interventions for health improvement

Greenhalgh and Papoutsis (2018, p. 2) defined complexity as 'a dynamic and constantly emerging set of processes and objects that not only interact with each other but come to be defined by those interactions'. Because of their dynamic nature, complex systems thus have fuzzy boundaries; their interacting agents operate based on internal rules that cannot always be predicted, and they adapt, interact and co-evolve with other systems (Cohn et al. 2013; Plsek & Greenhalgh 2001). Shiell, Hawe and Gold (2008) and Hawe (2015) argued that complexity is a feature of the system(s) or context, not merely a characteristic of interventions; as such, whether an intervention is simple (consisting of one component) or complex (consisting of multiple interacting components), the 'system' (context) in which the intervention is implemented will almost invariably need to adapt in some way to accommodate it. Therefore, a planned intervention and its context are interrelated and reciprocally interacting (Greenhalgh & Papoutsis 2018).

Reeve et al. (2016) emphasised that, because of the changes in health and health care that have occurred over the years, CIs have become the mode of efficient intervention. These authors argued that (1) the chronic nature that health problems have become (Tinetti & Fried 2004) and (2) the complex nature of the health conditions because of factors such as the co-existence of numerous interacting components (Sturmberg & Martin 2013) necessitate the use of CIs. Reeve et al. (2016, p. 1) asserted that 'complex problems need complex solutions'.

An intervention is defined as ‘a specified set of activities designed to put into practice an activity of known dimensions’ (Moir 2018, p. 2), and evidence-based interventions are defined as practices that drive the provider’s decision supported by appropriate information or evidence (McKibbin 1998; Hailemariam et al. 2019). Therefore, CIs are programmes that contain multiple interacting pillars, which may (1) act both independently and interdependently (Moore et al. 2015); (2) include behaviours, behaviour parameters and methods of organising those behaviours; (3) have an effect at an individual level, organisational level or population level (Datta & Petticrew 2013); and (4) may include the difficulty of their implementation as an additional dimension of complexity of the intervention (Craig et al. 2008). Shiell et al. (2008) maintained that complexity in health care is sometimes used by researchers to refer to the challenges encountered in assessing the effectiveness of many non-pharmaceutical interventions. These authors highlighted the importance of distinguishing between two meanings of complexity, with one referring to a property of the intervention and the other referring to a property of the system in which the intervention is implemented. Within HCPs, CI refers to both meanings and their interactions (Moroe 2020).

The MRC (2008) made a distinction between complex and complicated interventions in that CIs comprise numerous *interacting* components, where important variables vary in different contexts and for different stakeholders. Regardless of the diversity of contexts and stakeholders involved, the MRC has guiding documents to facilitate the implementation process of CIs to allow for contextually relevant evidence-based practice (MRC, 2000, 2008). Pawson (2006) and Peterson (2010) advocated that CIs can provide insights into ‘what works’, for whom and under what circumstances in order for contextually responsive intervention to be widely implemented (Mills et al. 2008; Treweek 2005). For the purposes of this chapter, Pawson et al.’s (2005) approach to CIs is adopted, with their definition of CIs that accurately describes HCPs and their complexities. The complexities speak not only to the number of pillars of HCPs but also to the context where the HCP is being implemented and to the actual implementation of the intervention by multiple stakeholders.

Pawson et al. (2005) summarised CIs as follows:

- Complex interventions are theory-driven. Datta and Petticrew (2013) stressed that intervention design must always be theory-driven, with a clear understanding of how the intervention causes change, thus the importance of understanding the theory behind all aspects of HCPs.
- Complex interventions are active and able to achieve their effect through the active involvement and engagement of individuals.
- Complex interventions comprise long journeys.

- Complex interventions are non-linear in their implementation chains and can even go into reverse.
- Complex interventions are fragile and embedded in multiple social systems.
- Complex interventions are prone to be borrowed.
- Complex interventions are open systems that feed back on themselves.

### ■ 8.1.2. Realist reviews and evidence-based complex interventions

Evidence-based CIs are developed and implemented to optimise health care quality. However, research shows that these interventions do not always produce the expected outcomes, adoption, reach and sustainability when rolled out in diverse contexts, particularly in low-resourced contexts (Alvidrez et al. 2019). Boyko et al. (2018), Pawson et al. (2005) and Moore et al. (2015) argued that context plays a critical role in the successful implementation of CIs. To understand the contribution of the context in implementing evidence-based CIs, one needs to conduct RRs, which may synthesise data to explain how an intervention performs (what works, for whom, in what circumstances, in what ways and how) in a particular context (Boyko et al. 2018).

According to Pawson (2005), RRs are a newer methodological approach for synthesising research in an explanatory manner and not a judgemental manner. Realist reviews aim to explain the mechanisms of how CIs perform or fail to perform in particular contexts and settings (Pawson 2005). Realist reviews can guide decision-makers to gain a rich and comprehensive understanding about a complex social intervention that can be planned and implemented by focusing on understanding the *context* (circumstances informing the implementation of an intervention), *mechanisms* (underlying processes that are responsive to the context and influence outcomes) and *outcomes* (effects that result over time) (Boyko et al. 2018).

The *context, mechanism and outcomes* (CMO) relationship explains how certain activities influence the context, induce certain mechanisms in turn and result in certain outcomes (Boyko et al. 2018, p. 32). Pawson et al. (2005) argued that RRs have several strengths that include (1) being a logic of inquiry that is 'pluralist and flexible' in that they incorporate both qualitative and quantitative methods of enquiry; (2) are summative and formative approaches to assessment; and (3) can be retrospective or prospective in nature. Additionally, RRs, as mentioned earlier, do not judge, but rather they explain what works, for whom, under what conditions and how (Pawson et al. 2005). Furthermore, RRs do not control for but rather learn from real-world phenomena such as 'diversity, change, idiosyncrasy, adaptation, cross-contamination and programme failure' (Pawson et al. 2005, p. 32). Realist reviews promote learning across policy disciplines and organisational

boundaries, and in their implementation, stakeholders are systematically engaged (Pawson et al. 2005). As with any other approach, RRs also have limitations. For instance, RRs cannot be used as protocol-driven approaches and are not standardisable or reproducible in other settings. Realist reviews lead to tentative recommendations and are not generalisable as they are context-specific (Pawson et al. 2005). Furthermore, they require a high level of experience and training, both in the academic (critical review of empirical studies) and service domains (programme implementation) (Pawson et al. 2005).

Therefore, the aforementioned discussion highlights the importance of context in the implementation of evidence-based CIs. Kilbourne et al. (2007) emphasised that numerous interventions do not achieve their intended outcomes when implemented in real-world situations, termed 'voltage drop'. This 'voltage drop' term, used by Kilbourne et al. (2007) to describe the suboptimal effectiveness of interventions, may be the result of reduced fidelity – the degree to which an intervention or programme is delivered as intended. This phenomenon is more common in resource-constrained settings (Alvidrez et al. 2019) such as the countries in sub-Saharan Africa.

### ■ 8.1.3. Hearing conservation programmes in South Africa

To provide evidence of the challenges of implementing evidence-based CIs in a resource-constrained setting, evidence from the South African mining industry requires consideration.

An HCP is an evidence-based complex intervention aimed at preventing ONIHL and eliminating hazardous noise exposure in the workplace (Moroe 2020). Moroe (2020) maintained that the programme is considered complex as it consists of seven pillars that are interdependent and independent and easily influenced by the behaviour of stakeholders and the context in which it is implemented. Furthermore, within HCPs, the chronic nature of ONIHL – which occurs in the context of not only excessive noise exposure but also other factors such as chemical exposures – adds to the complexity of HCPs (Khoza-Shangase et al. 2020; Pillay 2020; Pillay & Manning 2020). Additionally, ONIHL's co-occurrence with the burden of disease (Khoza-Shangase 2010a, 2010b, 2011, 2017, 2020a; WHO 2018), concomitant treatments with ototoxic medications (Brits et al. 2012; Khoza-Shangase 2020b) and other influencing risk factors emphasise the complex nature of HCPs. Moroe's (2018) thesis gave an account of hearing conservation in the South African mining industry. Moroe (2018) discussed how in South Africa, the deliberate implementation of HCPs was officially mandated by the national government in 1994, following a probe into health and safety in the mining sector (Moroe 2018; Stanton 2003). Historically, evidence as supported by various authors reveals that there were HCPs in place

prior to 1994 (Hessel & Sluis-Cremer 1987; Kahan & Ross 1994; Kane-Berman 2017); however, these were implemented under the apartheid regime and as such excluded black mineworkers, who were the majority of the workforce. Evidence suggests that before 1994, a study on hearing loss in gold mines was conducted on white mineworkers in South Africa to the exclusion of black mineworkers (Hessel & Sluis-Cremer 1987). It was only in 1994 that a study that included black workers was conducted in the mining sector (Kahan & Ross 1994). Thus, the advent of the democratically elected government ushered in OHS regulations that correctly included the historically marginalised population groups (Kane-Berman 2017; Moroe 2018). Specifically in the mines, *the Mine Health and Safety Act 29 of 1996* [MHSA] (RSA 1996) was promulgated in 1996, and subsequently, in 2003, the South African Mine Health and Safety Council (MHSC) implemented HCPs through what was dubbed the 2003 MHSC milestones on the elimination of ONIHL in the mining industry (Moroe 2020; Moroe & Khoza-Shangase 2018). Typically, HCPs consist of seven pillars that include: (1) periodic noise exposure measurement and monitoring; (2) engineering controls and personal hearing protection; (3) administrative controls; (4) employee-management education, motivation and training; (5) risk-based medical examination and medical surveillance; (6) audiometric evaluations; and (7) record-keeping (Hong et al. 2013; Khoza-Shangase et al. 2020).

In the implementation of the 2003 milestones within South African mines, while all seven pillars were accounted for, two pillars within the programme were given prominence:

1. Reducing noise at the source by December 2013, the first step of defence according to the hierarchy of control (National Institute for Occupational Safety and Health [NIOSH] 2016), specified that the intensity of noise produced by all equipment installed in any workplace must not exceed a sound pressure level of 110 dB(A) at any location in that workplace (including individual pieces of equipment) (Moroe 2020; Moroe & Khoza-Shangase 2018).
2. Use of personal protective devices by December 2008, the last step of defence according to the hierarchy of control (NIOSH 2016), specified that HCPs implemented by the industry must ensure that there is no deterioration in hearing greater than 10% among occupationally exposed individuals (Moroe 2018).

The rest of the pillars seem to have been embedded within these two prominent milestones. The aforementioned milestones were to be evaluated at the end of 2013 to measure progress insofar as minimising and or eliminating ONIHL in South African mines was concerned. However, at the 2013 summit, where reports from various mining companies were tabled, evidence indicated that the milestones had not been achieved (Moroe & Khoza-Shangase 2018). Stewart and Malatji (2018) argued that the milestones were achieved partially, and there was still room to improve on their implementation. Consequently,

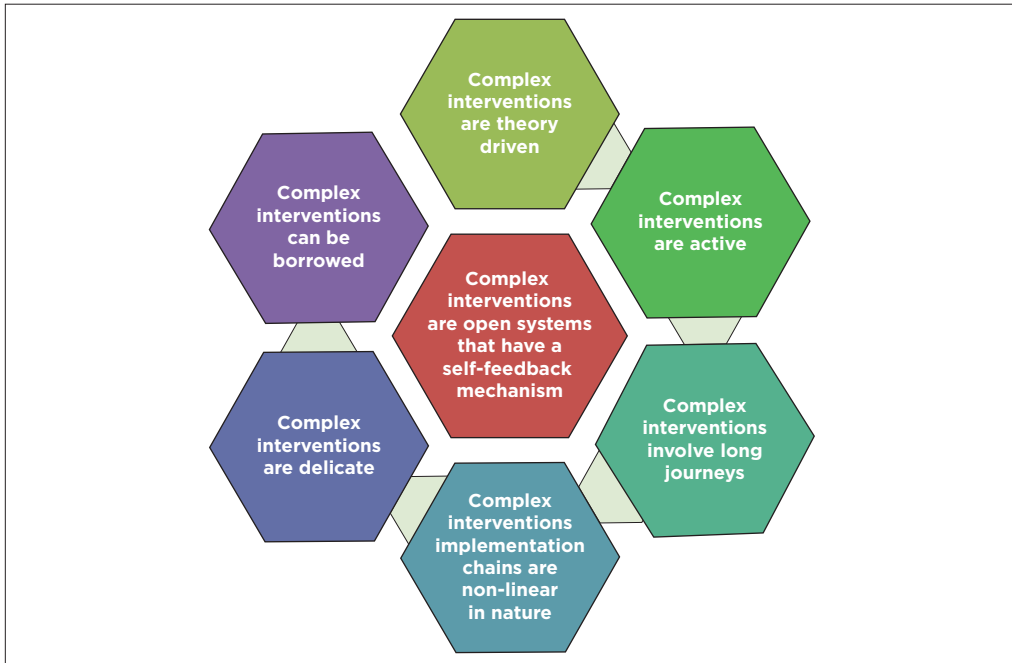
these initial milestones were revised and fine-tuned into the 2014 milestones. In fact, the revised 2014 milestones were responsive to the current global trends towards *preventive*-driven instead of *compensation*-focused goals, in that they migrated from the use of percentage loss of hearing (PLH) to the standard threshold shift (STS) (Moroe 2018; Moroe & Khoza-Shangase 2018; Ntlhakana, Nelson & Khoza-Shangase 2020b). Furthermore, the noise at the source target was reduced from 110 dB to 107 dB. The authors of this chapter believe that this was a notable change, considering that noise is measured on a logarithmic scale; therefore, a 3 dB change is a significant decrease in noise exposure levels. The revised milestones still focus on the two prominent pillars discussed and are: (1) by December 2024, the total operational or process noise produced by any equipment must not be above a milestone sound pressure level of 107 dB(A); and (2) by December 2016, no worker's STS will exceed 25 dB from baseline when averaged at 2 000 Hz, 3 000 Hz and 4 000 Hz in one or both ears (MHSC 2014).

Despite evidence of the South African MHSC being responsive to global trends and advocating for the implementation of the HCPs as recommended, while targeting all pillars of the programme and following the hierarchy of control in their milestones, documented cases of ONIHL within South African mines remain high (Grobler et al. 2020; Khoza-Shangase et al. 2020; Ntlhakana, Nelson & Khoza-Shangase 2020a, 2020b). The failure to achieve the desired set outcomes despite the sound policy and implementation of HCPs speaks to the complexities and challenges surrounding the CI that is the HCP itself. It is in the stages of CI implementation that challenges to the implementation of HCPs within the South African context become obvious, from the piloting and feasibility stage through to evaluation – including process evaluation (Moore et al. 2015) and implementation (Reeve et al. 2016).

Datta and Pettigrew (2013) highlighted that in the stages of implementation of CIs, two components are important in the development process, and these are (1) the importance of theory, which is shaped by a formative assessment of participant-stakeholders' engagement with the new idea as a driver of the development of the CI, and (2) contextual impact. Reynolds et al. (2014) raised how 'real-life' contexts drive the delivery and uptake of complex health interventions. For example, a real-life context in HCPs, which is one of these challenges, is an intervention to change employees' and or employers' or OHS practitioners' behaviours in the OHS mining setting towards preventing ONIHL.

#### ■ 8.1.4. Hearing conservation programmes as complex interventions

Referring back to the features of CIs in accordance with Pawson et al. (2005), as depicted in Figure 8.1, is a contextualisation of HCPs as CIs, as discussed by Moroe (2020, 2018).



Source: Authors' own work.

**FIGURE 8.1:** Features of hearing conservation programmes as complex interventions.

In illustrating how HCPs are CIs, Moroe (2020) drew from different sources consulted when investigating the management of ONIHL from formulation to implementation, monitoring and evaluation within the South African context. These sources include (1) interviews with the MHSC representatives from state, employer and labour; (2) document analysis of the Acts, regulations, policies and guidelines on the management of ONIHL in the South African mining sector since 1994; and (3) the systematic review on published literature on the management of ONIHL in sub-Saharan Africa from 1994 to 2017 (Moroe et al. 2018).

#### □ 8.1.4.1. Feature 1: Complex interventions are theory-driven

Complex interventions are premised on hypotheses that are causal in nature (Pawson et al. 2005). This means that CIs have a cause-and-effect relationship where an evidence-based intervention is implemented, and certain outcomes are expected. For example, implementing HCPs has the effect of reducing the number of people who acquire ONIHL. To illustrate this, Moroe (2020) drew from the Leon Commission of Enquiry into Safety and Health in the Mining Industry Report compiled by Stanton (2003). This report documents the iterative process of the most effective strategy to eradicate ONIHL in the



mining sector. This led to the implementation of the 2003 OHS Milestones to eliminate ONIHL within the sector. Moroe (2020) argued that the rationale behind implementing the milestones (HCP) was based on the understanding that implementing them would lower the incidence of ONIHL. Therefore, this assertion backs the causal hypothesis or theory supporting the implementation of HCPs in the South African mining industry. This supports Pawson et al.'s (2005) assertion that CIs are theories, based on a hypothesis which postulates that if an intervention is in this way or if services are managed in this manner, then this will result in improved outcomes. Therefore, this postulation supports the notion that if the mining industry implements an HCP, with deliberate consideration of the mine's context, noise reduction may be possible, thereby bringing into motion the desired outcome of eliminating or significantly reducing ONIHL.

#### □ 8.1.4.2. Feature 2: Complex interventions are active

Several authors such as Brown et al. (2014), Craig et al. (2008) and Hawe (2015) view CIs in relation to how programmes work as active ingredients or components of the intervention and how these ingredients exert their effect for the desired outcome. To this effect, Brown et al. (2014), as cited in Moroe (2020), highlighted three important components of active CIs: (1) raising awareness of the key issues in the choice of intervention preferred; (2) improving the knowledge pertinent to decision-making; and (3) providing preparation for the involvement of various stakeholders in the consultation.

With HCPs in particular, Moroe (2020) located the aforementioned components in the statement made by the Chairperson of the South African Mining Council, who decried that (Booyens 2013):

[7]he mining industry is not making the desired progress with noise-induced hearing loss, which is a major occupational health concern. As an industry, we have committed to the massive reduction and elimination of occupational noise-induced hearing loss. (p. 1)

This statement captures the Council's awareness of the key issues in the choice of intervention preferred – the involvement of critical stakeholders in providing knowledge pertinent to decision-making. Also, Moroe (2020) quoted the Journey to Zero Harm document (MHSC 2014, p. 9) which states 'the road to attaining Zero Harm is a long, winding and bumpy one'. However, it is a 'road that is walked alongside diverse people collaborating, executing plans and strongly rallying around a common objective' (Tabak et al. 2012, p. 9). Based on this assertion, Moroe (2020) surmised that stakeholders who participated in the conceptualisation and implementation of HCPs in the South African mining sector consulted and collaborated with different stakeholders to adopt the best evidence-based intervention to address the management of ONIHL.



### □ 8.1.4.3. Feature 3: Complex interventions comprise long journeys

Pawson et al. (2005) and Holmboe (2018), as cited by Moroe (2020), postulated that the CIs' journey to change takes time as ideas are conceptualised in the heads of policy architects or policymakers and are then passed on into the hands of practitioners and managers, and (sometimes) into the hearts and minds of the end-users. To contextualise this within the HCPs' journey, Moroe (2020) considered the journey undertaken by the MHSC to formally implement the milestones after the Leon Commission of Enquiry, following which the journey began. Subsequently, the MHSA RSA 1996) was commissioned to develop a comprehensive legal framework for providing a healthy and safe working environment. In 1997, the MHSC was established to spearhead the discussions leading to the development and implementation of the 2003 MHSC milestones on eliminating ONIHL. The 2003 milestones underwent the presidential health and safety audit in 2008 and were further refined in 2014. Based on the narration of this journey as highlighted by Moroe (2020), it is clear that the journey leading to the implementation of HCPs in the South African mining industry is long and ongoing, as the current milestones are yet to be evaluated in 2024. Perhaps there will be changes that may need to be implemented, thus affirming that CIs have long journeys.

### □ 8.1.4.4. Feature 4: Complex interventions are non-linear in their implementation chains

Pawson et al. (2005), Datta and Petticrew (2013) and Shendell, Barnett and Boese (2004) highlighted that CIs are non-linear, and because they are built from multiple interacting components, which may act both independently and interdependently, CIs can also go into reverse. According to Moroe (2020), the 2003 MHSC milestones aimed to eliminate ONIHL by focusing on monitoring the PLH; however, through engagements and consultations, the focus shifted from the use of PLH to the STS. This led to the revised 2014 milestones. According to Moroe (2020), the shift from PLH to STS use speaks to the non-linear process of developing and implementing HCPs. To specifically highlight how HCPs as a CI can go into reverse, the authors of this chapter draw from the study by Moroe and Khoza-Shangase (2018). In this study, the authors lamented the exclusion of audiologists in the development and implementation of the 2003 milestones and how the same audiologists actively influenced the change from PLH to STS. This demonstrates how interventions can go into reverse. Audiologists were not consulted in the initial development and implementation, but when the milestones did not completely achieve the desired outcomes, the process went into reverse to consider the evidence-based contribution from audiologists.

#### □ 8.1.4.5. Feature 5: Complex interventions are fragile

The CIs are fragile creatures and are often embedded in multiple social systems (Pawson et al. 2005), and because of the context in which they are implemented, they are rarely equally effective in all circumstances (Moroe 2020). In discussing the fragile nature of HCPs, Moroe (2020) emphatically highlighted the contribution of context in the implementation of HCPs. This author argued that some mining companies met the set targets while others did not because of the context in which they were implemented. Moroe (2020) postulated that the scales of mines (large versus small), the institutional culture of the mines and the active participation of stakeholders in the HCPs are some of the contextual drivers that influenced the success of the milestones. According to Moroe (2020), (1) the size of the mine, (2) availability of resources, (3) level of support and commitment from all stakeholders (buy-in) and (4) social systems all contribute to the fragility of the implemented MHSC milestones in this context.

#### □ 8.1.4.6. Feature 6: Complex interventions are prone to be borrowed

In developing and implementing CIs, consultations are critical, and they facilitate cross-fertilisation of intervention ideas and put ‘flesh on the bones of an intervention strategy’ (Pawson et al. 2005). Furthermore, consulting various stakeholders creates a transparent and meaningful engagement, which is key to informed decision-making and good governance (Pawson et al. 2005). To illustrate this, Moroe (2020) referred to the contribution made by audiologists in recrafting the 2014 milestones – moving from PLH to STS, the best strategy to monitor and thereby eliminate ONIHL in the mining sector – as a *prevention-driven* CI. Moroe (2020) further stated that shifting from 110 dB (2014 milestones target reducing noise exposure from the source) to 107 dB was based on observing and learning from global trends – an ideal supported by Stewart and Malatji (2018), who argued that mining houses can learn from each other and promote best practices within the industry.

#### □ 8.1.4.7. Feature 7: Complex interventions are open systems that feed back on themselves

Finally, CIs are open systems that feed back on themselves, meaning that as interventions are implemented, they evolve and the conditions that made them work initially may change (Pawson et al. 2005). This is because CIs are multifaceted, multifactorial, interconnected and functioning within open systems, which interact with personal, interpersonal and environmental factors outside of the intervention programme (Cooper et al. 2017). Because of the fact that CIs are multifactorial and interconnected systems, alterations

in one component of the system feed through other components of the system and feed back on themselves (Hawe, Shiell & Riley 2009); subsequently, learning occurs, and that influences receptivity to interventions, which results in unintended consequences in the longer term (Pawson et al. 2005). In discussing this aspect, Moroe (2020) referred to the interview with one MHSC representative who lamented that, because of poor socio-economic status and low wages in mines, some workers may expose themselves to excessive noise to get compensation for acquiring a hearing loss in the workplace. Furthermore, because most mines use production incentives for production, some employees may find the regulations cumbersome – for instance, using hearing protective devices (HPDs), which according to some end-users interfere with communication (Ntlhakana, Kanji & Khoza-Shangase 2015). Therefore, some employees may expose themselves to excessive noise to reach the production targets and earn a bonus. According to Moroe (2020), these challenges illustrate how CIs can be manipulated by factors outside the programme, including the experiences of stakeholders.

### ■ **8.1.5. Other settings where complex interventions have been implemented in sub-Saharan Africa**

Particularly focusing on sub-Saharan Africa, a review of the literature suggests a dearth of studies reporting the success of hearing conservation initiatives within this context. As discussed in Chapter 7, HCPs are implemented in the mining sector in Zimbabwe (Chadambuka, Mususa & Muteti 2013), Tanzania (Musiba 2020) and at a market mill in Ghana (Kitcher et al. 2014). These studies have indicated that HCPs are not completely effective because of the poor implementation of OHS regulations in sub-Saharan Africa.

According to published evidence, OHS regulations are not routinely implemented in sub-Saharan Africa because of poor infrastructure, poorly developed industries and low technology capacity (Ibrahim & Cheri 2013), lack of resources (Annan, Addai & Tulashie 2015; Kheni, Dainty & Gibb 2008) and competing burden of disease in this context (Khoza-Shangase 2020). Furthermore, there is a paucity of objective studies on ONIHL and HCPs in sub-Saharan Africa. In a study by Moroe et al. (2018), investigating the management of ONIHL, findings highlighted the failure of HCPs in sub-Saharan Africa. These failures were largely because of sub-Saharan countries not reporting on hearing conservation processes and outcomes comprehensively, as the majority of the studies reviewed in this systematic review were conducted in South Africa, neglecting to incorporate all HCP pillars in the implementation of programmes, with evidence of heavy reliance on one pillar over others in small sample sizes (Moroe 2018). Based on these earlier findings,

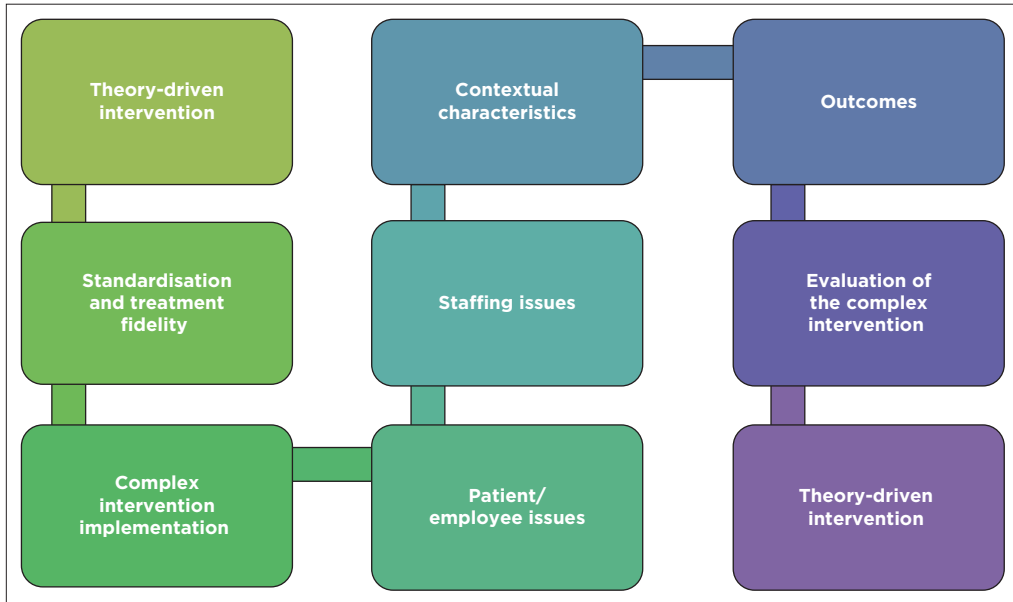
it is clear that HCPs are not adequately implemented in sub-Saharan Africa, and this has implications for the management of noise in this context.

### ■ 8.1.6. Considerations in implementing hearing conservation programmes as complex interventions

In a study investigating occupational therapists' and physiotherapists' experiences of a CI, where factors that can facilitate the implementation of the intervention were explored, Smith et al. (2019) found that three facilitating factors responsible for the successful implementation of a CI are important to keep in mind: (1) development of trusting relationships between stakeholders, (2) staff empowerment in the CI to facilitate ownership of the intervention programme and sustainability of the implementation and (3) remaining flexible in the provision of the intervention to facilitate continued engagement with the intervention by receivers of the intervention. These findings are equally important for HCPs within the South African context. Lazo-Porras et al. (2020) referred to 'co-creation' as an important process involving stakeholders in the conceptualisation and development of an intervention and highlighted that this is an important facilitating factor to successful CIs. These authors suggested that this co-creating process could include: (1) setting co-creation-related questions as part of the formative research that drives the CI; (2) micro-, meso- and macro-level stakeholder initial consultations, for example, mineworkers, employees, OHS practitioners and policymakers; (3) data analysis of all the collected information; micro-, meso- and macro-level stakeholder second consultations; (4) the process of prioritising the intervention options; and (5) designing a theory of change for all activities included in the CI, and in the case of HCPs, this would cover all seven pillars.

Datta and Petticrew (2013) presented challenges to CI design at every step of design implementation, and within HCPs, the authors of this chapter advance the following challenges that can be confronted, as depicted in Figure 8.2:

- **Theory-driven intervention:** If there are any gaps in how any aspect of HCPs minimise or eliminate ONIHL, this creates challenges as there needs to be a clear understanding of how the intervention causes change.
- **Standardisation and treatment fidelity:** Because HCPs are complex in nature and comprise multiple interacting components in the different pillars and different stakeholders, standardising their implementation across different mines could be challenging. In fact, Spillane et al. (2007) argued that standardising the *form* rather than the *function* of the intervention is inappropriate in CIs. The listed challenges to standardisation include the possibility of diversity in the delivery of the intervention on the



Source: Authors' own work.

**FIGURE 8.2:** Challenges to complex interventions design at every step of design implementation.

supply side (Wilson 2008), for example, differences in noise sources and HPDs used, and the diversity in the patient (employees) population in terms of factors such as risk factors for ONIHL, amount and level of exposure, length of exposure and other influencing factors such as needs and preferences on the demand side (Bird, Arthur & Cox 2011).

- **CI implementation:** This aspect of the design relies on stakeholders responsible for the different pillars in the HCP. With evidence from the South African context indicating significant capacity versus demands challenges (Khoza-Shangase & Moroe 2020; Moroe & Khoza-Shangase 2018a), which are further exacerbated by the very peripheral role played by audiologists in South African mines (Moroe & Khoza-Shangase 2018a), implementation of CIs is bound to be challenging and unsustainable. The Medical Research Council (MRC) (2008) highlighted that it is critical to plan for stakeholders and what their specific roles will be in various aspects of the CI right from the initial planning stages, while Tee et al. (2008) cautioned that the actual implementation in the 'real world' confronts numerous barriers such as political, financial, educational, cultural, logistic, anthropological and emotional barriers.
- **Patient or employee issues:** In HCPs, this could include issues such as employee adherence to the consistent use of HPDs (Ntlhakana et al. 2015), employee-OHS practitioner interaction in aspects such as training and audiometric and health surveillance assessments and so on. Within the

South African context, challenges regarding use of HPDs have been reported (Kanji, Khoza-Shangase & Ntlhakana 2019; Moroe et al. 2020; Mothiba, Malema & Muthelo 2019; Ntlhakana et al. 2015; Rashaad Hansia & Dickinson 2010).

- **Staffing issues:** Key personnel in the implementation of the HCPs, including OHS practitioners and audiologists, may confront challenges with workload and availability of resources required for programme implementation. Datta and Petticrew (2013) reported that lack of buy-in as well as political will around the value of the CIs from the various stakeholders is another staffing issue challenge in the design of interventions. Staffing challenges are particularly influential when a new intervention is being implemented, as the implementation also involves careful record-keeping, allowing for evaluation of the intervention and its outcomes.
- **Contextual characteristics:** Contextual challenges to the implementation of HCPs within the South African mining context, presented in Chapter 3, would all need to be addressed for CIs to be successfully implementable within this context. Van Herck et al. (2010) stressed that CIs rely on context for their success.
- **Outcomes:** It is important to have clarity regarding what the targets are for the intervention with the specific timeframe, as well as the types of measures that will be used to assess outcomes. Within HCPs, this can be a barrier to successful intervention implementation if not properly planned and executed, as evidenced by the failure to meet the first milestones with the consequent revisions. Mayo and Scott (2011) stated that outcomes must be multidimensional and plural in nature, including aspects covering 'the spectrum from mortality, morbidity, disability, to satisfaction and cost', while Van Herck et al. (2010) advocated that outcomes be assessed across various domains including clinical, service, team, process and cost. The authors of this chapter suggest that the outcomes be independently evaluated within the South African mining industry in order to prevent the influence of conflict of interest where the mining company evaluates the success of its own HCP (Khoza-Shangase & Moroe 2020; Moroe & Khoza-Shangase 2018b).
- **Evaluation of the CI:** Because the evaluation of CIs happens before, during and after implementation, Datta and Petticrew (2013) highlighted that challenges can occur at any of these stages; therefore, careful evaluation and monitoring of the implementation of HCPs should occur at every stage.

## ■ 8.2. Conclusion

This chapter's discussion has highlighted the complex nature of HCPs. Perhaps this understanding of HCPs as CIs may shed light on what considerations must be carefully deliberated on when implementing HCPs

within the South African context. Evidence reveals that implementing all the pillars is not a guarantee for the desired outcome. As such, various authors attribute the success of HCPs to the context. Therefore, the success of HCPs in the South African context goes beyond the actual implementation of the pillars, also relying on the actual context in which they are implemented and the interaction of this with the CI. This context is comprehensively discussed by Khoza-Shangase (2022) and Moroe (2022). The authors of this chapter believe that understanding HCPs as CIs, as well as the challenges confronted by audiologists in implementing them within the South African mining context, may require the use of RRs (Rycroft-Malone et al. 2012).

Rycroft-Malone et al. (2012, p. 1) stated that RRs are primarily concerned with 'understanding and unpacking the mechanisms by which an intervention works (or fails to work)'. Conducting RRs may explain why HCPs implemented locally are not achieving the set targets, despite the industry reporting itself to be following the hierarchy of control and implementing all the pillars of HCPs as regulated. The benefits of such an enquiry will include: (1) providing stakeholders and policymakers with sound evidence on the nature of the programme implemented in the South African context; (2), assisting policymakers in interpreting and clearly understanding why a programme may be more effective, for instance, in a large-scale mine versus a small-scale mine; (3) providing policymakers with a rationale for adopting one course of action over another, for example, PLH versus STS use or standard versus custom HPD use; and (4) conscientising policymakers to potential pitfalls and specific strategies to mitigate potential problems. Realist reviews of HCPs as CIs will allow for early identification of challenges to implementation presented in this chapter, leading to better outcomes in line with the set milestones.

# Using machine learning systems to predict occupational hearing loss for mineworkers in South Africa: A case study of ethical challenges to research in preventive audiology in the mining industry

**Liepollo Ntlhakana**

Department of Audiology, Faculty of Humanities,  
School of Human and Community Development,  
University of the Witwatersrand,  
Johannesburg, South Africa

**How to cite:** Ntlhakana, L 2022, 'Using machine learning systems to predict occupational hearing loss for mineworkers in South Africa: A case study of ethical challenges to research in preventive audiology in the mining industry', eds. K Khoza-Shangase, *Complexities and challenges in preventive audiology: An African perspective*, AOSIS Books, Cape Town, pp. 141-154. <https://doi.org/10.4102/aosis.2022.BK311.09>



## ■ 9.1. Introduction

Occupational noise-induced hearing loss is a comprehensively researched public health problem that affects employees in workplaces prone to excessive occupational noise exposure (World Health Organization [WHO] 2021). According to the WHO (2021), more than 30 million people are exposed to excessive noise levels in the workplace globally. Worldwide, workplaces with reportedly high prevalence of excessive noise and ONIHL include the manufacturing, farming, construction, transportation, music and mining industries (WHO 2021). The WHO (2021) reported that occupational noise exposure is the main contributor to ONIHL, with most researchers worldwide documenting excessive noise exposure levels emitted by various equipment.

Nelson et al. (2005) reported that the global estimated prevalence of hearing loss because of exposure to noise in the workplace ranged between 7% in HICs to 21% in low- and middle-income countries (LMICs). Recent reports indicate similar prevalence rates, as stated by the World Report on Hearing 2021 published by the WHO (2021). In South Africa, an LMIC, the construction and mining industries have documented the most cases of ONIHL (De Jager 2017). The South African mining industry reported a higher prevalence rate (30%) of ONIHL than this global prevalence of 21% in 2016/17 (South African Mine Health and Safety Inspectorate [MHSI] 2017). In a study on construction workers by Ayessaki and Smallwood (2015), findings revealed that workers in the South African construction industry were exposed to excessive noise levels which increased their susceptibility to ONIHL.

The South African mining industry has been spearheading noise-reduction measures since the late 1980s through the introduction of HCPs (Franz & Phillips 2001) and has provided HCP reports on progress made to reduce occupational noise exposure levels since then (MHSI 2017). Despite this practice, investigations continue to reveal that the South African mining industry struggles to reduce occupational noise exposure levels (Grobler et al. 2020; Ntlhakana, Khoza-Shangase & Nelson 2020a; Strauss et al. 2014), as the implemented HCPs are reportedly not efficient enough to yield the expected outcomes (Moroe 2020a), hence the prevailing cases of ONIHL in this context.

Hearing conservation programmes are designed on the premise that noise exposure for any worker should not exceed 85 decibels (dB) averaged over an 8-h working period, an 8-h time-weighted average (TWA) (South African National and Standards [SANS] 2013). Therefore, the South African mining industry designed and implemented their HCPs to reduce occupational noise at the source by using engineering controls to muffle noise emitted by some equipment and by purchasing more quiet equipment (Anglo-American 2018; AngloGold 2018; MHSI 2017). In addition, audiometry surveillance and the use

of HPDs are routinely used to monitor mineworkers' hearing function and to minimise personal exposure to excessive noise (Hansia & Dickinson 2010; Ntlhakana, Kanji & Khoza-Shangase 2015; Rikhotso, Harmse & Engelbrecht 2018).

The HCPs in the South African mines are implemented according to the hierarchy of noise control, which declares elimination and substitution as the first line of defence to noise (Edwards et al. 2011). However, in some occupations, elimination and substitution may not be possible for some South African mines, as there is a dearth of knowledge on the specificity of noise-producing mechanisms, particularly of old equipment used by some of the mines (Madahana, Nyandoro & Moroe 2020). Therefore, in such cases, the provision of HPDs has subsequently been the preferred mode of noise reduction (Hansia & Dickinson 2010; Ntlhakana et al. 2015; Rikhotso et al. 2018), although this is not recommended as the first line of defence.

There is evidence suggesting that other HCP pillars such as administrative controls, training and education and risk-based medical examinations have been neglected, with their contribution to ONIHL prevention having been partially interrogated by the individual South African mines (Moroe 2018; 2020b; Ntlhakana et al. 2020a). In fact, this was revealed in a systematic review conducted by Moroe et al. (2018), where it was discovered that only four pillars were targeted in practice and research: engineering controls, administrative controls, personal hearing protection, and education and training, to the exclusion of periodic noise-exposure measurements, audiometric evaluations and record-keeping (Moroe et al. 2018). This finding is in contradiction to best practice, as researchers such as Hong et al. (2013), Amedofu (2007) and Khoza-Shangase, Moroe and Edwards (2020) maintained that, for HCPs to be effective, all pillars of HCPs should be incorporated in the management of ONIHL. Despite these reported shortcomings of the currently implemented HCPs in the African context, some mines have submitted HCP reports that indicate reductions in noise exposure levels and new ONIHL cases (MHSI 2017).

The primary goal of submitting HCP reports to the Department of Mineral Resources and Energy of South Africa (DMRE) is to provide evidence of HCP record-keeping methods used by the mines to reflect on annual noise reductions and not necessarily to reflect on the prevention of ONIHL. Annual reports generated by individual mines, for example, AngloGold (2018) and Anglo Platinum (2018), and those submitted to the DMRE (MHSI 2017) for compliance have indicated that the HCP datasets widely used to report on the progress made towards the prevention of ONIHL include audiometry surveillance records and noise exposure levels (MHSI 2017). The audiometry records for individual mineworkers indicate the hearing function, key indicators for hearing loss (e.g. STS and PLH) used to measure

hearing health outcomes and cases of ONIHL (Begley 2006; Ntlhakana et al. 2021a).

Samantra, Datta and Mahapatra (2017) reported that studies in industries where excessive noise exposure was problematic show that electronic records accessed from medical surveillance programmes were essential to monitor occupational hazards and the associated health risks. Similarly, some studies have investigated mineworkers' audiometry records for various reasons, for example, to highlight the high prevalence rates of ONIHL (Grobler et al. 2020; Lie et al. 2016), to measure the deterioration of hearing in the high frequencies (Chang et al. 2019; Grobler et al. 2020), to identify and examine risk factors associated with ONIHL (Khoza-Shangase 2020a; Lie et al. 2016; Ntlhakana, Khoza-Shangase & Nelson 2020b) and so on; these studies utilised electronic records accessed from medical surveillance programmes. Evidently, electronic records were accessed from computers which used software that allows for electronic records storage, processing and analysis, widely referred to as machine learning (Tomiazzi et al. 2019). Machine learning is defined as a data analysis method that automates data and uses computer systems with AI and varies from, for example, Excel spreadsheets that offer basic AI to advanced electronic health care systems (EHSs) to predict outcomes (Tomiazzi et al. 2019). This chapter focuses on MLSs as integrated HCP tools for hearing health surveillance used to predict ONIHL.

The mines' health care practitioners' practices and recording of medical data are governed by the HPCSA ethical guidelines for good practice (HPCSA's 2016) and the *Occupational Health and Safety Act 85 of 1993* (OHSA) (Department of Labour 2001). During the annual reporting of occupational diseases to the DMRE, the South African mines exclude occupational exposures (e.g. dust, carbon monoxide, carbon dioxide and ammonia) from the HCP reporting; hence, there is a lack of integrated reporting of all occupational exposures that are associated with hearing health risks (Khoza-Shangase & Moroe 2020a; Ntlhakana et al. 2021a). Consequently, Ntlhakana et al. (2021a) argued that interventions used to mitigate these risks may not be reflected on in line with HCPs, which may in turn contravene the HPCSA guidelines on patient records (Booklet 9). The advent of the COVID-19 and its implications for this sector cannot be ignored. Although there has not been published evidence on the impact of this pandemic on ONIHL and or its potential to be an associated risk for ONIHL in the South African miners, the number of COVID-19 positive cases reported by the South African mines and the mines' response to the pandemic with regard to adherence to health and safety regulations does raise possible implications for HCPs (Heiberg & Reid 2020). There is a dearth in evidence-based studies on interactions between mineworkers' health record-keeping, reporting of occupational health diseases and now possibly COVID-19 infection and ethical rules that govern medical

surveillance. This presents complexities and challenges which affect the efficient implementation of HCPs within the South African context, hence the focus of this chapter.

## ■ 9.2. Predicting occupational hearing loss using machine learning systems

Efficient medical surveillance programmes require the availability of accurate medical records and the health care professionals' skills to apply complex statistical analysis to classify data and demonstrate outcomes intended to guide medical decisions (Char, Shah & Magnus 2018). Analysing misclassified data will provide incorrect medical diagnoses and lead to flawed medical decisions (Khoza-Shangase 2020b). Additionally, the rights of the mineworkers in surveillance programmes have a significant influence on medical decisions. Therefore, mineworkers' rights in understanding their medical conditions should be emphasised, as well as their understanding of the scoring systems used, for example, the PLH and the STS, which confirm ONIHL diagnosis. These should be made transparent and be clearly explained to individual mineworkers (Chen et al. 2021). However, research conducted in South African mines has reported that the mines' HCP records quality is questionable and inefficient, with, for example, some of the mineworkers' audiometry records incompletely captured and stored, noise exposure levels poorly recorded and other hearing loss-related medical conditions not accurately reported (Begley 2006; Edwards et al. 2011; Ntlhakana et al. 2020a, 2021a). Furthermore, no published evidence exists on South African mineworkers' knowledge of their hearing function and ONIHL diagnosis, which could raise questions about the involvement of mineworkers in their hearing health decisions (Kanji, Khoza-Shangase & Ntlhakana 2019).

Mineworkers' knowledge of risk factors associated with ONIHL empowers mineworkers to take charge of their hearing health care (Kanji et al. 2019). Research has shown that mineworkers' hearing function is affected by various medical conditions which co-occur with ONIHL, including ear infections, TB treatments and HIV treatments (Brits et al. 2012; Khoza-Shangase 2020a, 2020b), and these are recorded in the mines' medical surveillance electronic records. Other researchers have reported that occupational exposures (e.g. dust and chemicals) may not be statistically significantly associated with ONIHL but do have a relationship with ONIHL (Grobler et al. 2020; Ntlhakana et al. 2020, 2021b; Pillay 2020), yet records of these risk factors are kept separately from HCPs' data in most instances, if kept at all. Using different datasets for occupational exposures and medical surveillance records may be preferred by the mining companies for various reasons, for example, compliance reporting and protection of mineworkers' personal and medical

information; however, this precludes efficient utilisation of these data in HCP implementation and takes away an opportunity for mineworkers to understand risk factors associated with ONIHL (Khoza-Shangase 2020b). Furthermore, this use of different data sets reveals the inadequacy of current data recording systems, which negatively affects data analysis and consequent hearing health medical decisions. Although some studies and HCP policies have encouraged inclusive HCPs (Campo, Morata & Hong 2013; Department of Labor 1996; HPCSA 2016; Moroe et al. 2019, 2020), there are limited evidence-based research findings on inclusive HCP record-keeping or records.

There are risk factors, other than excessive noise exposure, that are associated with ONIHL, and these can be classified as modifiable and non-modifiable risk factors (Khoza-Shangase 2022a). Modifiable risk factors include, for example, occupational exposures such as dust, nitrogen sulphide and carbon monoxide, recreational noise and smoking (Campo et al. 2013; Gates et al. 2000; Khoza-Shangase 2022a; Lie et al. 2016; Oliveira, Cacodcar & Motghare 2014; Tao et al. 2013). Non-modifiable risk factors include ageing, sex, genetic susceptibility, race, history of ear-related conditions (e.g. ear infections and neurological ear diseases) and treatments for TB and HIV (Brits et al. 2012; Grobler et al. 2020; Khoza-Shangase 2020a, 2022a; Sebothoma 2020; Strauss et al. 2014; Zhang et al. 2019). Studies conducted in South African mines have not classified the risk factors as modifiable or non-modifiable but have highlighted the most common risk factors associated with ONIHL, for example, noise, age, sex, race, TB and HIV (Brits et al. 2012; Khoza-Shangase 2020a). In these investigations, not all risk factors associated with ONIHL have been studied or reported, for example, exposure to chemicals, dust, smoking and recreational noise, thus showing the insufficiency of risk reporting for ONIHL in the mining industry by South African mines.

In one South African study, platinum mineworkers' HCP electronic records from 2014 to 2018 were accessed and analysed to establish risk assessment practices used in this mine for the prediction and prevention of ONIHL (Ntlhakana et al. 2021a). Ntlhakana et al. (2021a) reported that mineworkers' medical conditions and treatments thereof were excluded from the HCP database, as observed by Ntlhakana et al. (2020b). In another study conducted by Begley (2006) more than a decade ago, it was found that some mineworkers' records were inconsistent and incomplete and lacked reproducibility. Although these studies were conducted in different decades, their findings are similar and indicate that current risk assessment methods used by the mines to predict ONIHL are inefficient and that not much progress has been made in all these years, regardless of developments in ICTs which should have facilitated significant changes (Khoza-Shangase & Moroe 2020a, 2020b). Evidently, there is a lack of inclusive HCP electronic

records that the mines may use for the accurate estimation of the risk for ONIHL (Begley 2006; Ntlhakana et al. 2021b).

Good quality audiometry surveillance records indicate skilled end-users who are familiar with MLSs in use. The end-users in this case, specifically for HCPs, are hearing conservation practitioners. Should these end-users not be able to measure HCP outcomes based on their data in MLSs, hearing health care delivery, medical decision-making including risk-benefit evaluations, HCP planning and research efforts may be restricted (Char et al. 2018; Khoza-Shangase & Moroe 2020a). Therefore, the quality of audiometry data and availability of audiometrists skilled in interpreting automated audiometry test results are essential for accurate prediction of ONIHL, but researchers have raised some concerns around the quality of HCP electronic records used in South African mines (Hansia & Dickinson 2010; Ntlhakana et al. 2020b). The quality of audiometry records is a key indicator of the effectiveness of an HCP, and thus it is a crucial requirement that audiometrists record audiometry data meticulously to enable accurate analysis, production of valid results to inform correct medical decisions, improvement of hearing health care service delivery and improvement of the efficiency of HCPs. High-quality data is also essential to encourage scientific research which guides hearing health medical decisions regarding HCPs and ONIHL prevention. High-income countries (HICs) have consistently reported on accurate audiometry data and noise measurements to show that data accessed from MLSs can be analysed to predict future ONIHL cases (Lie et al. 2016; Tan et al. 2018; Zhang et al. 2019; Zhao et al. 2019). Neither the HICs nor LMICs have assessed end-users' MLSs skills, but the fact that LMICs' HCP data quality has been questioned highlights the need to further investigations into end-user skills in MLSs used to predict ONIHL.

### ■ 9.3. Record-keeping methods for occupational noise-induced hearing loss prevention

The HCPs have been mandated since the late 1980s for the prevention of ONIHL in the mining sector and have focused more on noise monitoring and noise-reduction strategies. Noise-reduction strategies have been widely used and implemented by industries where excessive occupational noise exposure was problematic (Lie et al. 2016; WHO 2021). However, research has shown that for HCPs to be efficient and effective, all hearing health hazards should be included in the HCP records, yet research findings have demonstrated that this is not the case in South African mines, where deficiencies in electronic records have been documented (Ntlhakana et al. 2020a), as indicated by evidence of other occupational hazards such as dust and chemicals being omitted from such records (Campo et al. 2013; Pillay 2020), demonstrating

the value of deliberating on inclusive and contextually responsive record-keeping methods.

From records kept globally, cases of ONIHL in mining industries have shown signs of decreasing (WHO 2021). Evidence indicates that similar trends have been reported in LMICs (Chadambuka, Mususa & Muteti 2013; Musiba 2015, 2020). In South Africa, mines' annual occupational health reports have also revealed a decline in the number of ONIHL cases (MHSI 2017). Electronic data records accessed from the mines' MLSs have shown that AI capabilities to automatically classify and predict ONIHL cases were possible and can be used successfully with various HCP datasets available (Expert-System 2020). Hence, it is imperative that hearing conservation practitioners gain a basic understanding of MLSs, datasets information and their relevant algorithms, which may be used to support medical decisions towards the prevention of ONIHL (Char et al. 2018). With the current complaints about the quality and accuracy of data on ONIHL within South African mines, minimal efforts have been placed on studies that investigate data capturing and analysis methods adopted by the mines when reporting medical conditions associated with occupational exposures, as well as the ethical rules adhered to that govern mineworkers' protection of personal information and data sharing rules. Thus, the reported decrease in the number of ONIHL cases may not be because of improvements or efficiencies in HCPs, but rather because of practitioners' lack of training in and understanding of MLSs, incomplete HCP records or inconsistencies in HCP data capturing (Ntlhakana et al. 2020, 2021a); all these factors require extensive interrogation.

## ■ 9.4. Ethical guidelines for electronic health records

Legally, access to workers' medical records, for example, medical conditions and treatments as well as personal information, is restricted to health care practitioners employed by the company (HPCSA 2016). Furthermore, reporting of medical conditions and accessing worker's medical records are guided by legislative rules that include the *Protection of Personal Information Act (PoPIA) of 2020*, the *National Health Act 61 of 2003*, Booklet 5 of the HPCSA (Confidentiality: Protecting and Providing Information) and the *Health Professions Act 56 of 1974* to safeguard appropriate ethical protection of workers' information. However, health care practitioners employed by mining companies have rights and privileges regarding patients' personal and medical information, which allows them to use their discretion to share workers' personal and medical information (Republic of South Africa 1974). So far, there is no clarity on the details that guide the health care practitioners' discretion, but some researchers have reported difficulties in accessing mineworkers' medical records (Moroe & Khoza-Shangase 2018; Ntlhakana



et al. 2020b). Restricted access of mineworkers' HCP medical surveillance data limits data analysis, which in turn skews hearing health prevalence statistics and outcomes.

Predicting mineworkers' hearing function ahead of time with the goal of preventing new cases of ONIHL promotes quality and equitable quality hearing health care services (Khoza-Shangase 2022b). Therefore, transparency and justice around data access for surveillance analysis, compliance and research is encouraged. However, in some studies, research has reported some inconsistencies in HCP data accessed from the mines' MLSs, which has led to data analysis limitations and biased research findings (Heyer et al. 2011; Moroe 2018; Tikka et al. 2020). The potential unconscious bias has been linked to the use of historical data accessed from the mines' MLSs, which have not necessarily been acquired utilising standardised protocols nor captured in a user-friendly and user-efficient manner, negatively influencing quality hearing health care service provision. South African mines have been mandated to report ONIHL from 2001, and their EHSs have been in existence since then, with upgrades that come with system changes and specific needs for the mines, hence the use of historical data. The current EHSs seem not to have considered the ethical issues which may arise alongside their use and during data access and analysis for the prevention of ONIHL. The next section, therefore, describes audiometry medical surveillance data and ethical challenges in accessing data from MLSs used for the prediction and prevention of ONIHL in mineworkers in Africa.

## ■ 9.5. Ethical issues when using machine learning systems to predict and prevent occupational noise-induced hearing loss

Tensions exist between the application of ethical principles in data sharing regarding mineworkers' medical records, as the mine managers and OMPs regard medical records as more confidential than other records (Ntlhakana et al. 2020b). Issues around ethical guidelines for good practice, confidentiality and protection of personal information, as well as access to data for research purposes, co-exist with public health ethics but have not been interrogated by researchers. The public health ethics widely used in this context include public interest and the common good (Republic of South Africa 1974).

Table 9.1 summarises the basic ethical principles that guide the implementation of health care services by health care practitioners, as applied to mineworkers' audiometry medical surveillance data. The discussion of individual principles follows after that.

While protection of mineworkers' data is ensured by these ethical principles, the mines may have imposed challenges that restrict data sharing specifically



**TABLE 9.1:** Summary of ethical principles.

Ethical principle	Definition	Examples of the type of data	Ethical challenge
Confidentiality	Personal information will be held in confidence  Guidelines in Booklet 5 of the HPCSA state that a practitioner may divulge patient information under certain conditions	Mineworkers' personal and medical history records	Lack of clarity on the criteria used when sharing mineworkers' confidential information
Justice	Fair equitable treatment for all	All mineworkers' records should be eligible for inclusion in the medical surveillance records for review and analysis to ensure the prevention of occupational diseases	-
Beneficence	Duty to do more good than harm	Audiometry medical surveillance records collected during annual medicals	-

Source: Adapted from Flite and Harman (2013).  
Key: HPCSA, Health Professions Council of South Africa.

for external medical practitioners. So far, HCP records submitted to the DMRE for compliance have been accessed from the mines' MLSs (MHSI 2017; Rand Mutual Assurance 2018) but have not shown individualised datasets with ethical codes used (Ntlhakana et al. 2021a).

### ■ 9.5.1. Confidentiality

By using MLSs for data storage, research shows that individual mines complied with these record-keeping and confidentiality requirements. The mines have possibly added password protection and restricted access to their MLSs, thus adhering to the rules that govern patient health records for confidentiality and protection of personal information regarding occupational medical record-keeping (HPCSA 2016), which safeguards medical ethics and public health ethics for the common good. Furthermore, in line with the *National Health Act*, Booklet 5 of the HPCSA, the MHSA and the PoPIA that mandate health care professionals to record health data for all users (patients and employees) and to design electronic information systems to ensure the privacy of health records for the common good of the miner, the mine under investigation complied (Ntlhakana et al. 2021a). However, there was a lack of clarity, as reflected in the mines' annual health and safety reports, regarding which databases could be accessed and the ethical codes that may be applied as part of the motivation to share mineworkers' confidential records (Ntlhakana et al. 2021a).

### ■ 9.5.2. Justice

The ethical principle of justice in this case is premised on equitable access of medical services to all mineworkers; thus, annual medical surveillance is

mandatory to identify possible risk factors for occupational diseases (Franz & Phillips 2001; MHSC 2015; SANS 2013). Globally, previous studies have indicated that mines conduct annual audiometry surveillance to identify mineworkers at risk of developing ONIHL and to document interventions used to prevent ONIHL (Chadambuka et al. 2013; Grobler et al. 2020; Masterson et al. 2016; Nelson et al. 2005; Ntlhakana et al. 2020a).

The South African mines designed standardised procedures and data recording templates to collect similar information for individual mineworkers (*MHSA No. 29 of 1996*), with implementation guided by the regulations illustrated in Table 9.2 to ensure best practice in medical surveillance (HPCSA 2016). However, regardless of these regulations being available, the quality of occupational hygiene and medical records collected by the mines' hearing conservation practitioners remained questioned (Begley 2006; Ntlhakana et al. 2020a), hence the mines' efforts to ensure uniform record-keeping standards for annual medical surveillance in MLSs as reflected in Table 9.3.

**TABLE 9.2:** Summary of regulations for South African mines.

Regulation
Regulation 11.2 promulgated by GNR.1486 of 1999
Regulation 11.3 amended by GNR.1486 of 1999
GNR.303 of 2000 and substituted by GNR.1053 of 2010 and by GNR.621 of 2013
Regulation 11.4 promulgated by GNR.786 of 2002
Regulation 11.8 inserted by GNR.701 of 12 September 2014

Source: Adapted from Ntlhakana et al. (2021a).

Key: GNR, Regulation Gazette Number

**TABLE 9.3:** Summary of datasets used for hearing conservation.

Type of dataset	Example of records
Demographic information	Date of birth, sex, race, initial date of employment, employment history
Medical history	Medical conditions and health effects associated with occupational exposures
Hearing screening	Bilateral audiogram records which include the results of the following frequencies 0.5 kHz, 1 kHz, 2 kHz, 3 kHz, 4 kHz, 6 kHz and 8 kHz, which are used to calculate PLH or bilateral STS or averaged high-frequency deterioration
Risk-based medical surveillance	The audiometrist would have referred all those mineworkers (with a PLH shift of > 2.5% from baseline and mineworkers who presented with ear-related conditions and were considered to be at high risk for ONIHL) to the OMP for further review and intervention. An occupational medical practitioner would refer mineworkers who require diagnostic audiometry to the audiologist
Occupational hygiene	Occupational exposures (e.g. noise, dust and chemicals) that may cause illness or have adverse health effects

Source: Adapted from MHSC (2015; cf. SANS 2013).

Key: ONIHL, occupational noise-induced hearing loss; PLH, percentage loss of hearing; STS, standard threshold shift; OMP, occupational medical practitioner.

Scrutiny of Table 9.3 reveals that this standardised protocol may not adequately and efficiently address the ethical principle of justice. In addition, there is a dearth of evidence on the social implications, fairness and equality of such a protocol on mineworkers who have been misclassified and subsequently misdiagnosed, which in turn highlights implications for potential under-reporting and under-estimation of ONIHL in this context.

### ■ 9.5.3. Beneficence

The mines use MLSs to record occupational exposures and monitor mineworkers at risk of occupational medical conditions to ensure beneficence. Specific to this chapter, HCPs' reporting has been based on occupational noise exposure levels (hazard), and occupation types and monitoring of hearing deterioration of mineworkers from baseline (initial entry of employment) has been used by the mines' hearing conservation practitioners to predict future ONIHL cases (Franz & Phillips 2001). However, not all the risk factors – for example, TB and HIV treatments and ear diseases such as OM, otitis externa and impacted cerumen – are included in the mineworkers' HCP records (Khoza-Shangase 2020a; Ntlhakana et al. 2020b; Sebothoma 2020), thus hindering accurate prediction of future cases of potential OHL. Previous studies have indicated that mineworkers' hearing deterioration could be influenced by these ear-and-hearing-related risk factors, which, therefore, are important to include in HCP strategies used to monitor mineworkers' hearing function and to provide intervention where required (Khoza-Shangase et al. 2020; Ntlhakana et al. 2020a). The MHSA (2017) mandated reporting of accurate HCP data to the DMRE to ensure accurate tracking of mineworkers' hearing function and to identify mineworkers at risk for ONIHL, but with the current record-keeping system, not all mineworkers may benefit from the function of efficient MLSs that allows for accurate prediction of ONIHL. Subsequently, not all mineworkers may benefit from the audiometry surveillance programme designed by the mines (Ntlhakana et al. 2020a) as far as *preventive audiology* is concerned (Khoza-Shangase 2022b), and MLSs designed by the OMPs may not adequately mitigate risks for and prevent ONIHL. Currently, medical practitioners and researchers in HCPs do not seem to understand MLSs' functions used to classify and access data to predict future risks associated with ONIHL.

### ■ 9.5.4. Autonomy

Empowered mineworkers have a right to access their medical surveillance records, understand results obtained from various assessments and understand risks and benefits of the medical tests conducted on them. Subsequently, empowered mineworkers will be able to take care of their own ear and

hearing health. Therefore, the mines' hearing conservation practitioners should clearly communicate the purpose of audiometry medical surveillance to the mineworkers. In South Africa, the PoPIA (2013), *the National Health Act 61 of 2003* (RSA 2003) and the HPCSA Ethical Guidelines (2016) mandated companies to respect patients' rights to access information for educational and training purposes and to consider when to obtain consent for disclosure of patients' personal and medical information. For those patients for whom obtaining consent is not practicable, their data should be anonymised, and research ethics committees should be notified of that.

Previous research findings have reported some challenges around mineworkers' limited knowledge of their hearing function and ONIHL (Kanji et al. 2019), as well as limited understanding of the risk and benefits regarding HPD usage (Hansia & Dickinson 2010; Ntlhakana et al. 2015) as some of the reasons which may restrict mineworkers' ability to know and understand their hearing health care. Less empowered mineworkers render HCPs ineffective and require the mines to re-evaluate their HCP education and training pillar (Edwards et al. 2015; Moroe 2020b). This education and training should be designed in a way that encourages mineworkers to become actively engaged in their hearing health care matters.

## ■ 9.6. Recommendations

The mining industry should be well-informed about and comprehensively understand the legislation, rules, guidelines and policies that govern capturing, storing and sharing of employee data for clinical and research purposes. While data sharing should be guided by ethical rules and company policies, the application should ensure efficient surveillance programmes and encourage medical research, which is key to evidence-based practice. All databases that contain mineworkers' health and safety records should be accurate, comprehensive and integrated to ensure efficient risk management frameworks for occupational hazards, which will benefit all mineworkers. Quality checks should be implemented to ensure that high-quality data are kept for efficient programme planning, implementation and monitoring. Moreover, a standardised recording template for audiometry medical surveillance data should be used by hearing conservation practitioners to ensure accurate data analysis of hearing health trends, which will improve the prediction and prevention of OHL.

Furthermore, transparency is essential in the application of the confidentiality rule, and all hearing conservation practitioners and employees who handle mineworkers' data should be encouraged to be familiar with data sharing ethical principles, policies and regulations. Lastly, mining companies should constantly review their policies around data sharing for research

purposes for mineworkers' empowerment, permission rights granting to health care providers across the mining industry and evidence-based development by researchers.

## ■ 9.7. Conclusion

Efficient MLSs that are used to store and manage HCP data depend on accurate and consistent data input, clear checklists for medical ethics and comprehensive company regulations related to reporting and data access for medical research. To assess mineworkers' inclusive audiometry medical surveillance data contained in MLSs and data access processes, issues of data analysis and the application of ethical principles should be anticipated. Therefore, it is imperative to describe ethical challenges that may render HCPs ineffective at predicting and preventing ONIHL. The fact that some researchers have had difficulties accessing data intended for occupational hearing health research has imposed restrictions on an objective and independent evidence base for contextually relevant HCP implementation. There is value in ensuring confidentiality and privacy of mineworkers' information guided by company-specific policies; however, considerations around data sharing to promote accurate hearing health research are necessary. This chapter shared some evidence that requires further development and interrogation to improve HCP data quality, end-user skills in using MLSs and to address over-protection of employees' medical data, which consequently restricts the goal of HCP to predict ONIHL for preventive audiology purposes. In this chapter, discrepancies were highlighted in the implementation of HCP checklists used for record-keeping and the lack of clarity regarding ethical codes and principles applied, which rendered MLSs inefficient for the prediction and prevention of ONIHL. There is a need for the integration of the various medical ethics principles into the MLSs, together with HCP checklists, to enhance the efficiency of data collection, capturing, storage and analysis.

# Complexities with context: Cultural and linguistic diversity challenges in preventive audiology in Africa

**Munyane Mophosho**

Department of Speech Pathology, Faculty of Humanities,  
School of Human and Community Development,  
University of the Witwatersrand,  
Johannesburg, South Africa

**Khetsiwe P. Masuku**

Department of Speech Pathology, Faculty of Humanities,  
School of Human and Community Development,  
University of the Witwatersrand,  
Johannesburg, South Africa

**Katijah Khoza-Shangase**

Department of Audiology, Faculty of Humanities,  
School of Human and Community Development,  
University of the Witwatersrand,  
Johannesburg, South Africa

## ■ 10.1. Introduction

Africa is a diverse continent in terms of the languages, cultures, ethnicities, religions and nationalities represented in its demographic profile. It is documented that Africa is the second most densely populated continent

**How to cite:** Mophosho, M, Masuku, KP & Khoza-Shangase, K 2022, 'Complexities with context: Cultural and linguistic diversity challenges in preventive audiology in Africa', eds. K Khoza-Shangase, *Complexities and challenges in preventive audiology: An African perspective*, AOSIS Books, Cape Town, pp. 155-175. <https://doi.org/10.4102/aosis.2022.BK311.10>

globally with over a billion people, and it is also habitat to the most linguistic diversity in the world, with a record of greater than 1500 languages (Matshego 2019). These diversities, although enriching to the context, create complex challenges to the provision of audiology services that are linguistically, contextually and culturally relevant, despite what is enshrined in the country's constitution, regulations, laws and policies on the rights of patients and the equality of all. Many factors contribute to the challenges confronted in the provision of preventive audiology services, such as the inadequate number of audiologists for the size of the population, unequal distribution of professionals between the public and private health care sectors which service disproportionate numbers of the population and a cultural and linguistic mismatch between audiology professionals and the population served. This chapter deliberates on contextual, CLD influences on the provision of preventive audiology services within the South African context. The chapter begins by discussing CLD and contextual complexities in Africa, then goes on to interrogate factors influencing the provision of CLD-appropriate preventive audiology at the primary, secondary and tertiary prevention levels, with potential solutions and recommendations offered for challenges identified.

With a population of over 56.5 million and a diverse range of cultures, languages, religions, nationalities and ethnicities, South Africa's population is richly diverse, presenting complex challenges in terms of health care provision, assuming the country's constitution is respected and adhered to (StatsSA 2017). With 80.2% of the population being black African, a majority of whom speak isiZulu (23.8%) as a home language, and with English reported to be spoken as a home language by less than 10% of the population, any form of health care intervention that does not take this profile into consideration faces a danger of leading to poor outcomes and unsustainability. Although English is spoken by a small fraction of the South African population as a home language, it is the only high-status language in South Africa, and it has quickly become the lingua franca in government (Henrard 2003). This is the same for the rest of the continent, where even though the principal languages include Arabic and French, English reportedly reached the third position as the most commonly spoken language globally, thus becoming known as the 'lingua franca' of the world (Matshego 2019). Nonetheless, the constitution, laws and policies of South Africa recognise 12 official languages as well as a diverse range of cultural practices. Audiologists must recognise that language has meaning and forms part of the community's experience and that it is never just a means of communication; therefore, its consideration in the conceptualisation, planning, implementation and monitoring of services is vital. For the rest of the African continent, with the current population of over 1.3 billion (Worldometers 2022), Nigeria, Ethiopia, South Africa, Tanzania and

Kenya are documented to be the largest English-speaking countries in Africa, with approximately 50 million speakers. Although these African countries are documented to be the most English-speaking, not everyone in these countries can speak or write English. Similar to the South African context, although English is the official language in countries such as Tanzania, Uganda and Kenya, Swahili is the most commonly spoken language. Rwanda endorses both English and French as its official languages; however, the use of English in schools is more encouraged, in line with the East African bloc language choice (WorldAtlas 2022). The choice of which language each African country adopts, even after attaining independence from being colonised, is still aligned to the language of their colonisers for official matters in business, education and government – with indigenous languages still promoted and respected through language policies that advocate multilingualism.

Swanepoel (2006) reported that the South African audiology profession was facing a challenge in service provision to the hearing-impaired population of a diverse country. Now, 15 years later, the same challenge remains. Very little has changed in the training and practice of audiology in Africa (Khoza-Shangase & Mophosho 2018, 2021; Moonsamy et al. 2017; Pillay et al. 2020). The diverse cultures and languages of Africa necessitate the use of interpretation facilities in health care, without guarantee of efficient communication assistance being a critical tool for providing efficient and efficacious health care services. Furthermore, capacity versus demand challenges – as reflected by an inadequate number of audiologists, unevenly distributed between the public and private health care sectors and a culturally and linguistically incongruently represented occupation – are major obstacles to providing adequate and efficient audiological services to most of the population (Khoza-Shangase 2022a; Pillay & Kathard 2018; Pillay et al. 2020; Swanepoel 2006).

The authors of this chapter argue that the presence of power dynamics and CLD between the clinician and clients can potentially curtail audiology service delivery in various ways. Firstly, patients have a right to participate in decisions relating to their health and the health of their families, as reflected in the National Patients' Rights Charter (NPRC). The NPRC (2002, p. 10) declared that every patient has 'a right to participate in any decision affecting their personal health and treatment' and they also have a right to full knowledge regarding their health and treatment – underscored as 'every health care provider must inform a consumer in an appropriate manner of health status [and] the range of diagnostic procedures'. African citizens also have language rights; for example, in South Africa, they also have the Batho Pele policy, which seeks to provide people-centred public services that respect the individual's language and culture in accessing public services. The National Language



Policy Framework (NLPF) (2003) was approved by the government in 2003, with the following specified goals:

1. to encourage equitable utilisation of the 11 official languages
2. to promote equitable access to government information, knowledge and services
3. to safeguard redress for the historically relegated official indigenous languages
4. to promote the learning of other indigenous languages
5. to propagate national unity.

Kirmayer (2012) defined culture as ‘the way people think and behave’, emphasising the importance of culture in understanding how people think about and interpret life events such as healing and disease. Such a crucial influence of language and culture in health care delivery has been highlighted from global health evidence (Flood & Rohloff 2018) and specifically in the SLH professions within the South African context (Abrahams et al. 2019; Balton, Uys & Alant 2019; Barratt, Khoza-Shangase & Msimang 2012; Kathard & Pillay 2013; Kathard, Pillay & Samuel 1997; Khoza-Shangase & Mophosho 2018, 2021; Maluleke, Chiwutsi & Khoza-Shangase 2021a; Mdlalo, Flack & Joubert 2016, 2019; Moonsamy et al. 2017; Mophosho 2018; Pascoe & Norman 2011; Pascoe, Rogers & Norman 2013; Pillay & Kathard 2015; Pillay, Kathard & Samuel 1997), with the HPCSA having recently published their *Guidelines for Practice in a Culturally and Linguistically Diverse South Africa* (HPCSA 2019).

Miller (2009) claimed that the concept of culture can be understood as a progression from cultural awareness to cultural competence to cultural humility, a continuum that the authors of this chapter support. Being mindful that people have different values and customs from those of the health care provider is what cultural sensitivity and awareness is. This is different from cultural competence, where there is a concern about the ability of the health care professional to communicate with people from other cultures, with this progressing to cultural humility when the health care professional engages in self-reflection, which is an ongoing dialogue rather than a static construct (Miller 2009).

Within the South African context, the established status quo in how audiologists deliver SLH services to most of the country’s population has not dismantled the lack of critical thinking about power dynamics and health disparities since the apartheid era (Khoza-Shangase & Mophosho 2021). Significant responsibility for changing this status quo lies with the training institutions, the DoH and regulatory bodies such as the HPCSA. Audiology training in other African countries is very sparse, an additional challenge for the continent. Inclusion of training in critical diversity literacy in the curriculum will allow the audiology profession to identify and

acknowledge power dynamics in community relationships and engage in ways that would reduce health inequalities and improve ear-and-hearing health care outcomes (Mophosho 2018; Steyn, Burnett & Ndzwayiba 2021). Furthermore, decolonising the curriculum and confronting the inequity and injustice in training and clinical practice would facilitate contextually relevant preventive audiology within the African context (Khoza-Shangase & Mophosho 2018, 2021; Pillay & Kathard 2015, 2018; Pillay & Ramkisson 2020).

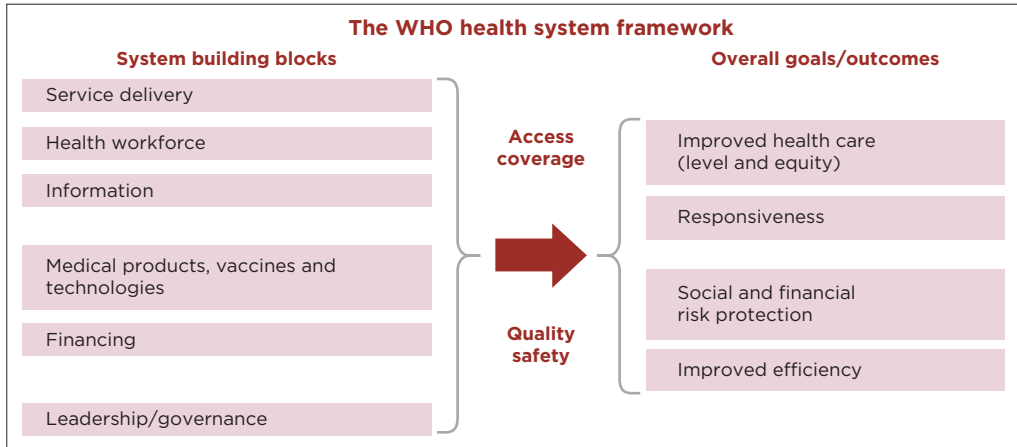
There is a great need for culturally knowledgeable audiologists who can use their knowledge of patients' health-related beliefs and practices to enhance the standard of treatment they provide. Ross and Deverell (2004) argued that cultural competence entails more than being culturally conscious and or sensitive. Audiologists who are culturally competent have a thorough understanding of their own and their clients' cultures, and they can consider similarities and disparities without being judgemental or patronising; within the African context, they do this by being aware of the influence that the *white gaze* might have in their clinical interactions and engagements (Hlatshwayo 2020; Khoza-Shangase & Mophosho 2021; Phaswana 2019). To this end, South African audiologists should learn to communicate with clients from a variety of cultural and linguistic backgrounds in a holistic manner during consultations, as knowing their clients' cultural and linguistic backgrounds would be advantageous to them as well as to the clinical outcomes (Khoza-Shangase & Mophosho 2018, 2021). Audiologists' area of practice as communication, hearing and balance disorders practitioners necessitates clinical competence as well as cultural sensitivity and competence. Penn, Mupawose and Stein (2009), however, acknowledged that the South African SLH training programmes are not adequately preparing practitioners for the types of circumstances and scenarios that they will face as part of their professional lives within the African context, and this sentiment was recently echoed by others (Abrahams et al. 2019; Moonsamy et al. 2017; Pillay & Kathard 2015, 2018).

Khoza-Shangase and Masondo (2021) found significant contextual issues affecting ototoxicity evaluation and management programme implementation within the South African context. Among other challenges found in this study, the language and culture were found to significantly impact the evaluation and management of ototoxicity. Pre-treatment counselling around risks of ototoxic medications, signs and symptoms of ototoxicity, as well as the value of ototoxicity monitoring and patient interactions during programme implementation all require linguistic and cultural competence on the part of the audiologist for treatment and intervention adherence (Khoza-Shangase 2017). This is in line with what Mogobe et al. (2016) believed are complexities of language and culture generally seen in most health interactions. Mogobe et al. (2016) found that linguistic and cultural considerations were important

themes in the sharing of HIV knowledge between health care providers and people living with HIV. These authors highlighted that health-seeking attitudes, ineffective communication, complementary and alternative or traditional healing methods and cultural facilitators are among the significant influencing factors, with health literacy being closely linked to language and culture.

Kathard et al. (2007) lamented that within the South African context, professional research is not representative of the demographic profile of the country, with the research questions being led by minorities who are actually the 'dominant culture' in the academic and clinical spaces (Khoza-Shangase & Mophosho 2018). The authors of this chapter concur with these sentiments and recommend that deliberate efforts be focused on making research contextually relevant and recognising the prevailing complexities, particularly in relation to the influence of language and culture in clinical training as well as service provision. Pillay and Kathard (2018) recommended that the profession should implement the equitable population-based innovations for communications (EPIC) framework in addressing some of these challenges linked to CLD. They suggested that this framework will facilitate decolonisation of the SLH professions and improve access for underserved populations. When audiologists lack the required training and expertise in CLD and EPIC, SLH service delivery suffers. The service delivery suffers because the audiologists may be unfamiliar with the language and or culture of their patients, or they may lack the necessary CLD assessment and treatment tools; furthermore, audiologists may believe that they understand community needs and provide services from that viewpoint, resulting in a biased approach – which may be influenced by the *white gaze* and Western epistemology (Khoza-Shangase 2019).

The World Health Organization (WHO 2018) indicated prevalence estimates of disabling hearing loss globally to be high and set to increase, and this is across all regions of the world. Currently, disabling hearing loss is estimated to be > 6.1% of the world's population. This translates to 466 million persons globally, of which 432 million (93%) are adults and 34 million (7%) children, with most causes of this hearing loss being preventable. One of the first population-based studies in Cape Town, South Africa's largest city, found a 4.57% estimated prevalence of debilitating hearing impairment (Ramma & Sebothoma 2016), and this number has most likely increased with the increased burden of disease associated with hearing loss (Kanji & Khoza-Shangase 2019; Khoza-Shangase 2021a, 2021b; Louw et al. 2018; Sebothoma et al. 2021). With hearing loss ranking fifth on the global causes of years lived with disability index, preventive approaches to ear-and-hearing health care seem prudent, particularly in resource-constrained contexts like low- and middle-income countries (LMICs) such as South Africa. Hearing loss is reported to be higher than other chronic diseases such as diabetes or dementia, and it is recognised as one of the leading contributors to the global burden of disease



Source: Adapted from WHO (2010).

**FIGURE 10.1:** The six building blocks of a health system.

(Louw et al. 2018). Curative care has long received the largest share of health care budgets (Starfield, Shi & Macinko 2005), but preventive health care is making inroads among researchers and academics, policymakers and decision-makers because of its success in improving people's health and its long-term effects on social expectancies and well-being.

In deliberating on the complexities and challenges presented by CLD in the provision of preventive audiology within the South African context, the authors of this chapter believe that it is important to be guided by the six building blocks of health systems designated by the World Health Organization (WHO 2010a). This WHO framework, amended for the purpose of this chapter, as depicted in Figure 10.1, regards (1) financing, (2) health information systems, (3) health workforce (SLH professionals), (4) leadership or governance, (5) service delivery and (6) access to audiological (ear and hearing) interventions (WHO 2010a) as important when evaluating challenges to health care delivery. The authors of this chapter believe that language and culture play a critical role in each of these building blocks within preventive audiology in South Africa, and its influence should be considered in the planning and execution of preventive systems and programmes.

## ■ 10.2. Cultural, linguistic and contextual diversity

Linguistic diversity comprises variations displayed by human languages often encountered in a variety of multilingual communities (Terralingua 2011). Language and culture are intertwined (Banks 2006). In fact, Banks (2006) summed up the relationship between culture, language and context by maintaining that culture is an all-inclusive concept that includes numerous

components such as worldviews, frames of reference, values, language and dialects and behavioural styles, as well as non-verbal communications and perspectives. Culture is deep, spirited and powerful, and it is an evolving concept (Khunou et al. 2019). South Africa is home to 12 official languages, therefore implying various cultural beliefs and traditions that should be held to the same status and level of importance. Additional to that are social standing or social class and economic brackets, which bring about the dynamics of various contexts which are language and culture-driven. Khunou et al. (2019) argued against Africans being stuck within the current geopolitics of knowledge and propose that they re-imagine epistemic privilege that is Afrocentric, rather than the current Western epistemology that does not affirm the epistemic rights of the racially devalued, where 'white knowledge and white history define and govern the culture' – a concept by Mignolo (2009, p. 8). Khoza-Shangase and Mophosho (2021) presented a proposal to the South African SLH professions that allows for access to epistemological freedom as well as language access in the provision of SLH services, and this proposal has value for preventive audiology training and provision.

### ■ 10.3. Preventive health care

The WHO (2010b) stated that preventive health care is composed of three layers, namely, primary prevention, secondary prevention and tertiary prevention. This organisation explains that primary prevention refers to the implementation of strategies that prevent the disability (in this case, hearing loss) from occurring. They also state that secondary prevention involves intervening earlier – for example, in early detection, diagnosis and management of the hearing loss to prevent the progression of symptoms – and describe tertiary prevention as the level that entails intervention to mitigate the impact, aftermath and consequence of the hearing loss. Cultural and linguistic diversity has an impact at all these levels of preventive audiology, including the primordial prevention level.

### ■ 10.4. Preventive audiology

Most population studies have attributed hearing loss not only to hereditary factors but also to *in utero* infections, prenatal and postnatal infections, trauma, syndromes and neurodegenerative disorders (JCIH 2019). Whether it is primordial, primary, secondary or tertiary prevention being planned or implemented, Khoza-Shangase (2022a) argues that contextual realities, including CLD, play a significant role in preventive audiology. Preventive audiology, which falls under preventive health care, are measures that are taken for the prevention of ear-and-hearing diseases or disorders. These measures are aimed at targeting preventable causes and or minimising the

consequences and their severity, such as hearing loss causes that are linked to lifestyle choices, environmental factors, genetic predisposition or burden of disease, as well as other causes (Khoza-Shangase 2022a).

When considering the challenges that CLD presents to preventive audiology initiatives within the South African context, the WHO's (2020) operational definition of disease prevention and health promotion becomes relevant. This organisation defines prevention as 'population-based and individual-based interventions for primary and secondary (early detection) prevention, aiming to minimise the burden of diseases and associated risk factors', a definition that clearly indicates the importance of considerations of individuals, families and communities, who form the population in which the preventive measures are planned for and implemented in. Without consideration of the influence of language and culture, preventive outcomes may be less impactful, and ear-and-hearing health care outcomes may be poorer (Flood & Rohloff 2018).

The authors of this chapter, in agreement with Khoza-Shangase (2022a), believe that prevention should begin at the primordial level, just before primary prevention (AFMC 2013), where measures and initiatives are focused on altering or addressing population health determinants and preventing the development of harmful factors (environmental, economic, social and behavioural factors) that are documented. These factors are recognised to raise the future risk of the disease or disorder, as well as how the service is delivered to the population (language) and the epistemological posture adopted during the planning and delivery of the initiatives. It is at this primordial level of prevention where determinants occur at the systemic level rather than changing personal risk factors, which is the objective of primary prevention. But this can only be successfully done if the systems are contextually relevant and contextually responsive (Khoza-Shangase & Kanji 2021).

The WHO (2020) listed clinical preventive services from cradle to grave such as immunisation and vaccination of people of all ages, as well as postexposure prophylaxis or vaccination for individuals exposed to communicable diseases as systemic interventions at this primordial level of prevention. Khoza-Shangase (2022a) suggests that in preventive audiology, part of primordial prevention is prenatal care for conditions known as risk factors for permanent childhood sensorineural hearing loss, such as toxoplasmosis, rubella, cytomegalovirus, herpes simplex and HIV (TORCH), as described by Kanji and Khoza-Shangase (2019a) and Fitzgibbons, Beswick and Driscoll (2021). Furthermore, Khoza-Shangase (2022a) includes initiatives such as:

1. Childhood immunisation against infections that are risk factors for hearing impairment.

2. Careful deliberations around medications that are prescribed for illnesses, where ototoxic medications are minimised and audiologists play a bigger role in the drug development processes in terms of pharmacovigilance (Khoza-Shangase 2017).
3. 'Buying quiet' in mines and other places known to present high risk for NIHL (Khoza-Shangase, Moroe & Edwards 2020).
4. Prevention of non-communicable diseases known to be risk factors for hearing loss such as cardiovascular diseases, cancer and diabetes (Khoza-Shangase 2022b; Khoza-Shangase, Pillay & Moolla 2013), and so on.

Khoza-Shangase (2022a) strongly argues that primordial prevention should be the foundation of preventive models in LMICs like South Africa, as this approach addresses possible future disease as a priority, thus preventing the disease from presenting itself – a position that is more costly for them with their limited resources. All this, which includes confronting and addressing social determinants of health, requires intimate understanding, acknowledgement and infusion of CLD into the planning and implementation of programmes. The Commission on the Social Determinants of Health (CSDH) (2008, p. 2) defines social determinants of health as 'the circumstances in which people are born, grow up, live, work and age, and the systems put in place to deal with illness'. Health prevention at any level cannot be discussed outside of the determinants of health (Khoza-Shangase 2021a). Health determinants are the core of who people are, where they are from and their social and cultural influences; they have significance on what is considered in the health agenda of each country. Olusanya (2011) argued that in a context and culture of resource deprivation, mostly experienced in LMICs, some risk factors associated with hearing loss may be missed because of the unavailability of equipment to detect these risks.

Once addressing social determinants of health has been prioritised at the primordial prevention level, preventive audiology strategies at primary, secondary and tertiary prevention levels can then logically follow. At the primary level of prevention, the goal is to reduce risk to prevent the onset of hearing loss or impairment – at a non-systemic level – because the system is addressed at the primordial level of prevention. So at this primary level, the goal is to modify behaviours or exposures that can cause hearing loss or engage in initiatives that increase resistance to the effects of exposure to the harmful behaviour or toxin (AFMC 2013; Khoza-Shangase 2022a). Moroe and Masuku (2022) posit that primary prevention in audiology entails raising awareness of the risk factors associated with hearing loss. Considering that primary prevention implies a measure that 'stops the disease or health outcome from occurring by eliminating the exposure' (Alvarez 2008, p. 7) and raises awareness of risk factors for hearing loss (Moroe & Masuku 2022),



as well as health prevention and health promotion, it becomes critical in any preventive health care-focused country. Health prevention and health promotion are relevant, particularly in resource-constrained settings such as most African countries, because these approaches do not require extravagant drugs and complex technology but only require investments in the form of time and energy for conducting the campaigns (WHO 2010b). In the essential package of care, health prevention and promotion are rightfully placed at the PHC level, which is the entry point into the health care system and typically accessible to most patients, as it is situated within proximity to the majority of communities (Kautzky & Tollman 2008; Langlois et al. 2020; Soderlund 1999).

Maternal health programmes can be used as a vehicle to facilitate health promotion and prevention. In South Africa, the Basic Antenatal Care (BANC) programmes currently exist, which encompass health promotion and the preservation of maternal and baby social and physical health as well as the early identification and treatment of pregnancy complications among its goals (Ekabua, Ekabua & Njoku 2011; Ngxongo 2018). Taking careful cognisance of language and culture, for successful and sustainable maternal health programmes related to preventive audiology to occur, the following would need to be particularly included at this level of prevention:

- Maternal health programmes that encompass immunisation campaigns.
- Genetic counselling about current or future pregnancies.
- Health information and education in accessible formats.
- Antenatal care, where access to health care, specifically antenatal care, plays a critical role in significantly reducing complications that may lead to disabilities, in this case hearing loss.
- Maternal exposure to other health conditions or diseases and environmental factors that have the potential to raise the risk of the unborn baby developing an auditory impairment (Alvarez 2008).

Accordingly, preventive audiology examples at the primary level include:

1. Early hearing detection and intervention initiatives that are part of the First 1000 Days programmes, where nutrition is part of the intervention.
2. The provision of material on medical and behavioural health risks in prenatal clinics, immunisation clinics, developmental clinics, schools, HIV and AIDS clinics, HCPs on prevention of hearing loss.
3. Measures and consultation to mitigate risk factors at the personal and community levels (Khoza-Shangase 2022a).

What the patient believes is the cause of illness and or what they believe will help them (culture) and how the information is transferred to them (language) will determine the failure or success of the preventive

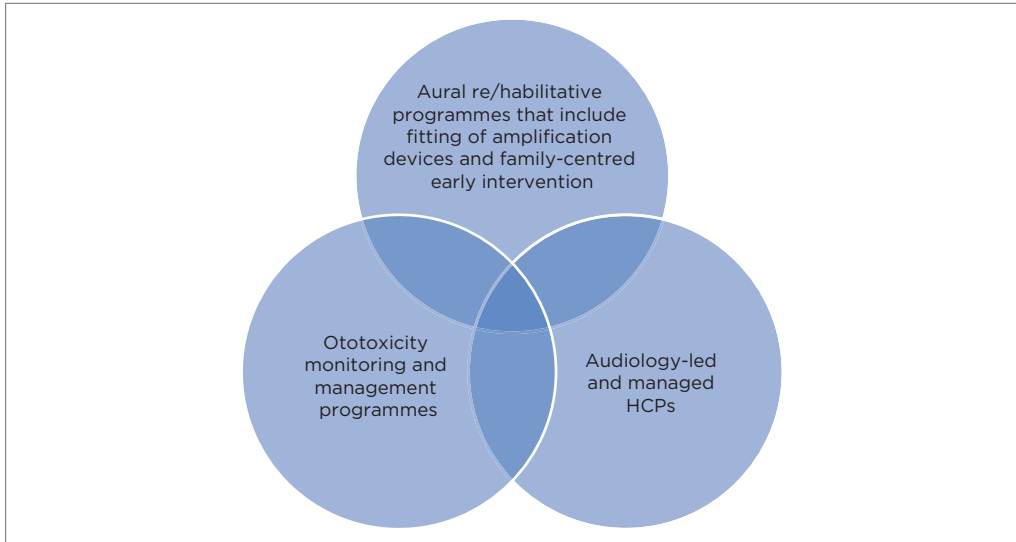


audiology initiatives at this level within the South African context (Khoza-Shangase & Mophosho 2018).

Similarly, at the secondary and tertiary prevention levels, language and culture play a significant role. With secondary prevention focusing on early detection of hearing loss, procedures adopted to detect and halt the development of hearing loss before it presents clinically and progresses to levels that lead to adverse outcomes for the individual affected also require contextual awareness and contextual responsiveness (AFMC 2013; WHO 2020). The measures that allow for earlier diagnosis and treatment of hearing loss require political will and therefore mandating by the government – a requirement that requires buy-in by the end-user (the population receiving the service) (Alegbeleye & Mohammed 2020; Oleribe et al. 2019). If the preventive audiology service delivery does not take careful cognisance of patients' language and culture, challenges with advocacy might arise. Early detection, diagnosis and intervention that occur at this level are important because undiagnosed and untreated hearing loss can lead to academic failure, higher unemployment, poorer general health, social isolation and an increased risk of depression later in life (Arlinger 2003, WHO 2013). Khoza-Shangase (2022a) lists the following as examples of programmes that fall under the secondary level of prevention in preventive audiology: (1) programmes aimed at early detection of hearing impairment and ear diseases or infections, such as NHS programmes, school and community hearing screening programmes, ototoxicity and ONIHL monitoring programmes, or those aimed at prevention of severe hearing loss such as early middle ear disease identification and treatment; and (2) early administration of preventive drug therapies and other interventions of proven effectiveness (e.g. use of otoprotective agents in ototoxicity prevention and use of personal protection devices in ONIHL).

At the tertiary level of preventive audiology, the AFMC (2013) stated that the goal is to provide intervention to decrease the impact or negative outcomes that hearing loss that could not be prevented leads to. This practice has the eventual goal of improving the affected individual's quality of life. Figure 10.2 illustrates these examples of tertiary-level preventive initiatives.

These initiatives have been argued to be best presented within a contextually relevant and responsive model of care, with Khoza-Shangase and Kanji (2021) and Maluleke, Khoza-Shangase and Kanji (2021b) arguing that, within the African context, such interventions need to be culturally and linguistically sensitive and relevant to the context.



Key: HCP, hearing conservation programmes.  
Source: Author's own work.

**FIGURE 10.2:** Examples of tertiary-level preventive initiatives.

## ■ 10.5. Factors influencing the provision of culturally and linguistically appropriate preventive audiology at the various levels of prevention

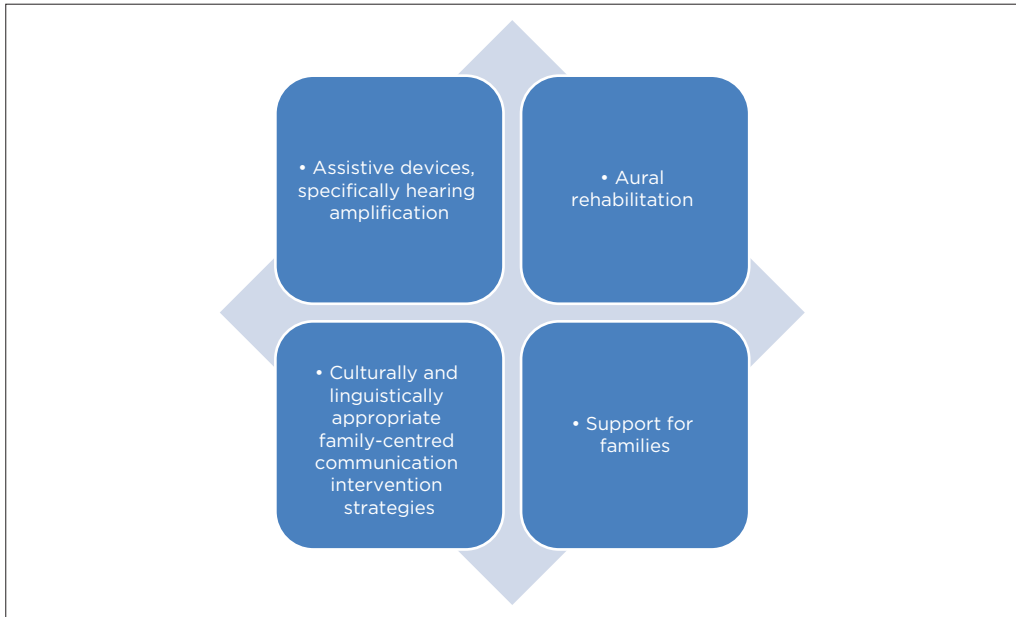
As far as primary prevention is concerned, although the JCIH risk factor registry is frequently updated for infant hearing screening programmes internationally, the programmes reflected in the JCIH may not necessarily be fully applicable for LMICs (Fitzgibbons et al. 2021, p. 91); therefore, context becomes crucial. Khoza-Shangase and Kanji (2021) argued that being context-naïve includes neglect of the influence that language and culture may have on SLH professions, particularly within the South African context where there is a linguistic and cultural mismatch between clinicians and the population being served. As far as risk factors are concerned, for example, risk factor prevalence can vary geographically and may differ between LMICs and high-income countries (HICs) and may change over time because of cultural traditions that may be practised amid particular religious and ethnic groups (Bittles & Blacks 2010). Bener, ElHakeem and Abdulhadi (2005) and Bittles and Blacks (2010) made an example of lineage that is associated with non-syndromic hearing loss, a tradition practised in Western nations wherein cousins or blood relatives marry. Knowledge of such cultural practices and beliefs inform the preventive approach adopted for the prevention programmes to be successful and sustainable.

Olusanya (2008) recommended that the JCIH considers context-specific risks that may not necessarily be applicable to other contexts, especially high-income contexts. Within the South African context, Khoza-Shangase and Kanji (2021) emphasised what Kanji and Khoza-Shangase (2019b) emphasised when they asserted that within the South African context, risk factors for hearing impairment are significantly influenced by the concept of *quadruple influence on risk*. These authors stated that the *quadruple influence on risk* includes human, medical and technological advancements, as well as the burden of disease – factors that influence risk for hearing impairment in the South African context and that are significantly influenced by cultural and linguistic factors. Therefore, any programme purporting to be contextually relevant and responsive should be aware of these influences and cognisant of how planning and implementation of such programmes should consider these.

Ndlovu (2016) argued that the ambivalence of African beliefs, cultures and spiritual beliefs around issues of health and particularly disability can perpetuate self and community stigma and embarrassment and can also result in families withholding crucial information related to their concerns and family history of hearing loss and maternal infections (Graham et al. 2019). The WHO (2010b) emphasised the commitment required in terms of time, energy and skills to implement a successful health promotion and prevention programme or campaign. Such commitment should include epistemological and linguistic access for the population where health promotion and prevention are implemented.

In a public health care sector context that is ravaged by a lack of human, financial, structural and skills resources, running a successful health promotion and prevention may be difficult to achieve. Cultural and linguistic diversity presents additional challenges that require attention within the South African context. The limited CLD SLH professions within the South African context results in an incongruent professional:patient ratio, with over 80% of the South African population not being represented culturally and linguistically in the SLH professions (Khoza-Shangase & Mophosho 2021). As a result, important implications for clinical efficacy and preventive initiatives such as preventive audiology become apparent (Barratt et al. 2012; Khoza-Shangase 2022a; Khoza-Shangase et al. 2017).

Although the gold standard is ideally intervention at the primary and secondary prevention levels, it should be acknowledged that disability cannot always be prevented. It is in such situations that it becomes necessary to implement tertiary prevention, where the emphasis is on (re)habilitative interventions (Moroe & Masuku 2022). Tertiary intervention encompasses strategies that mitigate or reduce the challenges associated with a disability (Kanji 2021; WHO 2010b). Alvarez (2008) recommended the following, as depicted in Figure 10.3, as tertiary intervention strategies in audiology.



Source: Author's own work.

**FIGURE 10.3:** Tertiary intervention strategies in audiology.

Khoza-Shangase and Mophosho (2018), in a viewpoint publication that challenges SLH professions in South Africa to reflect on and confront their academic and clinical inclination regarding African contextual, cultural and linguistic responsiveness, lamented the shortcomings of these professions in providing contextually, culturally and linguistically appropriate SLH services to clients. This is regardless of the fact that the country is almost 30 years post-democracy. Maluleke, Khoza-Shangase and Kanji (2020) and Maluleke et al. (2021a) similarly emphasised these issues when discussing the influence of language and culture on the provision of FCEI in the South African context. Ultimately, the people who feel the brunt of these shortcomings are mostly black South Africans who are from rural and poverty-stricken backgrounds and who mostly access tertiary prevention services from public health care facilities. The aforementioned challenge, along with the current human, financial and structural resource constraints being experienced by a health care system that is buckling under pressure as a result of the COVID-19 (Khoza-Shangase, Moroe & Neille 2021; Mbunge 2020), plays an important role in the provision of culturally and linguistically appropriate tertiary preventive audiology services.

Tertiary preventive audiology services are not available in all health care facilities in South Africa because of the shortage of staff within the public sector, with rural communities being worse hit (Khoza-Shangase et al. 2017; Malakoane et al. 2020). The 'freezing' of health care professional posts in

public hospitals because of the government's budgetary constraints (Manyisa 2016) further impacts on staffing challenges as well as the provision of appropriate SLH services, and the fact that most SLH professionals favour working in private and tertiary hospitals further aggravates the situation (Makhoba & Joseph 2016; Malakoane et al. 2020). The South African Human Rights Commission states that South Africa remains an inequitable society, where socio-economic status still significantly dictates the type and quality of services individuals receive as well as the ability to access these services, irrespective of the degree of need for care, which brings to the fore the relevance of the social determinants of health in such debates, as discussed in Chapter 1.

The implementation of culturally and linguistically appropriate preventive audiology at the tertiary level of preventive audiology is notably affected by the mismatch between language competencies of patients and health care professionals as a result of SLH professions being mostly white females who are only proficient in English or Afrikaans. As of 2020, only 15% of all SLH professionals were black African language speakers (Pillay et al. 2020). Black African patients who speak a language other than English or Afrikaans are disadvantaged when accessing health care services because of the continued use of English as the principal language of consultation in health care settings (Makhoba & Joseph 2016), ultimately infringing on their rights to access health care services in their language, thus negatively influencing autonomy and efficacy (Flood & Rohloff 2018) and, one could also argue, infringement of right to confidentiality. Confidentiality gets infringed because often untrained interpreters are utilised in the provision of services, individuals who do not have to adhere to the ethical standards as dictated by the HPCSA.

Khoza-Shangase and Mophosho (2018) were adamant that most black African language speakers with communication disorders do not receive health care services in their first language. Health care services in general and SLH services in particular are provided in either English or Afrikaans (Mdlalo et al. 2016, 2019; Moonsamy et al. 2017; Pascoe & Norman 2011; Pascoe et al. 2013; Seabi, Seedat & Khoza-Shangase 2014). This is a particularly important challenge when considering that the core of the scope of the professions are language development and language use, which are key aspects of aural rehabilitation. Khoza-Shangase and Mophosho (2018, p. 4) argued that 'actual diagnosis and treatment of language disorders cannot ethically and accurately happen without considerations of language and culture'. This, coupled with the continuous failure of these professions to invest in contextually and culturally relevant resources (Mdlalo et al. 2019; Pascoe 2011), despite the wealth of research and clinical skills available, hinders black South Africans from accessing quality preventive health care services that are culturally and linguistically appropriate.

Within the South African context, languages are not only a symbol of power, in reference to the 'status' English has and the history behind Afrikaans, but also a symbol of culture (Khunou et al. 2019). Therefore, the 'exaltation' of these languages at the expense of other African languages runs the risk of perpetuating stereotypes and beliefs about the South African context, which may have a ripple effect on accounts about linguistic, cultural, health-seeking and health-practising beliefs of black South Africans (Khoza-Shangase & Mophosho 2018). For example, the continued exclusion of black South Africans from participating in research related to audiology on account of their non-fluency in or lack of ability to read English or Afrikaans – the languages of the researchers and or research supervisors – has serious implications for knowledge generation that leads to 'informed', 'evidence-based' practice. Even where 'interpreters' are used in an attempt to be inclusive, the *white gaze* significantly influences such research – and its influence is never questioned (Khunou et al. 2019). The authors of this chapter argue that the *white gaze* currently governs everything in SLH professions in South Africa, where academics, therapists and or researchers who have limited knowledge and understanding of the diverse cultures and language groups of their students, patients and research participants impose their own cultural and linguistic frames of reference onto teaching, clinical service provision and development of research questions, selection of research methods and analysis and interpretation of the findings. All these challenges pose a significant impact on preventive audiology initiatives, as knowledge and practice are intertwined; hence, Khoza-Shangase and Mophosho (2021) called for *re-imagining practice* with epistemological freedom and linguistic access within the South African context.

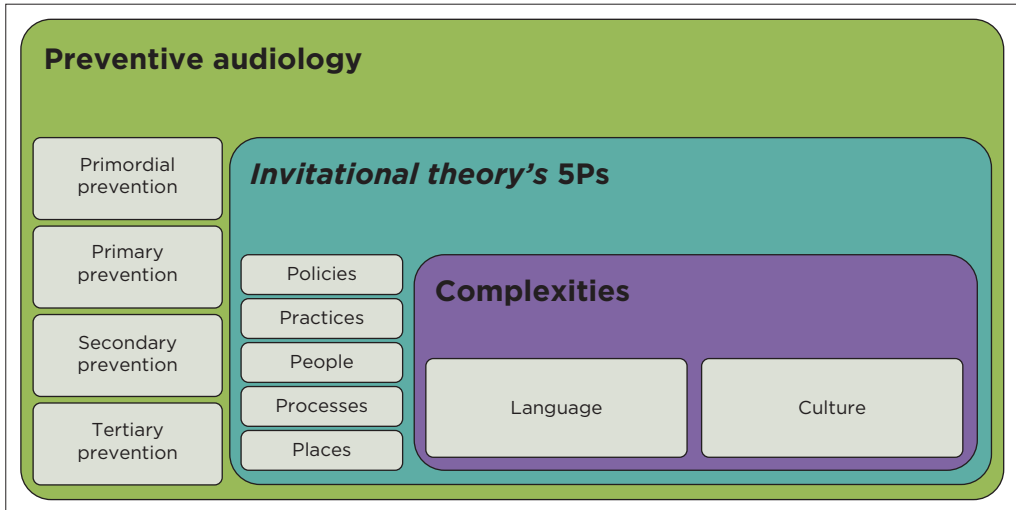
## ■ 10.6. Recommendations

For preventive health care (and thus preventive audiology) to be contextually relevant, taking careful cognisance of CLD in its conceptualisation, planning and implementation, it is imperative that HCWs, including SLH professions, exercise cultural humility (Khoza-Shangase & Mophosho 2021). Health care providers and programmes, including preventive programmes at all WHO-defined prevention levels, must be culturally respectful. When compared to cultural competence, cultural humility is a constant mechanism of self-reflection and self-critique that overtly examines power imbalances between health care service providers and their clients or patients (Miller 2009, p. 92), and this is important for linguistic access and epistemological autonomy (Khunou et al. 2019). This approach ensures that currently widely practised 'solutions' are carefully deliberated and used responsibly only as *interim measures* while permanent sustainable solutions, as recommended by the HPCSA (2019), are developed and or implemented.

One such 'solution', the usage of the interpretation approach, was misinterpreted as a panacea for multilingualism, resulting in further research on interpretation in contexts such as court interpretation, international conferences, Sign Language interpretation and (to a lesser degree) medical interpretation (Langdon & Cheng 2002). Given that CLD has a significant impact on how individuals and clinicians interact cross-culturally and collaborate in health promotion, prevention and treatment programmes (Centeno 2009), the DoH should devote resources to seeking qualified interpreters to support patients and health care providers in government facilities to avoid the current use of untrained interpreters. The NLPF's goals are clearly violated in public health care settings where there are no mediated or interpreter programmes. In South Africa, little research on interpreting in health care settings has been done, particularly in audiology. Studies in this field have examined mediation in various languages and what factors lead to making interpretations easier or more difficult (Levin 2006; Major & Napier 2012; Penn et al. 2010).

The authors of this chapter suggest the use of the *invitational theory* when reflecting on solutions for overcoming CLD challenges in delivering preventive audiology services within the South African context. For preventive audiology to be effective in serving the underserved people of South Africa, an approach should be developed based on invitational education theory that comprises five aspects (5Ps): policies, practices, people, processes and places (Purkey 1999). These five aspects, as depicted in Figure 10.4, have been discussed by Khoza-Shangase and Mophosho (2021) in detail when suggesting re-imagining practice within the South African context via addressing influencing factors within the clinical training curriculum and training platforms in the South African context.

Firstly, as far as *people* as an aspect to consider, South African audiologists, as well as other health care professionals, should be culturally and linguistically in tune with their patients. As the current generation of audiologists does not reflect the country's demographic profile, their linguistic and cultural competence and knowledge of the context are reduced, as is epistemological access to languages and cultures outside of the Western epistemology. Furthermore, in the practice of preventive audiology, evidence of limited preparation and comprehension of African CLD issues, such as cultural humility, cultural values and non-Western help-seeking behaviours, is typically missing (Abrahams et al. 2019; Barratt et al. 2012; Kathard & Pillay 2013; Khoza-Shangase & Mophosho 2018, 2021; Moonsamy et al. 2017; Pillay et al. 1997; Pillay & Kathard 2015). These challenges, if addressed, will facilitate conceptualisation and implementation of preventive audiology initiatives that are contextually relevant.



Source: Author's own work.

**FIGURE 10.4:** Aspects to consider during the implementation of preventive audiology at the different levels of prevention.

When it comes to *places* (the physical environment in which people interact), namely, the current health care context where audiology services are provided (be it in the public or private sector) significant access challenges because of cultural and linguistic barriers exist. Because a majority of the audiologists do not speak the language(s) of the majority of the South African patient population, clinical service provision can be restricted and limited, with or without interpreters – where available, they are often untrained. The paradox persists as a systemic framework in the new South African public health care system, which does not seem to be responsive to citizens' needs. Current trained interpreter resource constraints restrict the context once again. Given that cultural and linguistic complexities have a significant impact on how families and practitioners interact across cultures and engage in treatment programmes, SLH professions should strongly lobby the DoH to increase its focus on improving linguistic access to health care for its citizens through creating formalised trained interpreters' posts, with priority given to professions like SLH professions which actually deal with communication and language disorders. This is in line with the NLPF's goals (Khoza-Shangase & Mophosho 2021). With preventive audiology including key strategies such as FCEI (Maluleke et al. 2021a), such services must allow for mobility should intervention be best delivered at the patient's home and not at the health care centre.

As far as *practices* as an influencing factor are concerned, audiologists need to pay attention to their critical consciousness and raise their awareness of the impact of factors such as power and cultural capital on preventive



audiology practice. Furthermore, the use of culturally and linguistically inappropriate service delivery, including the use of inappropriate assessment and intervention tools, needs to be stopped and regulations put in place to increase the accountability of practitioners. The practice where resources are literally translated without adopting formal protocols and without even considering adaptations and translator abilities has serious implications for the efficacy of preventive audiology strategies and of SLH services as a whole within the South African context. The authors of this chapter argue against using inadequate, inappropriate, untested and non-normed terminology and sentence structures, which are some of the factors that can water down the complexity of the translated content, therefore compromising test validity and reliability. These authors strongly advised that test translations and adaptations be carried out by native speakers of the target language, most preferably from an academic linguistics department, who understand the value of ensuring the test measure's validity and utility, as advised by Khoza-Shangase and Mophosho (2021). Translating and adapting the measure, evaluating the translated version of the instrument, adapting the draft instrument based on reviewer comments, pilot-testing the instrument, field-testing the instrument, standardising the scores and conducting validation research should all be included in the protocols followed (Barratt et al. 2012; Geisinger 1994). This is important not only for assessment tools but for intervention measures as well in preventive audiology.

As far as *processes* (systematic series of actions directed to some end) are concerned, Penn et al. (2009) related SLH professionals' lack of preparedness for a South African health care context to problems with professional and regulatory issues, structural and administrative issues, ethical issues and interpersonal issues. These are because of a few complex causes, one of which is a lack of resources, such as culturally appropriate intervention tools, research and appropriate human resources - all factors which continue to prevail today (Khoza-Shangase & Mophosho 2021).

Finally, in terms of *policies* as an influencing factor, there are major difficulties with implementing existing policies and controlling the implementation of and adherence to the Department of Health's language policy and the Batho Pele (People First) principles, as well as in translating current policies and regulations around CLD in health care into effect (Khoza-Shangase & Mophosho 2021).

## ■ 10.7. Conclusion

Implementation of preventive audiology at the different levels of prevention and paying careful cognisance to the *invitational theory's* 5Ps within health care systems that observe and monitor the WHO building blocks of health care systems can only succeed and be sustainable if the context

is ideal, including the language and culture of the health care system users. This chapter has deliberated on CLD challenges in preventive audiology in South Africa, with recommendations provided around strategic planning around curriculum and clinical practice, research, resources (including human resources) and decolonisation.



# Complexities linked to traditional healing and alternative health care practices and preventive audiology in South Africa

**Dhanashree Pillay**

Department of Audiology, Faculty of Humanities,  
School of Human and Community Development,  
University of the Witwatersrand,  
Johannesburg, South Africa

**Najeebah Moola**

Department of Audiology, Faculty of Humanities,  
School of Human and Community Development,  
University of the Witwatersrand,  
Johannesburg, South Africa

**Tshepang Serooe**

Department of Audiology, Faculty of Humanities,  
School of Human and Community Development,  
University of the Witwatersrand,  
Johannesburg, South Africa

**How to cite:** Pillay, D, Moola, N & Serooe, T 2022, 'Complexities linked to traditional healing and alternative health care practices and preventive audiology in South Africa', eds. K Khoza-Shangase, *Complexities and challenges in preventive audiology: An African perspective*, AOSIS Books, Cape Town, pp. 177-196. <https://doi.org/10.4102/aosis.2022.BK311.11>

## ■ 11.1. Introduction

Audiologists face an array of complexities when practising within the South African context, including their engagement with traditional healing and alternative health care (THAH). A fear of the unknown might limit an audiologist's desire to explore and understand methods that are alternative to the common Western medical models of health care that are taught within a structured environment such as a university. This is where they gain knowledge that is acquired through formal training which is recognised globally as the idealised manner of teaching and learning and is documented as pure science. Audiology training and practice in South Africa still follows a medical model, with a recent emergence of interest towards family-centred and client-centred approaches, which should allow for a shift within audiological service delivery in this context (Maluleke, Khoza-Shangase & Kanji 2021; Pillay & Serooe 2019).

Changes in audiological care are beginning to emerge, with a focus on the medical and psychosocial factors that affect the family and the individual who is diagnosed with a hearing impairment, hence the adoption of a more holistic approach (Pillay & Serooe 2019). The use of holistic approaches within the South African context requires a re-imagining of health care practices with an Afrocentric stance, framed around the Batho Pele (people first) and *ubuntu* (humanity) principles (Khoza-Shangase & Mophosho 2021). The eight Batho Pele principles that are based on the South African Constitution were introduced in 1997 (Khoza & Du Toit 2011) to encourage efficient and effective service provision, with the inclusion of South African citizens as active role-players in policymaking (Nzimakwe & Mpehle 2012).

Complexities in the implementation of such holistic care in audiology occur as the spiritual, psychosocial and humanistic factors are still not fully adopted as mandatory areas of exploration when conducting prevention, assessment and management with persons diagnosed with hearing impairment (Pillay & Moonsamy 2018). Regardless of the lack of published evidence of THAH practices to prevent or restore ear health, these indigenous practices are utilised and even sought after by societies globally (Zhang et al. 2019). 'Medically trained' audiologists may be reluctant to engage with what is termed a 'rudimentary' form of care; however, religion, culture, belief systems and practices of individuals shape the journey taken when a medical need arises. Khoza-Shangase and Mophosho (2018, 2021) argued that health-seeking behaviours are significantly influenced by these factors and that ignorance and or lack of recognition of these factors creates a threat to the survival of the SLH professions in Africa. It is, therefore, important that health care practitioners in Africa take cognisance of THAH practices and how these influence health care practice. The content of this chapter centres on the complexities linked to THAH and preventive audiology within the South African context.

## ■ 11.2. Healing in context

The understanding of multicultural health care practices of preventive options and management methods is imperative within South Africa's diverse society. The objectivity and unbiased practices of the audiologist during the provision of ear-and-hearing health care services in South Africa play a significant role in the rapport and progress made with the individual who is diagnosed with a hearing impairment. Evidence is clear that a successful preventive and management plan for hearing-impaired individuals in South Africa cannot renounce the incorporation of cultural beliefs and practices and customs with respect to THAH methods (Dahlström & Frohm 2010; De Andrade 2011; Pillay & Moonsamy 2018). The limited research that documents experiences of healing, devoid of medical intervention, creates complexities in preventive audiology care within the South African context, hence highlighting the need for the exploration of other methods of health care for individuals with hearing impairment. Acceptance and implementation of an integrative intervention model that considers a holistic view of the individual is likely to go unpractised until there is sufficient trustworthy evidence to support the need for paradigm shifting in the practice of audiology in South Africa (Pillay & Moonsamy 2018).

Boorse (1975) argued that good health or a healthy individual is difficult to define, as all individuals have some form of abnormality, even on a minor level, such as tooth decay. On the contrary, Dubos (1987) best described health as:

The kind of health that males desire most is not necessarily a state in which they experience physical vigour and a sense of well-being, not even one giving them a long life. It is, instead, the condition best suited to reach goals that each individual formulates for himself. (p. 278)

Health care professionals often classify an individual as *healthy* if there is no illness or disease present; however, the World Health Organization (WHO) defines health as 'a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity' (International Health Conference 2002). Prevention, healing and rehabilitation are the focal points of a medical profession, as the restoration or maintenance of good health is the aim. The accomplishment of good health is also the aim of 'folk medicine', which describes any method that contrasts with the medical treatment provided by doctors in a conventional setting (Kirkland 1992), and these methods include traditional healing, religious faith healings and alternative healing (Pillay & Moonsamy 2018).

Science, religion and spirituality have been debated for centuries. In the early 1960s, literature describes that the mixture of the scientific field of medicine and THAH was a dangerous field between theology and medicine, a field that most dared not to explore (Bonser 1963). Arguably, not much has changed in 2021, as very few dare to explore the complexities surrounding THAH within health care and specifically within preventive audiology in South Africa.

There are documented limitations to scientific information, hence the exclusive reliance on science to make sense of humanistic behaviours (Kim 2015). Kim (2015, p. 31) best described this as 'asking Siri on my iPhone to cry for me when I get lost'. Scientific knowledge has a pertinent place in the understanding of the world; however, human behaviour has an equal place. Prevention, assessment and management of illness and disease have traditionally focused on the scientific medical model of prevention, detection and curing a disease, thus facilitating a narrow focus on the physical needs without considering the client holistically (Segal, Gerdes & Seiner 2010). Bramadat, Coward and Stajduhar (2013) argued that health care should operate both in the temporal and the spiritual realms. The spiritual aspect of client care is argued by some researchers to be alternative practices, while others see it as complementary to the temporal management of the client (Blanchette, Imamichi & McLean 2001). More inclusive models of client care are becoming favourable in South Africa as the influence of diversity of clients and health practitioners becomes more evident (De Man et al. 2016; Govender et al. 2018).

Puchalski (2001) asserted that medical care is beginning to reclaim the spiritual roots that were initially a vital aspect of client care, thereby amalgamating the medical aspects as well as the psychosocial aspects of the individual being seen during the consultation. This is supported by Clarke (2013), who highlighted that the sociology of health care and human development is significant when managing clients, as areas such as illness, social changes and health are considered. Healing, spirituality, divine intervention and THAH have been explored in psychology (Miller 2012), psychiatry (Incayawar et al. 2009), dentistry (Ayer 2005) and medicine (Lee et al. 2000); however, there is minimal evidence available on this type of intervention within the field of audiology.

Research indicates that every culture has a history of some form of healing practices (Moses 2011), so it can be assumed that some individuals in South Africa who are diagnosed with a hearing impairment are seeking THAH even though they do not explicitly volunteer this information to the attending audiologist. The authors of this chapter argue that science and spirituality are not isolated entities, and their complex symbiotic relationship is greater than audiologists may wish to acknowledge. The interconnectedness of the supernatural realm in the lives of individuals who are diagnosed with a hearing impairment is the beginning of future contributions of studies that are beginning to emerge. Healing is multidimensional and its effects on the individual's life cannot be calculated. Therefore, this chapter discusses the narratives and lived experiences of the South African populace and the South African audiologist regarding THAH within the field of audiology. A qualitative, multiple study approach is deliberately adopted in this chapter to allow for the evidence to speak for itself in a context where such voices and experiences

tend to get silenced (Khunou et al. 2019) The discussion highlights the complexities linked to THAH and preventive audiology in South Africa.

### ■ 11.3. History of South Africa: Complexities linked to traditional healing and alternative health care being shaped by religion

The concept of healing is changed and modified by the individual's experiences within a specific context (O'Connor 2010). The historical influence of religion is substantial in shaping the current views on and practices of THAH in South Africa. South Africa forms part of the geographical landscape within the continent of Africa. The country is infamous for its unique history of apartheid, which led to political oppression, racism, inequality and chastisement (Maylam 2017) along with suppression of embracing linguistic, cultural and religious diversity (Bornman 2006; Reagan 2001; Ruiters 2009). The commencement of the struggle towards democracy cannot be dated; however, the official demise of apartheid in South Africa began in 1994 with the election of the late former President Nelson Mandela (Coombes 2003).

The years leading up to 1994 saw key events occurring in the country, such as various policy implementations, freedom fights and boycotts that moulded the climate that South Africa finds itself in 2021 (Maylam 2017). It is with this history and context in mind that this chapter needs to be understood. This chapter relates to the field of audiology within the South African health care sector in the 21st century as it delves into the intricacies that shaped the present-day health care sector within a vibrant South Africa. The impact of apartheid includes social injustice and inequality; thus, there was and still remains a need for the transformation of health care in South Africa, particularly in the SLH professions, as training should equip practitioners to work in a diverse environment that is contextually and culturally complex (Moonsamy et al. 2017; Pillay et al. 2020; Pillay & Ramkissoo 2020).

The colourful and difficult history of South Africa and her people is well-documented to show the effects of the Western invasion and colonisation of the South African land and indigenous populace at the time (Coovadia et al. 2009; Maylam 2017). South Africa's history of apartheid, which means *apartness* in Afrikaans (Kothari & Mehta 1984), is complex and multifaceted. The facets that either shaped or were shaped by apartheid include religion, politics, education, liberation, economics and inequality through racial segregation (Bond 2003; Coovadia et al. 2009; Maylam 2017; Price 1986). Despite the major influence of apartheid in South Africa, the authors of this chapter have chosen not to present South Africa's history with subsections that refer to pre- and post-apartheid, as South Africa existed as a country that was full of potential prior to it being 'found' by European settlers in the 1400s. The authors cannot



argue that the English and Dutch literature about South Africa became more prolific since the 1400s, and there are more references to support research findings post-1400. Nevertheless, it must be noted that archaeological findings in South Africa date prehistoric rock illustrations back to 30 000 years BP (before present) (Wendt 1976). We may not be able to understand and reference the knowledge within these rock illustrations for research purposes; however, there is evidence that some form of knowledge sharing had transpired from one generation to the next pre-1400.

The San and Khoi-Khoi inhabited the geographical region of South Africa millennia before the European settlers 'discovered' the country (Smith 1990). These rock illustrations could contain significant information that relates to the prevention and management of health care conditions, hence the possible existence of documented THAH practices before colonisation. Between 1900 and 1989, there was the implementation of a series of legal policies such as the *Land Act 1913*, the *Group Areas and Immorality Acts 1950* and the *Passbook Act 1952* which related to racial and ethnic division and led to key events in segregation, then to apartheid in South Africa (Iheduru 2004; Ratele 2009). The history of South Africa between 1924 and 1994 played a significant role in the formation of the New South African Republic and in turn the health care system of the country at present.

Critics and social analysts in the 1970s and 1980s were unable to understand the South African dynamics at the time, because of the lack of religious inclusion (Enquist 1979). Social scientists paid little attention to religious forces, beliefs and theology when analysing the social forces that shaped South Africa (Gruchy 1986). When delving into the religious history of South Africa, Calvinism and its effects on apartheid is a popular documented belief system (De Gruchy 1986; Du Toit 1985; Gruchy 1986; Moosa 2000; Van Wyk 2016). One sector within Calvinism was pro-change, while another sector appeared to do everything in its power to stop the changes that democracy would bring (Gruchy 1986).

Calvinism is a theological tradition that emphasises the power of God that works in the world, politically, socially and economically (Gruchy 1986). John Calvin was a Christian theologian whose interpretation and teachings of the Bible became a denomination of Christianity after his death. In the 17th century (c. 1917) the Synod of Dort in the Netherlands determined the true marks of Calvinism. The Dutch settlers in the Cape belonged to the Reformed Church of Netherlands, who brought with them the doctrine of election under Calvinism (Gruchy 1986). The Calvinistic doctrine appeared to have undergone many modifications that were based on the changing religious, political and social situations in the world (Leith 2010; Toon 2001). Various forms of Calvinism arose from these modifications; a single principle of Calvinism was used as a foundation for most sects of Calvinism, and thereafter additions

were made that were not originally included in John Calvin's theology. Writers in the 1970s and 1980s indicated that the evolution of Calvinism, in all probability, would not be owned by Calvin as it differed greatly from his original thoughts; for example, he never intended for his theology to become a denomination in Christianity called Calvinism (De Gruchy 1986; Du Toit 1985). Dutch Calvinism was a modified form of the original doctrine, and literature argues that it is not a faithful representation of the novel theology of John Calvin (De Gruchy 1986). The Gereformeerde Kerk was founded in South Africa in the 1860s, and this church sect was faithful to Calvinism, taking theological direction from Abraham Kuyper (1837–1920) for the interpretation of the belief (De Gruchy 1986).

One argument against the roots of Calvinism being the only driving force behind the apartheid belief is the inherent belief within a nation to think that they are on a 'chosen, divinely ordered mission' (Van Wyk 2016). Hence, domination of land and resources, including health care resources, still occurs in the present era. Racial oppression dictated the domination in the past with different variables, leaving a legacy of oppression in South Africa at the present time. The religious influences in South Africa may have shaped the health care service provision in a negative way; however, a positive and more inclusive health care service provision is possible through the understanding and acceptance of diverse healing practices.

Post-apartheid, the South African population became famously known as the 'rainbow nation' (Woods 2000) because of the acknowledgement of an array of culturally, linguistically and racially diverse individuals (Afọlayan 2004; Zuberi et al. 2016) who make up the human landscape of South Africa. Despite the initiatives of empowerment and upward mobility of the previously disadvantaged individuals in South Africa, the country has a long road ahead in terms of attaining true equality and the fair distribution of resources, especially in the health care sector (Ataguba & McIntyre 2012).

The journey from segregated oppression to apartheid, culminating in the current democratic dispensation with freedom, has impacted the service provision in South Africa across all sectors. This journey towards equality continues, with the decolonisation of the systems being confronted (Sisk 2017). The South African apartheid government did not anticipate the eradication of apartheid; therefore, the country's infrastructure capacity was only proportionate to the white race group. Democracy has thus highlighted this lack of infrastructure, with an evident shortage of education facilities, houses, jobs and a struggling health care and economic system, despite the freedom afforded in 2021 (Ganiyu, Fapohunda & Haldenwang 2017; Matshipi, Mulaudzi & Mashau 2017; Otieno & Ochieng 2018).

Access to health care in South Africa has been reported to have improved post-apartheid; however, the increased burden on the public health care

system that was not equipped for the influx of clients has placed many hospitals in a state of crisis (Zihindula et al. 2019; Zihindula, MacGregor & Ross 2018). Poor infrastructure, underfunding and mismanagement are the causes of a burdened health care system in South Africa (Hangulu & Akintola 2017; Maphumulo & Bhengu 2019; Oleribe et al. 2019). Although, arguably, clients have better access to health care, the effectiveness and quality of this health care are under scrutiny in the South African context (Khoza-Shangase 2021; Moonsamy et al. 2017). The South African health care system is plagued by a quadruple burden of disease (WHO 2018) within a growing population, who depend upon a struggling health care system with a lack of sufficient health care professionals for the size of the population requiring health care services (Coovadia et al. 2009; Harris et al. 2011; Khoza-Shangase 2021; Khoza-Shangase & Kanji 2021; Mayosi & Benatar 2014; Pillay et al. 2020; Von Holdt & Murphy 2007). Mayosi and Benatar (2014) lamented on how South Africa is incurring the highest costs to train medical doctors at the greatest loss of investment as the locally trained doctors emigrate. This adds to the capacity versus demand challenges that plague the South African health care system, with the influx of people migrating into South Africa adding to the overburdened health care infrastructure and services (Vearey 2014), particularly the public health care sector.

The reversal of the racist apartheid legislation was the beginning of change towards a more equitable service provision in health care. Mayosi and Benatar (2014) argued that this change to new democratic legislation needed to consider the social determinants that affect health and the practical implementation of the laws within the diverse South African context. A need for a holistic model of health care is evident, as supported in the South African Constitution (Constitution & Devenish 2005). Democracy has afforded equal access to resources; however, there is still a focus on Western medicine that negates the significant influence of cultural health care beliefs, religion and spirituality within the South African context – which translates to physical access and not epistemological access (Khoza-Shangase 2019).

The area of health care, including ear-and-hearing health care within the South African context, is marred by oppressive teachings and practices (Heleta 2018; Khoza-Shangase 2019; Khoza-Shangase & Mophosho 2021). The complexities linked to THAH and preventive audiology go beyond the university classroom where the theory is learned to the clinical practice in all sectors of ear-and-hearing health care service delivery. One needs to interrogate one's beliefs, morals and practices to understand why there is a need for change, a change that can only come from a genuine desire for the inclusion of all individuals in South Africa. Khoza-Shangase and Mophosho (2021) argued for *confronting the dangers of a single story* and *re-imagining practice* in SLH training and service provision within the South African context, and this supports the notion of respecting one's individuality and experiences.

## ■ 11.4. Complexities linked to traditional healing and alternative health care: Global overview with a focus on South Africa

Traditional and alternative health care is an important and often underestimated health resource with many applications, especially in the prevention and management of lifestyle-related chronic diseases, and in meeting the health needs of ageing populations. (Ghebreyesus 2019, p. 5)

For centuries, humanity has utilised natural remedies with ingredients sourced from herbs, plants, minerals and animals to treat and alleviate illnesses (Yuan et al. 2016). Globally, the use of natural remedies for the treatment of illnesses dates to approximately 60 000 years ago (Yuan et al. 2016). In Africa, traditional healing, using natural remedies, is known as the oldest form of healing (Mothibe & Sibanda 2019), with this practice reported to be currently utilised by approximately 80% of the South African population (Oyebode et al. 2016).

Countries such as China, India and Japan were some of the first countries to use medicines derived from plants to treat illness (Yuan et al. 2016). The Western world documented Alexander Fleming's discovery of penicillin in 1928; however, the same Western records show that traditional healers were using the same ingredients that make up a penicillin-type treatment since 1826 (Gaynes 2017). Gaynes (2017) reported that traditional healers used penicillin-type treatments as an antibacterial which assisted victims of war. Additionally, morphine and aspirin's main ingredients also originate from natural substances (Veeresham 2012). Furthermore, *taxus brevifolia* has been used by traditional healers for centuries to cure illnesses and has recently been used in pharmaceutical products to treat ovarian, lung and breast cancer (Veeresham 2012). This evidence clearly illustrates how THAH has been utilising natural ingredients and treatment methods before biomedicine. Traditional healing and alternative health care has been the primary choice for many individuals for centuries, and evidence shows that biomedicine utilised and commercialised the same ingredients and methods (Alves & Rosa 2007; Perroux 2017).

Complexities arise between THAH and medical health care practices, as countries have different policies regarding THAH (Bodeker & Burford 2007). Globally, the development of policies and regulations pertaining to THAH within countries can be broadly grouped under three categories: (1) countries that are developing policies for the integration of THAH into the public health care system, (2) countries that promote and finance THAH and (3) countries in which the recognition and policy processes for THAH have not yet started (Bodeker & Burford 2007). By viewing the way policy is either developed or developing in various countries, the value of THAH may be

better understood (WHO 2012). Holistic health care requires the integration of THAH within the country's biomedical health care system (Pourbohloul & Kiény 2011; WHO 2012).

In South Africa, complexities in the use of THAH stem from oppressive legislation such as the *Witchcraft Suppression Act of 1957* and the amended *Suppression Act of 1970*, which prohibited the use of THAH as the apartheid government claimed that THAH was unscientific and ancient, yielding no benefit for the users (Tugendhaft 2010). Despite the attempt to eradicate THAH, large portions of the South African population continued to use THAH in both rural and urban areas (De Andrade & Ross 2005; Mothibe & Sibanda 2019). Currently, there are developments towards the use of both biomedicine and THAH in mainstream health care (Guma & Mokgoatšana 2020). Post-apartheid, South Africa has been involved in the development of policies and frameworks for THAH and THAH practitioners (Tshehla 2015). In 1994, The White Paper for the Transformation of the Health System in South Africa (1997) was formulated (DoH 1997). The White Paper included the recognition of traditional healers as part of the larger health care system (DoH 1997). Alternative health care practices have been regulated according to the *Allied Health Professions Act 63 of 1982* in South Africa (Allied Health Professions Council of South Africa 2018). Alternative health care professionals are governed by the AHPCSA, to ensure that there is a regulatory system that ensures accountability and adherence to regulations. The framework for traditional healers in South Africa (known as the *Traditional Health Practitioners Act 35*) was enacted in 2004 with the purpose of creating recognition of traditional health care practices and establishing centres of traditional health care, with the inclusion of traditional practice in the health care system. *The South African Traditional Health Practitioners Act* attempted to regulate THAH; however, the Doctors for Life group, representing over a thousand medical professionals in South Africa, objected to the government's plan to legitimise traditional healers (Madomombe 2006). Reasons for the objection included traditional healers not being validated scientifically, patients reportedly experiencing complications because of the use of traditional medicines and the assumption that this law would result in legal controversies and medical complications (Madomombe 2006). The Doctors for Life group urged that all the traditional remedies should be thoroughly researched before being approved (Madomombe 2006). Despite the objection from this group, there are medical professionals who acknowledge that traditional healers are already providing services in many communities regardless of the documented objections (Madomombe 2006).

The DoH estimates that there are approximately 200,000 active traditional healers in South Africa and approximately 80% of the South African population

are accessing traditional and or alternative health care practitioners (Oyebode et al. 2016). These high numbers of people accessing THAH indicate that THAH has the potential to contribute to the South African health care system by providing alternative treatment methods and reducing the strain on biomedical resources and staff (Tugendhaft 2010). Ten years ago, THAH was estimated to contribute to the South African health care system by providing an alternative option to the crisis of HIV and AIDS, malaria and so forth (Health & Democracy 2010). While THAH and biomedicine remained separate entities, practices of THAH continued to contribute knowledge in their fields of expertise, based on an evidence base, and which could be incorporated within the South African biomedical health care system to provide enhanced treatment options (Tugendhaft 2010).

Despite the statistics indicating that THAH health care is important to the South African population, there have been several concerns from the DoH that there is a lack of knowledge of the products used for treatment by THAH practitioners (Gavriilidis & Östergren 2012; Health & Democracy 2010; Mothibe & Sibanda 2019). Medical professionals believe that traditional healers are not transparent about the type of treatment they offer and the substances given to clients during treatment (Gavriilidis & Östergren 2012). Doctors report that clients die because of substances taken from traditional healers (Tugendhaft 2010). In 2002, medical professionals described traditional healers as unapproachable and unwilling to change the negative impacts of their treatment (Peltzer & Khoza 2002). This lack of trust and collaborative spirit remains, with health care practitioners in South Africa reported to still be reluctant to work with THAH (Nemutandani, Hendricks & Mulaudzi 2016). This is contrary to the Department of Health's position that strives to preserve life and encourages regularity of treatment from traditional healers (Gavriilidis & Östergren 2012). The fact that doctors request proof for the efficacy of THAH does not define THAH as irregular and unprofessional (Cloatre 2019). Instead, it can be argued that this request for regularity of THAH indicates the power relations through law, policy and profession.

Traditional healers within the PHC sector should be seen as beneficial for society. In African countries, including South Africa, the complexity surrounding the dialogue for collaboration between traditional healers and medical professionals has changed because of the increasing burden of diseases such as HIV and AIDS (UNAIDS 2006; WHO 2003). Collaboration between the two groups was seen as beneficial in interventions, including in those with TB, where 89% of the patients were able to complete their treatment with the support of traditional healers (UNAIDS 2006; WHO 2007). Evidence suggests that there is increased research into THAH practitioners as well as into the treatments offered by these practitioners (Goodman et al. 2015), as this is a complex area. The challenge of sustainability of this collaboration is linked to



the complex balance in the positive relationship between the traditional healers and the medical professionals. Building a strong relationship between the two groups who serve the same population is ongoing, and research evidence is necessary to show the ultimate benefit for the South African population.

Health and Democracy (2010) reported that there is ongoing research into the benefits of products used by THAH practitioners. The government has put various teams together, such as the MRC and the Council for Scientific and Industrial Research (CSIR), to evaluate various health care practices (Health & Democracy 2010). South African universities have started to transform the curriculum to include African and South African history (Makhanya 2019), which is fundamental for the culture of Africans. The inclusion of THAH into the curriculum indicates a positive shift in health care (Makhanya 2019); however, the extent to which inclusion is being carried out is not known as there is minimal research in this area.

There is a paucity of research into THAH and the mechanisms and experiences of audiologists and individuals who are diagnosed with hearing impairment. The lack of the inclusion of spirituality and religion in health care training and practice is one of the complex contributors to the avoidance of these pertinent aspects in ear-and-hearing health care provision (Best et al. 2016). Presently there is a focus on healthier, more spirit-focused lifestyles, which demand a change in the way health care services are provided, from prevention to intervention (Susta et al. 2019). The lived experiences of individuals in South Africa that have sought and have been impacted by THAH is relevant in understanding the complexities of THAH in preventive audiology, and these are presented in the next section, adopting a qualitative approach.

### ■ 11.4.1. Rehabilitation health care and its links to traditional healing and alternative health care

The authors of this chapter conducted three studies investigating THAH within the South African health care system. Results from these studies are presented as a combined section of findings to illustrate views and perceptions about THAH within the South African context. Pillay and Serooe (2019) explored the perceptions of audiologists regarding traditional healers in South Africa. Two additional studies by Moola and Pillay (2016, 2020) explored the role of hakeems in speech-language pathology and audiology, as well as perceptions, experiences and thoughts of rehabilitation health care professionals in South Africa regarding THAH. A total of 53 rehabilitation health care professionals, four hakeems and 25 Muslim individuals were included in these studies.

Five themes related to the complex links between THAH and the practice of audiology in South Africa were identified in the data obtained from all three

studies, and these include (1) THAH as a substitute to biomedicine, (2) THAH is perceived positively and negatively, (3) rehabilitation health care professionals' perceptions, thoughts and experiences related to THAH within the current health care system in South Africa, (4) training at university and (5) herbal medication or dietary changes for prevention and treatment within the Muslim communities. The following section is a presentation of these themes, with supportive narrative evidence illustrating the themes.

#### □ 11.4.1.1. Theme 1: Traditional healing and alternative health care as a substitute to biomedicine

Participants' responses in this theme highlight that THAH is seen as a replacement for Western medical practices. The responses align with the constant comparison between indigenous knowledge and biomedical Western knowledge:

'Traditional healing is often referred to as using techniques other than Western medicine.' (P36, Rehabilitation professional, 15 December 2020)

'Relates to healing practices that rely on indigenous knowledge and not Western medicine.' (P18, Audiologist, 30 May 2016)

'Non-Western medicine practised by traditional healers such as *inyanga* or *sangoma* in Africa or Chinese medicine, traditional practices passed down through generations.' (P13, Rehabilitation professional, 15 December 2020)

#### □ 11.4.1.2. Theme 2: Traditional healing and alternative health care is perceived positively and negatively

Under this theme, participants' responses highlight the varying opinions of positive and negative thoughts and ideologies about THAH. The responses were equally distributed between positive and negative, thus illustrating the mixed responses to THAH and highlighting the need for constant consideration of different views, perceptions and practices:

'Medical health treatment from uneducated and unregistered people.' (P19, Rehabilitation professional, 15 December 2020)

'Someone providing alternative (often gruesome and medieval) treatment for conditions, be it medical, psychological or social. The treatment does not usually relate directly to the problem and is often more focused on pleasing the ancestors instead of actually providing healing.' (P38, Rehabilitation professional, 15 December 2020)

'It's where African medicine are being use for curing long-term illnesses.' (P44, Rehabilitation professional, 15 December 2020)

Moola and Pillay (2020) revealed that rehabilitation professionals in South Africa have varied opinions on traditional healing and healers, as they documented 66 different types of traditional healing and healers patients reportedly consult, as per Table 11.1. Complexities presented by THAH in



**TABLE 11.1:** Types of traditional healing and alternative health care in the South African context.

<b>Number of types of traditional healing and alternative health care</b>	<b>Type of traditional healing and healers</b>	<b>Number of participants who identified it</b>
1	<i>Sangomas</i>	35
2	Herbal remedies	10
3	Witch doctors (one participant responded with a specific mention of a white witch and one with a specific mention of an African witch doctor. The remaining four just stated witch doctor)	6
4	Priest/pastor	5
5	Faith-based	5
6	<i>iNyanga</i>	5
7	Chinese traditional medicine	4
8	Reiki	4
9	Acupuncturist	3
10	Prayer	3
11	African traditional medicine	4
12	<i>Umthandazi</i>	2
13	<i>Unani Tibb</i> practitioners	2
14	Shaman	2
15	Faith-based healer	2
16	Kinesiologists	2
17	Body talk	2
18	<i>Moulanas</i> (Islamic faith)	2
19	Indian healing faith	2
20	<i>Boererate</i>	2
21	<i>Hakeems</i>	2
22	Chiropractics	2
23	<i>Aafiyah</i> healing	1
24	Medicinal healing with plants	1
25	Hot stones	1
26	<i>Ayurvedi</i>	1
27	Chakra cleansing	1
27	Jesus	1
29	<i>Ixhwele</i>	1
30	Other than Western medicine	1
31	Homeopathy	24
32	Acupuncture	13
33	Chiropractitioner	12
34	Herbal practices	6
35	Aromatherapy	6
36	Reflexology	6
37	Traditional healing	6
38	Chinese medicine	5
39	Naturopath	5
40	Reiki	5
41	Cupping	3
42	Body talk	3
43	Biokinetics	3

Table 11.1 continues on the next page→

**TABLE 11.1 (cont.):** Types of traditional healing and alternative health care in the South African context.

Number of types of traditional healing and alternative health care	Type of traditional healing and healers	Number of participants who identified it
43	Pressure points practitioners	2
44	Yoga	2
45	Faith-based healers	2
46	<i>Ayurvedi</i>	2
47	Meditation	2
48	<i>Unani tibb</i>	2
49	Mystics like psychics	2
50	<i>Ukuthwasa</i> (responding to your ancestral calling)	2
51	Spiritual practices	2
52	Ceremonies	1
53	Mind, body, spirit alternatives	1
54	Organic	1
55	Massage	1
56	<i>Sangoma</i>	1
57	Shaman	1
58	Needling	1
59	Essential oils	1
60	Folklore	1
61	Craniosacral therapy	1
62	Cannabis oil	1
63	<i>Inyanga</i>	1
64	Frequency healing	1
65	Exercise, eating healthy and following doctors attending to health issues and do not know	1
66	<i>Amagqirha</i>	1

Source: Adapted from Moola and Pillay (2020).

preventive audiology can arise because of the array of opinions regarding the types of THAH that exist. These complexities impact the audiological service delivery if one type of THAH is deemed to be more important or relevant than another.

### □ 11.4.1.3. Theme 3: Rehabilitation health care professionals' perceptions, thoughts and experiences related to traditional healing and alternative health care within the current health care system in South Africa

This theme illustrates participants' personal emotions and opinions of THAH that are often related to their own beliefs and understanding. The responses clearly reveal that participants' responses were not shaped by formal education on the topic but instead by their lived experiences:

'I work mostly with children. Often medical treatment is delayed as a client's caregiver will seek traditional healing before standard medical care. This can

lead to late diagnosis, late referrals and impacts the child's later development.' (P3, Rehabilitation professional, 15 December 2020)

'Traditional healers treat individuals that are seen by us too. There has to be an understanding regarding the roles and respect between the two professions. In this way, we are both able to treat and satisfy the individual's health needs. If the individuals are used to traditional healers, but they have a health case in which medical treatment (e.g. surgery, hearing assessment) is required, the traditional healer needs to be able to motivate and encourage the individual to receive necessary treatment. Each profession has to know their roles.' (P53, Rehabilitation professional, 15 December 2020)

'I don't think there should be an integration. I currently don't have all the facts, so I think health care professionals should be made more aware of the different alternative medicines and their benefits, especially to the different practices, so that we might be able to form an equal integration.' (P10, Audiologist, 30 May 2016)

'I don't think it's appropriate to be included in the audiology scope of practice.' (P20, Audiologist, 30 May 2016)

'Yes. I think they play a crucial role in the community and to ignore them is to ignore a cultural practice. Some people need to seek comfort in alternative treatment, and some see success. To each their own.' (P26, Rehabilitation professional, 15 December 2020)

Eleven participants had positive experiences relating to THAH. Eight out of 11 participants use THAH themselves and have found it beneficial. Two out of the 11 participants are trained in alternative health care while also having biomedical degrees:

'Religious healer performed a method called cupping where she made small incisions on my back and placed small suction cups to extract blood to relieve pain on muscles.' (P14, Community member, 30 June 2016)

'I have had clients who have had previous treatments as elaborated, and many have had positive results.' (P6, Rehabilitation professional, 15 December 2020)

Twenty-five participants had negative experiences relating to THAH. Twenty participants reported that their negative experiences were because of clients' interaction and treatment from traditional healing or specifically *sangomas*. Three participants described that the negative experiences were because of ancestral callings and two participants reported negative experiences because of cannabis oil. As such, 20 of the participants' negative experiences describe that *sangomas* had prescribed treatment which impacted their clients severely, which included brain damage, perforated eardrum, miscarriage, rejection of Down syndrome, false hope of treating stroke, seizures, hypoxic brain injury, poisonous substances that cause spasms and disability, refusal of treatment until meeting with the *sangoma*, hospitalisation because of traditional healing 'muti' or herbs and parents believing it was their fault their child had a disability:

'Some of my patients who visited a traditional healer and that received "*muti*" were admitted for seizures and hypoxic brain injuries.' (P11, Rehabilitation professional, 15 December 2020)

‘Seen multiple cases of normal paediatric patients consulting with “traditional healers” who gave them poisonous substances as treatment that left them spastic and disabled afterwards.’ (P19, Rehabilitation professional, 15 December 2020)

Despite the negative aspects that individuals presented, 29 enquired about the clients’ use of THAH during consultations, assessment and treatment processes. Rehabilitation health care professionals in South Africa deemed it vital to query the use of THAH to ensure that holistic care is provided to patients:

‘To ensure that the patient is treated holistically, and that their beliefs and culture are taken into account.’ (P20, Rehabilitation professional, 15 December 2020)

‘Generally, to understand the ethos of the family. It gives an understanding on how the family will comply or not comply to rehab.’ (P8, Rehabilitation professional, 15 December 2020)

On the contrary, there are rehabilitation health care professionals who do not ask their clients about THAH as they deem it as:

‘It is something that is often personal.’ (P1, Rehabilitation professional, 15 December 2020)

‘It is not part of the assessment process.’ (P10, Rehabilitation professional, 15 December 2020)

‘Because that doesn’t affect my intervention with the client. Only if the client reveals such information will I probe.’ (P34, Rehabilitation professional, 15 December 2020)

#### □ 11.4.1.4. Theme 4: Training at university

Forty-six participants reported that they did not have adequate training at university regarding THAH. This theme illustrates the lack of formal training and interrogation of THAH at the higher education level, which, if included, can aid in critical thinking around THAH and health care practices:

‘We were taken on a field trip to see a traditional healer but not much was discussed in terms of it specifically relating to our field.’ (P25, Rehabilitation professional, 15 December 2020)

‘We had no such training.’ (P48, Rehabilitation professional, 15 December 2020)

‘We were never taught about traditional/alternative healing.’ (P19, Rehabilitation professional, 15 December 2020)

#### □ 11.4.1.5. Theme 5: Herbal medication or dietary changes for prevention and treatment within the Muslim communities

The word ‘hakeem’ is derived from the Arabic word *ḥakīm*, meaning wise or learned and hence a physician (Collins Dictionary 2021). In Moola and Pillay’s (2016) study, these traditional healers were found to be willing to refer to audiologists; however, they reported that they did not receive

referrals from audiologists. All Muslim community members who participated in this study stated that they were aware of hakeems in South Africa. Hakeems are seen as individuals who treat ailments using herbal medication or dietary changes within Muslim communities. The main aim of seeking the advice of a hakeem is to determine the root of the problem that the client may be experiencing and thereafter diagnose and treat accordingly. Furthermore, individuals indicated that the purpose of a hakeem is neither spiritual nor counselling but rather providing treatment using herbs and dietary changes. Prevention of illness and disease in audiology is preferred to treatment and management; therefore, hakeems as Muslim traditional healers may play a vital role in prevention within the community. The Muslim community hold hakeems in high esteem, and they deem them as critical in the prevention and diagnosis of illness. Collaborative work with audiologists has potential benefits for preventive audiology and requires careful deliberation by the South African audiology community.

From the aforementioned five themes, it is clear that individuals in these studies had varying perceptions and experiences regarding THAH within the South African context. They describe THAH as a substitute to biomedicine and perceive THAH as either positive or negative. Rehabilitation health care professionals do perceive THAH as an important factor in South Africa; however, they are wary of THAH integration within the traditional health care system because of their scope of practice. Implications relating to the inclusion of THAH at undergraduate training, including some focus on policies relating to THAH, are highlighted.

## ■ 11.4.2. Prevention is better than a cure

‘Prevention is better than a cure’ is a long-standing axiom coined by Desiderius Erasmus, a Dutch philosopher in the 15th century (Royal College of Nursing). The costs involved in prevention programmes create controversy as healthy individuals are the main target group, with their needs being a strong motivation for the long-term benefits of preventive methods. When tackling the prevention of ear-and-hearing illnesses and diseases, there is a need for manpower from various influences to create a multidisciplinary team. Bronfenbrenner (2009) divided these influences into micro-, meso-, exo- and macro-system levels. A holistic prevention model of care in audiology should aim to consider all these aspects that influence the individual. It is crucial to consider the micro-systems, face-to-face encounters of influence, the meso-systems from various settings where these interactions occur, the exo-systems involving the external influence on the individual and the macro-systems which are the cultural beliefs and values of the individual (McLeroy et al. 1988). Human behaviour is shaped and moulded by internal or environmental influences; however, people can self-organise, reflect and regulate their

thoughts and actions on a personal level (Bandura 2001, 2003). Hence, there is a cause-and-effect relationship for every action or event on a personal level in an individual's life. Despite the new developments and influences from the world, everybody has personal benchmarks of values and morals that function as intrinsic regulators for redesigning actions or ideas based on the situation and context (Bandura 1998). The actions of others are role-players in decisions taken, as people very rarely influence their own lives. Hence, with health care and preventive audiology, there are proxy or group agent influencers such as religious leaders, audiologists, therapists, doctors and significant others, and these individuals play a major role in the well-being of the individual. The audiologist plays a significant role in facilitating the inclusion of THAH leaders, such as religious, spiritual, and cultural leaders in prevention programmes. The inclusion of THAH leaders may be beneficial in the early identification of hearing impairment and the prevention of certain acquired hearing losses within the South African context.

## ■ 11.5. Solutions and recommendations

When evaluating and managing a client, professionals (including audiologists) should consider the client's lifestyle, family, vocation, disease or illness, values, spirituality and religious beliefs (Ferrans 1990, 1996) to provide holistic and effective service to the client. Individual differences of values and beliefs will determine how one reacts or responds to situations, while an impairment may have different effects in different people based on individual preferences, values and beliefs (Wilson & Cleary 1995). Religious beliefs and practices are the biggest influences on a person's responses to life events, including how they react to disease and illness (Ellison & Levin 1998). Ellison and Levin (1998) postulated that spirituality is one of the fundamental strengths in personal well-being. Religious and spiritual aspects of a client's life can be freely discussed between the audiologist and the client during narrative sessions of case history taking and feedback sessions, as well as during aural rehabilitation sessions. Narrative medicine can be an effective way to acquire information about all aspects that influence the client's life, aspects that can be utilised to enhance the rehabilitation process, including adherence to treatment (Khoza-Shangase & Mophosho 2018). Caron, cited in Kim (2015) fittingly stated that:

[M]edicine practised with narrative competence will more ably recognise clients and disease, convey knowledge and regard, join humbly with colleagues, and accompany clients and their families through the ordeals of illness. These capacities will lead to more humane, more ethical, and perhaps more effective care. (p. 17)

This chapter illustrates the varying perceptions and experiences in relation to THAH within South African health care, thus opening a door to discussing the inclusion of THAH in health care. Evidence provided in this chapter highlights the lived experiences of the community, Muslim traditional healers,

rehabilitation practitioners and audiologists, providing an initial glimpse into the views, perceptions and practices of THAH within this context, with implications for audiologists in preventive audiology. Collaboration and integration are a favourable suggestion from the traditional healers and audiologists, and despite the differences in views and perspectives, there is a common goal, which is comprehensive person-centred supportive care for the client. With the history of this country and its negative influence on inclusive knowledge systems in both theory and practice, the authors of this chapter invite the readers to deeply interrogate, reflect on and explore their own spiritual, religious and traditional beliefs and how these influence their health-seeking behaviours, so that they may afford their clients with the same opportunities.

## ■ 11.6. Conclusion

The complexities associated with health care practice in South Africa are varied as the country and its people face the consequences of a history of oppression from the apartheid regime. Audiology is one such health care field in South Africa that experiences the effects of linguistic and cultural suppression, as detailed in Chapter 10. Attempts at the inclusion of religious practices and beliefs that are indigenous to South Africa have had negative connotations, which have resulted in the lack of discussion or inclusion of THAH in audiological training and practices in this country. The results from the studies that are presented in this chapter illustrate the diverse experiences, perceptions and thoughts of rehabilitation HCWs, hakeems and Muslim individuals. The diversity and differences require a platform for discussion, as open debates can lead to a better understanding of health care practices in South Africa, which have a significant impact on any preventive or intervention programmes. Health care training and practices are dominated by the medical model of care, and it is time for a shift and overhaul of these practices to a more holistic and inclusive model of care that incorporates the Afrocentric principles of *ubuntu* and Batho Pele.

# References

## Chapter 1

- Abubakar, M, Basiru, S, Oluyemi, J, Abdulateef, R, Atolagbe, E, Adejoke, J, Kadiri K 2018, 'Medical tourism in Nigeria: Challenges and remedies to health care system development', *International Journal of Development and Management Review*, vol. 13, no. 1, pp. 223-238.
- Adeloye, D, David, RA, Olaogun, AA, Auta, A, Adesokan, A, Gadanya, M, Opele, JK, Owagbemi, O & Iseolorunkanmi A 2017, 'Health workforce and governance: The crisis in Nigeria', *Human Resources for Health*, vol. 15, no. 1, pp. 1-8. <https://doi.org/10.1186/s12960-017-0205-4>
- Adua, E, Frimpong, K, Li, X & Wang, W 2017, 'Emerging issues in public health: A perspective on Ghana's health care expenditure, policies and outcomes', *EPMA Journal*, vol. 8, no. 3, pp. 197-206. <https://doi.org/10.1007/s13167-017-0109-3>
- Ahluwalia, SC, Damberg, CL, Silverman, M, Motala, A & Shekelle, PG 2017, 'What defines a high-performing health care delivery system: A systematic review', *The Joint Commission Journal on Quality and Patient Safety*, vol. 43, no. 9, pp. 450-459. <https://doi.org/10.1016/j.jcjq.2017.03.010>
- Avnstorp, MB, Homøe, P, Bjerregaard, P & Jensen, RG 2016, 'Chronic suppurative otitis media, middle ear pathology and corresponding hearing loss in a cohort of Greenlandic children', *International Journal of Pediatric Otorhinolaryngology*, vol. 83, pp. 148-153. <https://doi.org/10.1016/j.ijporl.2016.01.017>
- Azevedo, MJ 2017, 'The state of health system(s) in Africa: Challenges and opportunities', in *Historical perspectives on the state of health and health systems in Africa*, Palgrave Macmillan, Camden, vol. II, pp. 1-73. [https://link.springer.com/chapter/10.1007/978-3-319-32564-4\\_1](https://link.springer.com/chapter/10.1007/978-3-319-32564-4_1)
- Barratt, J, Khoza-Shangase, K & Msimang, K 2012, 'Speech-language assessment in a linguistically diverse setting: Preliminary exploration of the possible impact of informal "solutions" within the South African context', *South African Journal of Communication Disorders*, vol. 59, no. 1, pp. 34-44. <https://doi.org/10.4102/sajcd.v59i1.20>
- Begg, K, Mamdoo, P, Dudley, L, Engelbrecht, J, Andrews, G & Lebeso, L 2018, 'Development of a national strategic framework for a high-quality health system in South Africa', *South African Health Review*, vol. 2018, no. 1, pp. 77-85. <https://hdl.handle.net/10520/EJC-144dab3906>
- Benatar, S 2013, 'The challenges of health disparities in South Africa', *South African Medical Journal*, vol. 103, no. 3, pp. 154-155. <https://doi.org/10.7196/samj.6622>
- Boffa, J, Mhlaba, T, Sulis, G, Moyo, S, Sifumba, Z, Pai, M, Daftary, A 2020, 'COVID-19 and tuberculosis in South Africa: A dangerous combination', *South African Medical Journal*, vol. 110, no. 5, pp. 1-2. <https://doi.org/10.7196/SAMJ.2020.v110i5.14747>
- Britnell, M 2015, 'South Africa: No more false dawns', in M Britnell (ed.), *Search of the perfect health system*, Palgrave Macmillan, Camden, pp. 74-79.
- Central Intelligence Agency 2018, *Africa: South Africa*, viewed 10 January 2020, <<https://www.cia.gov/the-world-factbook/countries/south-africa/>>
- Chisholm, D & Evans, DB 2010, 'Improving health system efficiency as a means of moving towards universal coverage', *World Health Report*, viewed 17 August 2018, <[https://cdn.who.int/media/docs/default-source/health-financing/technical-briefs-background-papers/whr-2010-background-paper-28.pdf](https://cdn.who.int/media/docs/default-source/health-financing/technical-briefs-background-papers/whr-2010-background-paper-28.pdf?sfvrsn=1)>
- Conny, A 2018, 'South African health care system analysis', *Public Health Review*, vol. 1, no. 1, pp. 1-8. <https://pubs.lib.umn.edu/index.php/phr/article/download/1568/1349>
- Coovadia, H, Jewkes, R, Barron, P, Sanders, D & McIntyre, D 2009, 'The health and health system of South Africa: Historical roots of current public health challenges', *The Lancet*, vol. 374, no. 9692, pp. 817-834. [https://doi.org/10.1016/S0140-6736\(09\)60951-X](https://doi.org/10.1016/S0140-6736(09)60951-X)
- Dale, LM, Goudreau, S, Perron, S, Ragettli, MS, Hatzopoulou, M & Smargiassi, A 2015, 'Socioeconomic status and environmental noise exposure in Montreal, Canada', *BMC Public Health*, vol. 15, no. 1, p. 205. <https://doi.org/10.1186/s12889-015-1571-2>



## References

- Daniel, OJ, Adejumo, OA, Soyinka, FO, Oritogun, KS, Jaiyesimi, EO & Ladi-Akinyemi, TW 2017, 'The effect of health sector industrial actions on TB and TB/HIV case finding in Ogun State, Nigeria: Is public-private mix a viable solution?', *Annals of Health Research*, vol. 3, no. 2, pp. 126-131.
- Ding, T, Yan, A & Liu, K 2019, 'What is noise-induced hearing loss?', *British Journal of Hospital Medicine*, vol. 80, no. 9, pp. 525-529. <https://doi.org/10.12968/hmed.2019.80.9.525>
- Dramowski, A, Cotton, MF & Whitelaw, A 2017, 'A framework for preventing health care-associated infection in neonates and children in South Africa', *South African Medical Journal*, vol. 107, no. 3, pp. 192-195. <https://doi.org/10.7196/SAMJ.2017.v107i3.12035>
- Durrani, H 2016, 'Health care and health care systems: Inspiring progress and future prospects', *Mhealth*, vol. 2, a3. <https://doi.org/10.3978/j.issn.2306-9740.2016.01.03>
- Essien, MJ 2018, 'The socio-economic effects of medical unions strikes on the health sector of Akwa Ibom State of Nigeria', *Asian Business Review*, vol. 8, no. 2, pp. 12-90. <https://doi.org/10.18034/abr.v8i2.157>
- Etienne, C, Asamoah-Baah, A & Evans, DB 2010, *Health systems financing: The path to universal coverage*, World Health Organization, viewed 18 April 2018, <<https://apps.who.int/iris/handle/10665/44371>>
- Fenny, AP, Yates, R & Thompson, R 2018, 'Social health insurance schemes in Africa leave out the poor', *International Health*, vol. 10, no. 1, pp. 1-3. <https://doi.org/10.1093/inthealth/ihx046>
- Fraser, SW & Greenhalgh, T 2001, 'Complexity science: Coping with complexity: Educating for capability', *BMJ*, vol. 323, no. 7316, pp. 799-803. <https://doi.org/10.1136/bmj.323.7316.799>
- Govender, M & Paken, J 2015, 'Practices employed by audiologists in the management of adult patients with multidrug-resistant tuberculosis in South Africa', *South African Family Practice*, vol. 57, no. 6, pp. 363-372. <https://doi.org/10.1080/20786190.2015.1085222>
- Greenhalgh, T 2020, 'Bridging the "two cultures" of research and service: Can complexity theory help? Comment on "Experience of health leadership in partnering with university-based researchers in Canada - a call to "re-imagine" "research"', *International Journal of Health Policy and Management*, vol. 9, no. 2, pp. 87-88. <https://doi.org/10.15171/ijhpm.2019.89>
- Greenhalgh, T & Papoutsis, C 2018, 'Studying complexity in health services research: Desperately seeking an overdue paradigm shift', *BMC Medicine*, vol. 16, no. 1, p. 95. <https://doi.org/10.1186/s12916-018-1089-4>
- Guo, JJ, Pandey, S, Doyle, J, Bian, B, Lis, Y & Raisch, DW 2010, 'A review of quantitative risk-benefit methodologies for assessing drug safety and efficacy-report of the ISPOR risk-benefit management working group', *Value in Health: The Journal of the International Society for Pharmacoeconomics and Outcomes Research*, vol. 13, no. 5, 657-666. <https://doi.org/10.1111/j.1524-4733.2010.00725.x>
- Hawe, P, Shiell, A & Riley, T 2009, 'Theorising interventions as events in systems', *American Journal of Community Psychology*, vol. 43, no. 3-4, pp. 267-276. <https://doi.org/10.1007/s10464-009-9229-9>
- Heywood, M 2014, 'The broken thread: Primary health care, social justice and the dignity of the health worker', in *History workshop and Wits political studies department*, WiSER, Johannesburg.
- Joint United Nations Programme on HIV/AIDS (UNAIDS) 2020, *Country factsheets: South Africa, 2019*, viewed 18 October 2021, <<https://www.unaids.org/en/regionscountries/countries/southafrica>>
- Kanji, A & Khoza-Shangase, K 2021, 'A paradigm shift in early hearing detection and intervention in South Africa', eds. K Khoza-Shangase & A Kanji, *Early detection and intervention in audiology: An African perspective*, Wits University Press, Johannesburg, n.p.
- Kannampallil, TG, Schauer, GF, Cohen, T & Patel, VL 2011, 'Considering complexity in health care systems', *Journal of Biomedical Informatics*, vol. 44, no. 6, pp. 943-947. <https://doi.org/10.1016/j.jbi.2011.06.006>
- Keeton, C 2010, 'Bridging the gap in South Africa', *Bulletin of the World Health Organization*, vol. 88, no. 11, pp. 803-804. <https://doi.org/10.2471%2FBLT.10.Q21110>

- Khoza-Shangase, K 2010, 'Is there a need for ototoxicity monitoring in patients with HIV/AIDS?', *African Journal of Pharmacy & Pharmacology*, vol. 4, no. 9, pp. 574–579.
- Khoza-Shangase, K 2017, 'Risk vs. benefit: Who assesses this in the management of patients on ototoxic drugs?', *Journal of Pharmacy and BioAllied Sciences*, vol. 9, no. 3, pp. 171–177. [https://doi.org/10.4103/jpbs.JPBS\\_17\\_17](https://doi.org/10.4103/jpbs.JPBS_17_17)
- Khoza-Shangase, K 2020, 'Speech-language and hearing professions' considerations around national health insurance: Need for paradigm shift?', *HPCSA SLH Newsletter*, pp. 4–8, viewed 26 November 2020, <[https://www.hpcs.co.za/Uploads/SLH/Newsletter/SLH\\_newsletter\\_2020.pdf](https://www.hpcs.co.za/Uploads/SLH/Newsletter/SLH_newsletter_2020.pdf)>
- Khoza-Shangase, K 2021, 'Confronting realities to early hearing detection in South Africa', eds. K Khoza-Shangase & A Kanji, *Early detection and intervention in audiology: An African perspective*, Wits University Press, Johannesburg, pp. 66–88.
- Khoza-Shangase, K 2022, 'Preventive audiology ramping up efforts towards an ear and hearing healthy nation', ed. K Khoza-Shangase, *Preventive audiology: An African perspective*, AOSIS Books, Cape Town.
- Khoza-Shangase, K, Lecheko, L & Ntlhakana, L 2020b, 'The impact of medical interventions for reducing ototoxicity during treatment for multi-drug resistant tuberculosis', *Acta Otorrinolaringologica Espanola*, vol. 71, no. 6, pp. 333–400. <https://doi.org/10.1016/j.otorri.2019.12.003>
- Khoza-Shangase, K & Masondo, N 2021, 'In pursuit of preventive audiology in South Africa: Scoping the context for ototoxicity assessment and management', *Journal of Pharmacy and BioAllied Sciences*, vol. 13, no. 1, p. 46. [https://doi.org/10.4103/jpbs.JPBS\\_334\\_19](https://doi.org/10.4103/jpbs.JPBS_334_19)
- Khoza-Shangase, K & Mophosho, M 2018, 'Language and culture in speech-language and hearing professions in South Africa: The dangers of a single story', *South African Journal of Communication Disorders*, vol. 65, no. 1, a594. <https://doi.org/10.4102/sajcd.v65i1.594>
- Khoza-Shangase, K & Moroe, N 2020, 'South African hearing conservation programmes in the context of tele-audiology: A scoping review', *South African Journal of Communication Disorders*, vol. 67, no. 2, a670. <https://doi.org/10.4102/sajcd.v67i2.670>
- Khoza-Shangase, K, Moroe, N & Edwards, A 2020a, 'Occupational hearing loss in Africa: An interdisciplinary view of the current status', *South African Journal of Communication Disorders*, vol. 67, no. 2, a700. <https://doi.org/10.4102/sajcd.v67i2.700>
- Khoza-Shangase, K, Moroe, N & Neille, J 2021b, 'Speech-language pathology and audiology in South Africa: Clinical training and service in the era of COVID-19', *International Journal of Telerehabilitation*, vol. 13, no. 1, a6376. <https://doi.org/10.5195/ijt.2021.6376>
- Khoza-Shangase, K & Prodromos, M 2021, 'Impact of drug-resistant tuberculosis treatment on hearing function in South African adults: Bedaquiline versus kanamycin', *South African Journal of Communication Disorders*, vol. 68, no. 1, a784. <https://doi.org/10.4102/sajcd.v68i1.784>
- Khoza-Shangase, K & Sebothoma, B 2022, 'Tele-audiology and preventive audiology: A capacity versus demand challenge imperative in South Africa', in K Khoza-Shangase (ed.), *Preventive audiology: An African perspective*, AOSIS Books, Cape Town.
- Khoza-Shangase, K, Sebothoma, B & Moroe, N 2021a, 'Tele-audiology as part of efforts to enhance inclusivity and equality through ICT', eds. S Mphahlele, M Maguvhe & S Moonsamy, *Empowering students and maximising inclusiveness and equality through ICT*, Brill Publishers, Leiden, pp. 223–243.
- Kolo, ES, Salisu, AD, Yaro, AM & Nwaorgu, OGB 2012, 'Sensorineural hearing loss in patients with chronic suppurative otitis media', *Indian Journal of Otolaryngology Head and Neck Surgery*, vol. 64, no. 1, pp. 59–62. <https://doi.org/10.1007/s12070-011-0251-5>
- Laskin, DM 1987, 'Pseudo-specialization: An idea whose time should not have come', *Journal of Oral and Maxillofacial Surgery*, vol. 45, no. 10, p. 833. [https://doi.org/10.1016/0278-2391\(87\)90228-X](https://doi.org/10.1016/0278-2391(87)90228-X)
- Lusk, SL, McCullagh, M, Dickson, VV & Xu, J 2016, 'Position statement: Harmful effects of environmental noise exposures', *Nursing Outlook*, vol. 64, no. 4, pp. 395–396. <https://doi.org/10.1016/j.outlook.2016.06.001>

## References

- Mack, N, Wong, C, McKenna, K, Lemons, A, Odhiambo, J & Agot, K 2015, 'Human resource challenges to integrating HIV pre-exposure prophylaxis (PrEP) into the public health system in Kenya: A qualitative study', *African Journal of Reproductive Health*, vol. 19, no. 1, pp. 54–62.
- Maharaj, B 2004, *Immigration to post-apartheid South Africa*, Global Commission on International Migration, KwaZulu-Natal.
- Mahlathi, P & Dlamini, J 2015, *Minimum data sets for human resources for health and the surgical workforce in South Africa's health system: A rapid analysis of stock and migration*, African Institute of Health and Leadership Development, viewed 07 March 2019, <<http://www.prographic.com/wp-content/uploads/2016/07/0316-south-africa-case-studies-web.pdf>>
- Malakoane, B, Heunis, JC, Chikobvu, P, Kigozi, NG & Kruger, WH 2020, 'Public health system challenges in the free state, South Africa: A situation appraisal to inform health system strengthening', *BMC Health Services Research*, vol. 20, no. 1, p. 58. <https://doi.org/10.1186/s12913-019-4862-y>
- Malherbe, J 2013, 'Counting the cost: The consequences of increased medical malpractice litigation in South Africa', *South African Medical Journal*, vol. 103, no. 2, pp. 83–84, viewed 07 March 2019, <[http://www.scielo.org.za/scielo.php?script=sci\\_arttext&pid=S0256-95742013000200015&lng=en&nrm=iso](http://www.scielo.org.za/scielo.php?script=sci_arttext&pid=S0256-95742013000200015&lng=en&nrm=iso)>
- Maluleke, NP, Khoza-Shangase, K & Kanji, A 2019, 'Communication and school readiness abilities of children with hearing impairment in South Africa: A retrospective review of early intervention preschool records', *South African Journal of Communication Disorders*, vol. 66, no. 1, a604. <https://doi.org/10.4102/sajcd.v66i1.604>
- Maluleke, NP, Khoza-Shangase, K & Kanji, A 2021, 'School readiness and academic achievement of children with hearing impairment: A South African exploratory study', *South African Journal of Childhood Education*, vol. 11, no. 1, a898. <https://doi.org/10.4102/sajce.v11i1.898>
- Maphumulo, WT & Bhengu, BR 2019, 'Challenges of quality improvement in the health care of South Africa post-apartheid: A critical review', *Curationis*, vol. 42, no. 1, a1901. <https://doi.org/10.4102/curationis.v42i1.1901>
- Marais, DL & Petersen, I 2015, 'Health system governance to support integrated mental health care in South Africa: Challenges and opportunities', *International Journal of Mental Health Systems*, vol. 9, no. 1, pp. 1–21. <https://doi.org/10.1186/s13033-015-0004-z>
- Martin, WH, Sobel, J, Griest, SE, Howarth, L & Yongbing, SHI 2006, 'Noise induced hearing loss in children: Preventing the silent epidemic', *Journal of Otology*, vol. 1, no. 1, pp. 11–21. [https://doi.org/10.1016/S1672-2930\(06\)50002-9](https://doi.org/10.1016/S1672-2930(06)50002-9)
- Mayosi, BM & Benatar, SR 2014, 'Health and health care in South Africa – 20 years after Mandela', *New England Journal of Medicine*, vol. 371, no. 14, pp. 1344–1353. <https://doi.org/10.1056/NEJMs1405012>
- Mayosi, BM, Flisher, AJ, Lalloo, UG, Sitas, F, Tollman, SM & Bradshaw, D 2009, 'The burden of non-communicable diseases in South Africa', *The Lancet*, vol. 374, no. 9693, pp. 934–947. [https://doi.org/10.1016/S0140-6736\(09\)61087-4](https://doi.org/10.1016/S0140-6736(09)61087-4)
- Mayosi, BM, Lawn, JE, Van Niekerk, A, Bradshaw, D, Karim, SSA, Coovadia, HM, Lancet South Africa team 2012, 'Health in South Africa: Changes and challenges since 2009', *The Lancet*, vol. 380, no. 9858, pp. 2029–2043. [https://doi.org/10.1016/S0140-6736\(12\)61814-5](https://doi.org/10.1016/S0140-6736(12)61814-5)
- Mbunge, E 2020, 'Effects of COVID-19 in South African health system and society: An explanatory study', *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*, vol. 14, no. 6, pp. 1809–1814. <https://doi.org/10.1016/j.dsx.2020.09.016>
- Moeller, MP 2000, 'Early intervention and language development in children who are deaf and hard of hearing', *Pediatrics*, vol. 106, no. 3, a43. <https://doi.org/10.1542/peds.106.3.e43>
- Mogashoa, MG & Pelsler, GP 2014, 'An analysis of the implementation of the national core standards in public hospitals', *African Insight*, vol. 44, pp. 142–147.
- Mokoele, MS 2012, 'The impact of the undocumented immigrants on the provision of housing, job opportunities and health facilities in Limpopo province: A case study of Polokwane Municipality', Master's Degree, University of Limpopo, Polokwane.

- Moroe, N, Khoza-Shangase, K, Kanji, A & Ntlhakana, L 2018, 'The management of occupational noise-induced hearing loss in the mining sector in Africa: A systematic review - 1994 to 2016', *Noise & Vibration Worldwide*, vol. 49, no. 5, pp. 181-190. <https://doi.org/10.1177/0957456518781860>
- Moroe, NF 2020, 'Occupational noise-induced hearing loss in South African large-scale mines: Exploring hearing conservation programmes as complex interventions embedded in a realist approach', *International Journal of Occupational Safety and Ergonomics*, vol. 26, no. 4, pp. 753-761. <https://doi.org/10.1080/10803548.2018.1498183>
- Moyakhe, NP 2014, 'Quality health care: An attainable goal for all South Africans', *South African Journal of Black Leadership*, vol. 7, pp. 80-83. <https://doi.org/10.7196/sajbl.355>
- Naidoo, S 2012, 'The South African national health insurance: A revolution in health-care delivery!', *Journal of Public Health*, vol. 34, no. 1, pp.149-150. <https://doi.org/10.1093/pubmed/fds008>
- Department of Health (DoH) 2013, *Annual performance plan 2013/14 to 2015/16*, DoH, Pretoria.
- Department of Health (DoH) 2014, *Department of health strategic plan 2014/15-2018/19*, Health e-News, Pretoria, viewed 07 July 2017, <<https://www.health-e.org.za/2014/09/25/report-department-health-strategic-plan-201415-201819/>>
- Naudé, A & Bornman, J 2021, 'Ethical considerations and tele-audiology in early hearing detection and intervention', eds. K Khoza-Shangase & A Kanji, *Early detection and intervention in audiology: An African perspective*, Wits University Press, Johannesburg.
- Ngomane, TS 2010, 'The socio-economic impact of migration in South Africa: A case study of illegal Zimbabweans in Polokwane municipality in the Limpopo province', Doctoral dissertation, University of Limpopo.
- Nieman, CL, Reed, NS & Lin, FR 2018, 'Otolaryngology for the internist: Hearing loss', *The Medical Clinics of North America*, vol. 102, no. 6, pp. 977-992. <https://doi.org/10.1016/j.mcna.2018.06.013>
- Ntlhakana, L, Khoza-Shangase, K & Nelson, G 2020a, 'Occupational noise-induced hearing loss in platinum miners: What do the data tell us?', *Occupational Health Southern Africa*, vol. 26, no. 1, pp. 8-14. <https://doi.org/10.4102/sajcd.v67i2.677>
- Ntlhakana, L, Nelson, G & Khoza-Shangase, K 2020b, 'Estimating miners at risk for occupational noise-induced hearing loss: A review of data from a South African platinum mine', *South African Journal of Communication Disorders*, vol. 67, no. 2, a677. <https://doi.org/10.4102/sajcd.v67i2.677>
- Nyasulu, J & Pandya, H 2020, 'The effects of coronavirus disease 2019 pandemic on the South African health system: A call to maintain essential health services', *African Journal of Primary Health Care & Family Medicine*, vol. 12, no. 1, a2480. <https://doi.org/10.4102/phcfm.v12i1.2480>
- Oleribe, OO, Ezieme, IP, Oladipo, O, Akinola, EP, Udofia, D & Taylor-Robinson, SD 2016, 'Industrial action by health care workers in Nigeria in 2013-2015: An inquiry into causes, consequences and control - a cross-sectional descriptive study', *Human Resources for Health*, vol. 14, no. 1, pp. 1-10. <https://doi.org/10.1186/s12960-016-0142-7>
- Oleribe, OO, Momoh, J, Uzochukwu, BS, Mbofana, F, Adebisi, A, Barbera, T, Williams, R & Taylor-Robinson, SD 2019, 'Identifying key challenges facing health care systems in Africa and potential solutions', *International Journal of General Medicine*, vol. 12, a395. <https://doi.org/10.2147/IJGM.S223882>
- Oleribe, OO, Udofia, D, Oladipo, O, Ishola, TA & Taylor-Robinson, SD 2018, 'Health care workers' industrial action in Nigeria: A cross-sectional survey of Nigerian physicians', *Human Resources for Health*, vol. 16, no. 1, pp. 1-10. <https://doi.org/10.1186/s12960-018-0322-8>
- Olusanya, B 2005, 'Can the world's infants with hearing loss wait?', *International Journal of Pediatric Otorhinolaryngology*, vol. 69, pp. 735-738. <https://doi.org/10.1016/j.ijporl.2005.03.024>
- Olusanya, B & Newton, V 2007, 'Global burden of childhood hearing impairment and disease control priorities for developing countries', *The Lancet*, vol. 369, pp. 1314-1317. DOI 10.1016/S0140-6736(07)60602-3

## References

- Orenyi, MD, Paul, AO & Joseph, O 2018, 'Assessment of effect of labour strikes on access to service delivery in secondary health institutions in Cross River State, Nigeria', *Assessment*, vol. 6, no. 2, viewed 10 March 2019, <[https://www.texilajournal.com/thumbs/article/Public\\_Health\\_Vol6\\_Issue2\\_Article\\_11.pdf](https://www.texilajournal.com/thumbs/article/Public_Health_Vol6_Issue2_Article_11.pdf)>
- Paken, J, Govender, CD, Pillay, M & Sewram, V 2016, 'Cisplatin-associated ototoxicity: A review for the health professional', *Journal of Toxicology*, vol. 2016, a1809394. <https://doi.org/10.1155/2016/1809394>
- Perneger, TV 2005, 'The Swiss cheese model of safety incidents: Are there holes in the metaphor?', *BMC Health Services Research*, vol. 5, no. 1, pp. 1–7. <https://doi.org/10.1186/1472-6963-5-71>
- Petersen, I, Marais, D, Abdulmalik, J, Ahuja, S, Alem, A, Chisholm, D, Egbe, C, Gureje, O, Hanlon, C, Lund, C, Shidhaye, R, Jordans, M, Kigozi, F, Mugisha, J, Upadhaya, N & Thornicroft, G 2017, 'Strengthening mental health system governance in six low-and middle-income countries in Africa and South Asia: Challenges, needs and potential strategies', *Health Policy and Planning*, vol. 32, no. 5, pp. 699–709. <https://doi.org/10.1093/heapol/czx014>
- Pillay-Van Wyk, V, Msemburi, W, Laubscher, R, Dorrington, RE, Groenewald, P, Glass, T, Nojilana, B, Joubert, JD, Matzopoulos, R, Prinsloo, M, Nannan, N, Gwebushe, N, Vos, T, Somdyala, N, Sithole, N, Neethling, I, Nicol, E, Rossouw, A & Bradshaw D 2016, 'Mortality trends and differentials in South Africa from 1997 to 2012: Second national burden of disease study', *The Lancet Global Health*, vol. 4, no. 9, pp. 642–653. [https://doi.org/10.1016/S2214-109X\(16\)30113-9](https://doi.org/10.1016/S2214-109X(16)30113-9)
- Plsek, PE & Greenhalgh, T 2001, 'The challenge of complexity in health care', *BMJ*, vol. 323, no. 7313, pp. 625–628. <https://doi.org/10.1136/bmj.323.7313.625>
- Plsek, PE & Wilson, T 2001, 'Complexity, leadership, and management in health care organizations', *BMJ*, vol. 323, no. 7315, pp. 746–749. <https://doi.org/10.1136/bmj.323.7315.746>
- Reason, J 1990, *Human error*, Cambridge University Press, Cambridge.
- Reason, J 1995, 'Understanding adverse events: Human factors', *BMJ Quality & Safety*, vol. 4, no. 2, pp. 80–89. <https://doi.org/10.1136/qshc.4.2.80>
- Reason, J 2000, 'Human error: Models and management', *BMJ*, vol. 320, no. 7237, pp. 768–770.
- Reason, J 2016, *Managing the risks of organizational accidents*, Routledge, London.
- Reason, JT, Carthey, J & De Leval, MR 2001, 'Diagnosing “vulnerable system syndrome”: An essential prerequisite to effective risk management', *BMJ Quality & Safety*, vol. 10, no. suppl\_2, pp. 21–25. <https://doi.org/10.1136/qhc.0100021>
- Reed, JE, Howe, C, Doyle, C & Bell, D 2018, 'Simple rules for evidence translation in complex systems: A qualitative study', *BMC Medicine*, vol. 16, no. 1, pp. 1–20. <https://doi.org/10.1186/s12916-018-1076-9>
- Republic of South Africa (RSA) 2019, *National Health Insurance Bill*, viewed 10 March 2020, <[https://www.gov.za/sites/default/files/gcis\\_document/201908/national-health-insurance-bill-b-11-2019.pdf](https://www.gov.za/sites/default/files/gcis_document/201908/national-health-insurance-bill-b-11-2019.pdf)>
- Romdhane, HB, Tlili, F, Skhiri, A, Zaman, S & Phillimore, P 2015, 'Health system challenges of NCDs in Tunisia', *International Journal of Public Health*, vol. 60, no. 1, pp. 39–46. <https://doi.org/10.1007/s00038-014-0616-0>
- Rossetti, L 2004, *Communication intervention: Birth to three*, 2nd edn., Thomson Learning.
- Rouse, WB & Serban, N 2014, *Understanding and managing the complexity of health care*, MIT Press, Cambridge.
- Ruiters, G & Van Niekerk, R 2012, *Universal health in Southern Africa: Health sector reform in South Africa and Zimbabwe*, UKZN Press, Scottsville.
- Sebothoma, B & Khoza-Shangase, K 2020, 'Middle ear pathologies in adults living with human immunodeficiency virus: A systematic review', *Annals of Otolaryngology, Rhinology & Laryngology*, vol. 129, no. 8, pp. 821–828. <https://doi.org/10.1177/0003489420909847>
- Sebothoma, B & Khoza-Shangase, K 2022, 'Preventing middle ear pathologies in the South African context: A proposed programmatic approach', ed. K Khoza-Shangase, *Preventive audiology: An African perspective*, AOSIS Books, Cape Town, pp. 93–109. <https://doi.org/10.4102/aosis.2022.BK209.05>



- Sebothoma, B, Khoza-Shangase, K, Masege, D & Mol, D 2021a, 'The use of tele practice in assessment of middle ear function in adults living with HIV during the COVID-19 pandemic', *Indian Journal of Otolaryngology and Head & Neck Surgery*, vol. 2021, pp. 1-8. <https://doi.org/10.1007/s12070-021-02836-x>
- Sebothoma, B, Khoza-Shangase, K, Mol, D & Masege, D 2021b, 'The sensitivity and specificity of wideband absorbance measure in identifying pathologic middle ears in adults living with HIV', *South African Journal of Communication Disorders*, vol. 68, no. 1, a820. <https://doi.org/10.4102/sajcd.v68i1.820>
- Sharma, N, Jaiswal, AA, Banerjee, PK & Garg, AK 2015, 'Complications of chronic suppurative otitis media and their management: A single institution 12 years' experience', *Indian Journal of Otolaryngology and Head Neck Surgery*, vol. 67, no. 4, pp. 353-360. <https://doi.org/10.1007/s12070-015-0836-5>
- Shiell, A, Hawe, P & Gold, L 2008, 'Complex interventions or complex systems? Implications for health economic evaluation', *BMJ*, vol. 336, no. 7656, pp. 1281-1283. <https://doi.org/10.1136/bmj.39569.510521.AD>
- Siddle, AM 2011, 'Decentralisation in South African local government: A critical evaluation', Doctoral thesis, University of Cape Town.
- Stuckler, D, Basu, S & Mckee, M 2011, 'Health care capacity and allocations among South Africa's provinces: Infrastructure-inequality traps after the end of Apartheid', *American Journal of Public Health*, vol. 101, pp. 165-172. <https://doi.org/10.2105/AJPH.2009.184895>
- Tsintis, P & La Mache, E 2004, 'CIOMS and ICH initiatives in pharmacovigilance and risk management: Overview and implications', *Drug Safety*, vol. 27, no. 8, pp. 509-517. <https://doi.org/10.2165/00002018-200427080-00004>
- Uzochukwu, BSC, Ughasoro, MD, Etiaba, E, Okwuosa, C, Envuladu, E & Onwujekwe, OE 2015, 'Health care financing in Nigeria: Implications for achieving universal health coverage', *Nigerian Journal of Clinical Practice*, vol. 18, no. 4, pp. 437-444. <https://doi.org/10.4103/1119-3077.154196>
- Van Rensburg, HCJ & Engelbrecht, MC 2012, 'Transformation of the South African health system post-1994', *Health and health care in South Africa*, vol. 2, pp. 121-188.
- Villa, PC & Zanchetta, S 2014, 'Auditory temporal abilities in children with history of recurrent otitis media in the first years of life and persistent in preschool and school ages', *CoDAS*, vol. 26, no. 6, pp. 494-502. <https://doi.org/10.1590/2317-1782/20142014008>
- Wilson, T, Holt, T & Greenhalgh, T 2001, 'Complexity and clinical care', *BMJ*, vol. 323, no. 7314, pp. 685-688. <https://doi.org/10.1136/bmj.323.7314.685>
- World Health Organization (WHO) 2000, *The world health report 2000 - health systems: Improving performance*, Geneva, viewed 15 August 2018, <<https://apps.who.int/iris/handle/10665/42281>>
- World Health Organization (WHO) 2007, *Everybody's business: Strengthening health systems to improve health outcomes, WHO's framework for action*, World Health Organization, Geneva, viewed 15 August 2018, <<https://apps.who.int/iris/handle/10665/43918>>
- World Health Organization (WHO) 2010, *Monitoring the building blocks of health systems: A handbook of indicators and their measurement strategies*, World Health Organization, viewed 15 August 2018, <<https://apps.who.int/iris/handle/10665/258734>>
- World Health Organization (WHO) 2012, *Systems and the effect of complexity on patient care: Summary*, viewed 15 August 2018, <[https://cdn.who.int/media/docs/default-source/integrated-health-services-\(ihs\)/psf/curriculum-guide/resources/ps-curr-handouts/course03\\_handout\\_systems-and-the-effect-of-complexity-on-patient-care.pdf?sfvrsn=87957996\\_9](https://cdn.who.int/media/docs/default-source/integrated-health-services-(ihs)/psf/curriculum-guide/resources/ps-curr-handouts/course03_handout_systems-and-the-effect-of-complexity-on-patient-care.pdf?sfvrsn=87957996_9)>
- World Health Organization (WHO) 2018a, *Prevention of blindness and deafness*, viewed 10 March 2019, <<http://www.emro.who.int/entity/blindness/index.html>>
- World Health Organization (WHO) 2018b, *Addressing the rising prevalence of hearing loss*, viewed 30 March 2020, <<https://apps.who.int/iris/bitstream/handle/10665/260336/9789241550260-eng.pdf>>
- Yoshinaga-Itano, C 2004, 'Levels of evidence: Universal newborn hearing screening (UNHS) and early hearing detection and intervention systems (EHDI)', *Journal of Communication Disorders*, vol. 37, pp. 451-465. <https://doi.org/10.1016/j.jcomdis.2004.04.008>

## Chapter 2

- Alam, S, Satterfield, A, Mason, CA & Deng, X 2016, 'Progress in standardization of reporting and analysis of data from early hearing detection and intervention (EHDI) programs', *Journal of Early Hearing Detection and Intervention*, vol. 1, no. 2, pp. 2-7.
- Ataguba, JE, Akazili, J & McIntyre, D 2011, 'Socioeconomic-related health inequality in South Africa: Evidence from general household surveys', *International Journal for Equity in Health*, vol. 10, no. 1, pp. 1-10. <https://doi.org/10.1186/1475-9276-10-48>
- Ataguba, JEO & Alaba, O 2012, 'Explaining health inequalities in South Africa: A political economy perspective', *Development Southern Africa*, vol. 29, no. 5, pp. 756-764. <https://doi.org/10.1080/0376835X.2012.730962>
- Aurélio, FS & Tochetto, TM 2010, 'Newborn hearing screening: Experiences of different countries', *International Archives of Otorhinolaryngology*, vol. 14, no. 3, pp. 355-363. <https://doi.org/10.1590/S1809-48722010000300014>
- Bezuidenhout, JK, Khoza-Shangase, K, De Maayer, T & Strehlau, R 2018, 'Universal newborn hearing screening in public healthcare in South Africa: Challenges to implementation', *South African Journal of Child Health*, vol. 12, no. 4, pp. 159-163. <https://doi.org/10.7196/SAJCH.2018.v12i4.1522>
- Bezuidenhout, JK, Khoza-Shangase, K, De Maayer, T & Strehlau, R 2021, 'Outcomes of newborn hearing screening at an academic secondary level hospital in Johannesburg, South Africa', *South African Journal of Communication Disorders*, vol. 68, no. 1, a741. <https://doi.org/10.4102/sajcd.v68i1.741>
- Bhutani, VK, Zipursky, A, Blencowe, H, Khanna, R, Sgro, M, Ebbesen, F, Bell, J, Mori, R, Slusher, TM, Fahmy, N, Paul, VK, Du, L, Okolo, AA, De Almeida, M-F, Olusanya, BO, Kumar, P, Cousens, S & Lawn, JE 2013, 'Neonatal hyperbilirubinemia and Rhesus disease of the newborn: Incidence and impairment estimates for 2010 at regional and global levels', *Pediatric Research*, vol. 74, no. 1, pp. 86-100. <https://doi.org/10.1038/pr.2013.208>
- Bush, ML, Bianchi, K, Lester, C, Shinn, JB, Gal, TJ, Fardo, DW & Schoenberg, N 2014, 'Delays in diagnosis of congenital hearing loss in rural children', *The Journal of Pediatrics*, vol. 164, no. 2, pp. 393-397.
- Byford, J & Veenstra, N 2004, 'The importance of cultural factors in the planning of rehabilitation services in a remote area of Papua New Guinea', *Disability and Rehabilitation*, vol. 26, no. 3, pp. 166-175. <https://doi.org/10.1080/0963828032000159167>
- Campbell, W & Hyde, M 2010, 'eEHDI: functions and challenges', in *Proceedings from a Sound Foundation through Early Amplification, International Pediatric Audiology Conference*, viewed 18 October 2020, <[https://www.phonakpro.com/content/dam/phonakpro/gc\\_hq/en/events/2010/pediatric\\_audiology\\_conference\\_chicago/Pho\\_Chap\\_06\\_Campbell\\_final.pdf](https://www.phonakpro.com/content/dam/phonakpro/gc_hq/en/events/2010/pediatric_audiology_conference_chicago/Pho_Chap_06_Campbell_final.pdf)>
- Carter, L, Hudyma, S & Horrigan, J 2010, 'Investigating the educational needs of nurses in telepractice: A descriptive exploratory study', *Canadian Journal of University Continuing Education*, vol. 36, no. 1, pp. 1-20. <https://doi.org/10.21225/D5RP4B>
- Casoojee, A, Kanji, A & Khoza-Shangase, K 2021, 'Therapeutic approaches to early intervention in audiology: A systematic review', *International Journal of Pediatric Otorhinolaryngology*, vol. 150, a110918. <https://doi.org/10.1016/j.ijporl.2021.110918>
- Ching, TY, Dillon, H, Marnane, V, Hou, S, Day, J, Seeto, M, Crowe, K, Street, L, Thomson, J, Van Bunyder, P, Zhang, V, Wong, A, Burns, L, Flynn, C, Cupples, L, Cowan, RSC, Leigh, G, Sjahalam-King, J & Yeh, A 2013, 'Outcomes of early- and late-identified children at 3 years of age: Findings from a prospective population-based study', *Ear and Hearing*, vol. 34, no. 5, a535. <https://doi.org/10.1097/AUD.0b013e3182857718>
- Chundu, S, Manchaiah, VK, Stephens, D & Kumar, N 2013, 'Parental reported benefits and shortcomings of cochlear implantation: Pilot study findings from Southeast Asia', *Cochlear Implants International*, vol. 14, no. 1, pp. 22-27. <https://doi.org/10.1179/1754762811Y.0000000036>
- De Andrade, V & Ross, E 2005, 'Beliefs and practices of black South African traditional healers regarding hearing impairment: Creencias y prácticas de los curanderos Negros sudafricanos en torno a la hipoacusia', *International Journal of Audiology*, vol. 44, no. 9, pp. 489-499. <https://doi.org/10.1080/14992020500188999>

- Deng, X, Finitzo, T & Aryal, S 2018, 'Measuring early hearing detection and intervention (EHDI) quality across the continuum of care', *eGEMs*, vol. 6, no. 1, a239. <https://doi.org/10.5334/egems.239>
- Deng, X, Gaffney, M & Grosse, SD 2020, 'Early hearing detection and intervention in the United States: Achievements and challenges in the 21st century', *China CDC Weekly*, vol. 2, no. 21, a97. <https://doi.org/10.46234/ccdcw2020.097>
- Department of Social Development 2006, *Guidelines for early childhood development*, viewed 18 October 2020, <[https://www.gov.za/sites/default/files/gcis\\_document/201409/childhooddev0.pdf](https://www.gov.za/sites/default/files/gcis_document/201409/childhooddev0.pdf)>
- Dilip, S, Narayanan, A & Roshni, PR 2020, 'Need for screening and early hearing detection and intervention system (EHDI) in a neonatal ICU setup', *Research Journal of Pharmacy and Technology*, vol. 13, no. 4, pp. 2000-2004. <https://doi.org/10.5958/0974-360X.2020.00360.1>
- Edirippulige, S, Armfield, NR & Smith, AC 2012, 'A qualitative study of the careers and professional practices of graduates from an e-health postgraduate programme', *Journal of Telemedicine and Telecare*, vol. 18, no. 8, pp. 455-459. <https://doi.org/10.1258/jtt.2012.gth107>
- Ehlert, K & Coetzer, C 2020, 'Maternal knowledge and views regarding early hearing detection and intervention in children aged 0-5 years at a semi-urban primary care clinic in South Africa', *South African Journal of Communication Disorders*, vol. 67, no. 1, a681. <https://doi.org/10.4102/sajcd.v67i1.681>
- Fitzgibbons, J, Beswick, R & Driscoll, CJ 2021, 'Contextualisation of risk factors for hearing impairment', eds. K Khoza-Shangase & A Kanji, *Early detection and intervention in audiology: An African perspective*, Wits University Press, Johannesburg.
- Fitzpatrick, E, Durieux-Smith, A, Eriks-Brophy, A, Olds, J & Gaines, R 2007, 'The impact of newborn hearing screening on communication development', *Journal of Medical Screening*, vol. 14, no. 3, pp. 123-131. <https://doi.org/10.1258/096914107782066248>
- Govender, SM & Mars, M 2018, 'The perspectives of South African academics within the disciplines of health sciences regarding telehealth and its potential inclusion in student training', *African Journal of Health Professions Education*, vol. 10, no. 1, pp. 38-43. <https://doi.org/10.7196/AJHPE.2018.v10i1.957>
- Greenhalgh, T & Papoutsis, C 2018, 'Studying complexity in health services research: Desperately seeking an overdue paradigm shift', *BMC Medicine*, vol. 16, a95. <https://doi.org/10.1186/s12916-018-1089-4>
- Grogan-Johnson, S, Meehan, R, McCormick, K & Miller, N 2015, 'Results of a national survey of preservice telepractice training in graduate speech-language pathology and audiology programs', *Contemporary Issues in Communication Science and Disorders*, vol. 42, Spring, pp. 122-137. [https://doi.org/10.1044/cicsd\\_42\\_S\\_122](https://doi.org/10.1044/cicsd_42_S_122)
- Grol, R & Grimshaw, J 2003, 'From best evidence to best practice: Effective implementation of change in patients' care', *The Lancet*, vol. 362, no. 9391, pp. 1225-1230. [https://doi.org/10.1016/S0140-6736\(03\)14546-1](https://doi.org/10.1016/S0140-6736(03)14546-1)
- Grosse, SD, Riehle-Colarusso, T, Gaffney, M, Mason, CA, Shapira, SK, Sontag, MK, Van Naarden Braun, K & Iskander, J 2017, 'CDC grand rounds: Newborn screening for hearing loss and critical congenital heart disease', *Morbidity and Mortality Weekly Report*, vol. 66, no. 33, a888. <https://doi.org/10.15585/mmwr.mm6633a4>
- Health Professions Council of South Africa (HPCSA) 2018, *Early hearing detection and intervention (EHDI) guidelines*, viewed 18 February 2019, <[https://www.hpcs.co.za/Uploads/SLH/Guidelines%20for%20Early\\_Hearing\\_Detection\\_and\\_Intervention\\_\(EHDI\)\\_2018.pdf](https://www.hpcs.co.za/Uploads/SLH/Guidelines%20for%20Early_Hearing_Detection_and_Intervention_(EHDI)_2018.pdf)>
- Health Professions Council of South Africa (HPCSA) n.d., *A guideline for planning STA services at all levels of health care*, viewed 18 October 2020, <[https://www.hpcs.co.za/Uploads/SLH/Policy%20and%20Guidelines/guideline\\_planning\\_STA\\_services\\_at\\_all\\_levels\\_health%20care.pdf](https://www.hpcs.co.za/Uploads/SLH/Policy%20and%20Guidelines/guideline_planning_STA_services_at_all_levels_health%20care.pdf)>
- Hyde, ML 2005, 'Newborn hearing screening programs: Overview', *Journal of Otolaryngology*, vol. 34, no. 2, a70.



## References

- Jacob, J, Kurien, M, Kumar, P & Krishnan, L 2020, 'Challenges of universal newborn hearing screening in a developing country-a double-edged sword', *Indian Journal of Otolaryngology and Head and Neck Surgery*, vol. 2020, pp. 1-7. <https://doi.org/10.1007/s12070-020-02170-8>
- Jewel, J, Varghese, PV, Singh, T & Varghese, A 2013, 'Newborn hearing screening: Experience at a tertiary hospital in northwest India', *International Journal of Otolaryngology Head and Neck Surgery*, vol. 2, no. 5, pp. 211-214. <https://doi.org/10.4236/ijohns.2013.25044>
- John, M, Balraj, A & Kurien, M 2009, 'Neonatal screening for hearing loss: Pilot study from a tertiary care centre', *Indian Journal of Otolaryngology and Head and Neck Surgery*, vol. 61, no. 1, pp. 23-26. <https://doi.org/10.1007/s12070-009-0028-2>
- Joint Committee on Infant Hearing (JCIH) 2019, 'Year 2019 position statement: Principles and guidelines for early hearing detection and intervention programs', *Journal of Early Hearing Detection and Intervention*, vol. 9, no. 1, pp. 9-29. [https://doi.org/10.1044/1059-0889\(2000/005\)](https://doi.org/10.1044/1059-0889(2000/005))
- Kanji, A 2016, 'Early hearing screening in South Africa-Time to get real about context', *South African Journal of Child Health*, vol. 10, no. 4, a1928. <https://doi.org/10.7196/SAJCH.2016.v10i4.1298>
- Kanji, A & Khoza-Shangase, K 2018, 'In pursuit of successful hearing screening: An exploration of factors associated with follow-up return rate in a risk-based newborn hearing screening programme', *Iranian Journal of Pediatrics*, vol. 28, no. 4, a56047. <https://doi.org/10.5812/ijp.56047>
- Kanji, A & Khoza-Shangase, K 2019, 'Early detection of hearing impairment in high-risk neonates: Let's talk about the high-risk registry in the South African context', *South African Journal of Child Health*, vol. 13, no. 2, pp. 53-55. <https://doi.org/10.7196/SAJCH.2019.v13i2.01675>
- Kanji, A & Khoza-Shangase, K 2021, 'A paradigm shift in early hearing detection and intervention in South Africa', eds. K Khoza-Shangase & A Kanji, *Early detection and intervention in audiology: An African perspective*, Wits University Press, Johannesburg.
- Kanji, A, Khoza-Shangase, K & Ballot, D 2010, 'Hearing screening follow-up return rate in a very low birth weight project: A retrospective record review', *South African Journal of Child Health*, vol. 4, no. 4, pp. 95-99. <https://hdl.handle.net/10520/EJC64793>
- Kanji, A, Khoza-Shangase, K, Petrocchi-Bartal, L & Harbinson, S 2018, 'Feasibility of infant hearing screening from a developing country context: The South African experience', *Hearing, Balance and Communication*, vol. 16, no. 4, pp. 263-270. <https://doi.org/10.1080/21695717.2018.1519144>
- Kanji, A & Krabbenhoft, K 2018, 'Audiological follow-up in a risk-based newborn hearing screening programme: An exploratory study of the influencing factors', *South African Journal of Communication Disorders*, vol. 65, no. 1, a587. <https://doi.org/10.4102/sajcd.v65i1.587>
- Kannampallil, TG, Schauer, GF, Cohen, T & Patel, VL 2011, 'Considering complexity in healthcare systems', *Journal of Biomedical Informatics*, vol. 44, no. 6, pp. 943-947. <https://doi.org/10.1016/j.jbi.2011.06.006>
- Kennedy, C, McCann, D, Campbell, MJ, Kimm, L & Thornton, R 2005, 'Universal newborn screening for permanent childhood hearing impairment: An 8-year follow-up of a controlled trial', *The Lancet*, vol. 366, no. 9486, pp. 660-662. [https://doi.org/10.1016/S0140-6736\(05\)67138-3](https://doi.org/10.1016/S0140-6736(05)67138-3)
- Khan, NB & Joseph, L 2020, 'Healthcare practitioners' views about early hearing detection and intervention practices in KwaZulu-Natal, South Africa', *South African Journal of Child Health*, vol. 14, no. 4, pp. 200-207. <https://doi.org/10.7196/SAJCH.2020.v14i4.01708>
- Khoza-Shangase, K 2019, 'Early hearing detection and intervention in South Africa: Exploring factors compromising service delivery as expressed by caregivers', *International Journal of Pediatric Otorhinolaryngology*, vol. 118, pp. 73-78. <https://doi.org/10.1016/j.ijporl.2018.12.021>
- Khoza-Shangase, K 2021, 'Continuity of care at school for the hearing-impaired child', eds. K Khoza-Shangase & A Kanji, *Early detection and intervention in audiology: An African perspective*, Wits University Press, Johannesburg.
- Khoza-Shangase, K & Harbinson, S 2015, 'Evaluation of universal newborn hearing screening in South African primary care', *African Journal of Primary Health Care and Family Medicine*, vol. 7, no. 1, a769. <https://doi.org/10.4102/phcfm.v7i1.769>

- Khoza-Shangase, K & Kanji, A 2021, 'Best practice in South Africa for early hearing detection and intervention', eds. K Khoza-Shangase & A Kanji, *Early detection and intervention in audiology: An African perspective*, Wits University Press, Johannesburg.
- Khoza-Shangase, K, Kanji, A & Ismail, F 2021, 'What are the current practices employed by audiologists in early hearing detection and intervention in the South African healthcare context?', *International Journal of Pediatric Otorhinolaryngology*, vol. 141, a110587. <https://doi.org/10.1016/j.ijporl.2020.110587>
- Khoza-Shangase, K, Kanji, A, Petrocchi-Bartal, L & Farr, K 2017, 'Infant hearing screening in a developing-country context: Status in two South African provinces', *South African Journal of Child Health*, vol. 11, no. 4, pp. 159-163. <https://doi.org/10.7196/SAJCH.2017.v11i4.1267>
- Khoza-Shangase, K & Mophosho, M 2018, 'Language and culture in speech-language and hearing professions in South Africa: The dangers of a single story', *South African Journal of Communication Disorders*, vol. 65, no. 1, a594. <https://doi.org/10.4102/sajcd.v65i1.594>
- Khoza-Shangase, K & Mophosho, M 2021, 'Language and culture in speech-language and hearing professions in South Africa: Re-imagining practice', *South African Journal of Communication Disorders*, vol. 68, no. 1, a793. <https://doi.org/10.4102/sajcd.v68i1.793>
- Khoza-Shangase, K, Moroe, N & Neille, J 2021, 'Speech-language pathology and audiology in South Africa: Clinical training and service in the era of COVID-19', *International Journal of Telerehabilitation*, vol. 13, no. 1, a6376. <https://doi.org/10.5195/ijt.2021.6376>
- Korver, AM, Konings, S, Dekker, FW, Beers, M, Wever, CC, Frijns, JH, Oudesluys-Murphy, AM & DECIBEL Collaborative Study Group 2010, 'Newborn hearing screening vs. later hearing screening and developmental outcomes in children with permanent childhood hearing impairment', *JAMA*, vol. 304, no. 15, pp. 1701-1708. <https://doi.org/10.1001/jama.2010.1501>
- Krishnamoorthy, K, Samy, RN & Shoman, N 2014, 'The challenges of starting a cochlear implant programme in a developing country', *Current Opinion in Otolaryngology and Head and Neck Surgery*, vol. 22, no. 5, pp. 367-372. <https://doi.org/10.1097/MOO.0000000000000088>
- Krishnan, LA & Donaldson, LK 2013, 'Newborn hearing screening in developing countries: Understanding the challenges and complexities of implementation', *Perspectives on Global Issues in Communication Sciences and Related Disorders*, vol. 3, no. 2, pp. 54-61. <https://doi.org/10.1044/gics3.2.54>
- Krishnan, LA & Van Hyfte, S 2014, 'Effects of policy changes to universal newborn hearing screening follow-up in a university clinic', *American Journal of Audiology*, vol. 23, no. 3, pp. 282-292. [https://doi.org/10.1044/2014\\_AJA-14-0008](https://doi.org/10.1044/2014_AJA-14-0008)
- Krumm, M, Huffman, T, Dick, K & Klich, R 2008, 'Telemedicine for audiology screening of infants', *Journal of Telemedicine and Telecare*, vol. 14, no. 2, pp. 102-104. <https://doi.org/10.1258/jtt.2007.070612>
- Krumm, M, Ribera, J & Schmiedge, J 2005, 'Using a telehealth medium for objective hearing testing: Implications for supporting rural universal newborn hearing screening programs', *Seminars in Hearing*, vol. 26, no. 1, pp. 3-12. <https://doi.org/10.1055/s-2005-863789>
- Lamb, GS & Shea, K 2006, 'Nursing education in telehealth', *Journal of Telemedicine and Telecare*, vol. 12, no. 2, pp. 55-56. <https://doi.org/10.1258/135763306776084437>
- Lantos, PM, Maradiaga-Panayotti, G, Barber, X, Raynor, E, Tucci, D, Hoffman, K, Permar, SR, Jackson, P, Hughes, BL, Kind, A & Swamy, GK 2018, 'Geographic and racial disparities in infant hearing loss', *Otolaryngology - Head and Neck Surgery*, vol. 159, no. 6, pp. 1051-1057. <https://doi.org/10.1177/0194599818803305>
- Liu, CL, Farrell, J, MacNeil, JR, Stone, S & Barfield, W 2008, 'Evaluating loss to follow-up in newborn hearing screening in Massachusetts', *Pediatrics*, vol. 121, no. 2, pp. 335-343.
- Louw, B & Avenant, C 2002, 'Culture as context for intervention: Developing a culturally congruent early intervention program', *International Pediatrics*, vol. 17, no. 3, pp. 145-150. <https://doi.org/10.1542/peds.2006-3540>
- Maluleke, NP, Chiwutsi, R & Khoza-Shangase, K 2021, 'Family-centred early hearing detection and intervention', in K Khoza-Shangase & A Kanji (eds.), *Early detection and intervention in audiology: An African perspective*, Wits University Press, Johannesburg.

## References

- Maluleke, NP, Khoza-Shangase, K & Kanji, A 2019a, 'Communication and school readiness abilities of children with hearing impairment in South Africa: A retrospective review of early intervention preschool records', *South African Journal of Communication Disorders*, vol. 66, no. 1, a604. <https://doi.org/10.4102/sajcd.v66i1.604>
- Maluleke, NP, Khoza-Shangase, K & Kanji, A 2019b, 'Hearing impairment detection and intervention in children from centre-based early intervention programmes', *Journal of Child Health Care*, vol. 23, no. 2, pp. 232-241. <https://doi.org/10.1177/1367493518788477>
- Maluleke, NP, Khoza-Shangase, K & Kanji, A 2020, 'An integrative review of current practice models and/or process of family-centered early intervention for children who are deaf or hard of hearing', *Family and Community Health*, vol. 44, no. 1, pp. 59-71. <https://doi.org/10.1097/FCH.0000000000000276>
- Martin, P, Nicholson, N & Hall, C 2012, 'Family support in early hearing detection and intervention (EHDI) systems', *Perspectives on Hearing and Hearing Disorders in Childhood*, vol. 22, no. 1, pp. 11-21. <https://doi.org/10.1044/hhdc22.111>
- Mason, CA, Gaffney, M, Green, DR & Grosse, SD 2008, 'Measures of follow-up in early hearing detection and intervention programs: A need for standardization', *American Journal of Audiology*, vol. 17, no. 1, pp. 60-67. [https://doi.org/10.1044/1059-0889\(2008\)007](https://doi.org/10.1044/1059-0889(2008)007)
- McPherson, B 2011, 'Innovative technology in hearing instruments: Matching needs in the developing world', *Trends in Amplification*, vol. 15, no. 4, pp. 209-214. <https://doi.org/10.1177/1084713811424887>
- Meinzen-Derr, J, Do, T, Folger, A, VanHorn, A, Dedino, N, Grove, W, Wiley, S & Gaffney, M 2017, 'Successes and challenges in implementing the Ohio early hearing detection and intervention (EHDI) system to improve developmental outcomes in deaf and hard of hearing children', in *10th Annual Conference on the Science of Dissemination and Implementation*, AcademyHealth, viewed 18 October 2020, <<https://academyhealth.confex.com/academyhealth/2017di/meetingapp.cgi/Paper/20251>>
- Meyer, ME & Swanepoel, DW 2011, 'Newborn hearing screening in the private health care sector: A national survey', *South African Medical Journal*, vol. 101, no. 9, pp. 665-667.
- Moodley, S & Störbeck, C 2015, 'Narrative review of EHDI in South Africa', *South African Journal of Communication Disorders*, vol. 62, no. 1, a126. <https://doi.org/10.4102/sajcd.v62i1.126>
- Moodley, S & Störbeck, C 2017, 'Data management for early hearing detection and intervention in South Africa', *South African Journal of Information Management*, vol. 19, no. 1, a779. <https://doi.org/10.4102/sajim.v19i1.779>
- Mukari, SZ, Tan, KY & Abdullah, A 2006, 'A pilot project on hospital-based universal newborn hearing screening: Lessons learned', *International Journal of Pediatric Otorhinolaryngology*, vol. 70, no. 5, pp. 843-851. <https://doi.org/10.1016/j.ijporl.2005.09.018>
- Muñoz, K, Olson, WA, Twohig, MP, Preston, E, Blaiser, K & White, KR 2015, 'Pediatric hearing aid use: Parent-reported challenges', *Ear and Hearing*, vol. 36, no. 2, pp. 279-287. <https://doi.org/10.1097/AUD.0000000000000111>
- Naudé, A & Bornman, J 2021, 'Ethical considerations and tele-audiology in early hearing detection and intervention', eds. K Khoza-Shangase & A Kanji, *Early detection and intervention in audiology: An African perspective*, Wits University Press, Johannesburg.
- Nwosu, CO & Oyenubi, A 2021, 'Income-related health inequalities associated with the coronavirus pandemic in South Africa: A decomposition analysis', *International Journal for Equity in Health*, vol. 20, no. 1, pp. 1-12. <https://doi.org/10.1186/s12939-020-01361-7>
- Olusanya, BO 2009, 'Follow-up default in a hospital-based universal newborn hearing screening programme in a low-income country', *Child Care, Health and Development*, vol. 35, no. 2, pp. 190-198. <https://doi.org/10.1111/j.1365-2214.2008.00923.x>
- Olusanya, BO 2015, 'Screening for neonatal deafness in resource-poor countries: Challenges and solutions', *Research and Reports in Neonatology*, vol. 2015, no. 5, pp. 51-64. <https://doi.org/10.2147/RRN.S61862>
- Olusanya, BO & Akinyemi, OO 2009, 'Community-based infant hearing screening in a developing country: Parental uptake of follow-up services', *BMC Public Health*, vol. 9, no. 1, pp. 1-10. <https://doi.org/10.1186/1471-2458-9-66>

- Olusanya, BO, Emokpae, AA, Zamora, TG & Slusher, TM 2014a, 'Addressing the burden of neonatal hyperbilirubinaemia in countries with significant glucose-6-phosphate dehydrogenase deficiency', *Acta Paediatrica*, vol. 103, no. 11, pp. 1102-1109. <https://doi.org/10.1111/apa.12735>
- Olusanya, BO, Luxon, LM & Wirz, SL 2004, 'Benefits and challenges of newborn hearing screening for developing countries', *International Journal of Pediatric Otorhinolaryngology*, vol. 68, no. 3, pp. 287-305. <https://doi.org/10.1016/j.ijporl.2003.10.015>
- Olusanya, BO, Luxon, LM & Wirz, SL 2005, 'Screening for early childhood hearing loss in Nigeria', *Journal of Medical Screening*, vol. 12, no. 3, pp. 115-118. <https://doi.org/10.1258/0969141054855274>
- Olusanya, BO, Neumann, KJ & Saunders, JE 2014b, 'The global burden of disabling hearing impairment: A call to action', *Bulletin of the World Health Organization*, vol. 92, pp. 367-373. <https://doi.org/10.2471/BLT.13.128728>
- Olusanya, BO, Wirz, SL & Luxon, LM 2008, 'Hospital-based universal newborn hearing screening for early detection of permanent congenital hearing loss in Lagos, Nigeria', *International Journal of Pediatric Otorhinolaryngology*, vol. 72, no. 7, pp. 991-1001. <https://doi.org/10.1016/j.ijporl.2008.03.004>
- Petrocchi-Bartal, L & Khoza-Shangase, K 2014, 'Factors influencing the Implementation of newborn and infant hearing screening programmes at primary health care clinics in South Africa', *Advances in Research*, vol. 2, no. 12, pp. 935-949. <https://doi.org/10.9734/AIR/2014/11387>
- Petrocchi-Bartal, L & Khoza-Shangase, K 2016, 'Infant hearing screening at primary healthcare immunisation clinics in South Africa: The current status', *South African Journal of Child Health*, vol. 10, no. 2, pp. 139-143. <https://doi.org/10.7196/SAJCH.2016.v10i2.1114>
- Petrocchi-Bartal, L, Khoza-Shangase, K & Kanji, A 2021, 'Implementing early hearing detection in the South African health care context', eds. K Khoza-Shangase & A Kanji, *Early detection and intervention in audiology: An African perspective*, Wits University Press, Johannesburg.
- Picot, J 2000, 'Meeting the need for educational standards in the practice of telemedicine and telehealth', *Journal of Telemedicine and Telecare*, vol. 6, suppl 2, pp. 59-62. <https://doi.org/10.1258/1357633001935608>
- Pimperton, H & Kennedy, CR 2012, 'The impact of early identification of permanent childhood hearing impairment on speech and language outcomes', *Archives of Disease in Childhood*, vol. 97, no. 7, pp. 648-653. <https://doi.org/10.1136/archdischild-2011-301501>
- Plsek, PE & Greenhalgh, T 2001, 'The challenge of complexity in health care', *BMJ*, vol. 323, no. 7313, pp. 625-628. <https://doi.org/10.1136/bmj.323.7313.625>
- Ramesh, A, Jagdish, C, Nagapoorinima, M, Rao, PS, Ramakrishnan, AG, Thomas, GC, Dominic, M & Swarnarekha, A 2012, 'Low cost calibrated mechanical noisemaker for hearing screening of neonates in resource constrained settings', *The Indian Journal of Medical Research*, vol. 135, no. 2, n.p.
- Sass-Lehrer, M 2014, *Early beginnings for children who are deaf or hard of hearing: Guidelines for effective services*, viewed 18 October 2020, <<https://www.gallaudet.edu/Documents/Clerc/Early%20Beginnings.pdf>>
- Scheepers, LJ, Swanepoel, DW & Le Roux, T 2014, 'Why parents refuse newborn hearing screening and default on follow-up rescreening: A South African perspective', *International Journal of Pediatric Otorhinolaryngology*, vol. 78, no. 4, pp. 652-658. <https://doi.org/10.1016/j.ijporl.2014.01.026>
- Smith, LR, Layton, C, Ramirez, C, Hendershot, T, Dai, L & Hershey, J 2007, 'An evaluation of loss to follow-up in State EHDI programs: Findings from the Virginia EHDI program', *Final Report, RTI Project*, (0208235.013), viewed 15 October 2018, <[http://www.infantheating.org/states/documents/evaluation\\_tools/Virginia%20CDC%20EHDI%20Survey%20Final%20Results.pdf](http://www.infantheating.org/states/documents/evaluation_tools/Virginia%20CDC%20EHDI%20Survey%20Final%20Results.pdf)>
- South African Health Review (SAHR) 2017, *Health systems trust*, viewed 28 March 2018, <[www.hst.org.za/.../South%20African%20Health%20Reviews/HST%20SAHR%202017%20](http://www.hst.org.za/.../South%20African%20Health%20Reviews/HST%20SAHR%202017%20)>
- Spivak, L, Sokol, H, Auerbach, C & Gershkovich, S 2009, 'Newborn hearing screening follow-up: Factors affecting hearing aid fitting by 6 months of age', *American Journal of Audiology*, vol. 18, no. 1, pp. 24-33. [https://doi.org/10.1044/1059-0889\(2008\)08-0015](https://doi.org/10.1044/1059-0889(2008)08-0015)

## References

- Stephens, D, Stephens, R & Von Eisenhart-Rothe, A 2000, 'Attitudes toward hearing-impaired children in less developed countries: A pilot study [Actitudes hacia los niños con trastornos auditivos en los países en desarrollo: Un estudio piloto]', *Audiology*, vol. 39, no. 4, pp. 184–191. <https://doi.org/10.3109/00206090009073076>
- Störbeck, C & Young, A 2016, 'The HI HOPES data set of deaf children under the age of 6 in South Africa: Maternal suspicion, age of identification and newborn hearing screening', *BMC Pediatrics*, vol. 16, no. 1, pp. 1–10. <https://doi.org/10.1186/s12887-016-0574-1>
- Subbiah, K, Mason, CA, Gaffney, M & Grosse, SD 2018, 'Progress in documented early identification and intervention for deaf and hard of hearing infants: CDC's hearing screening and follow-up survey, United States, 2006–2016', *Journal of Early Hearing Detection and Intervention*, vol. 3, no. 2, p. 1. <https://doi.org/10.26077/6sjl-mw42>
- Swanepoel, D & Almec, N 2008, 'Maternal views on infant hearing loss and early intervention in a South African community', *International Journal of Audiology*, vol. 47, suppl. 1, pp. 44–48. <https://doi.org/10.1080/14992020802252279>
- Swanepoel, D, Hugo, R & Louw, B 2005, 'Infant hearing loss: Silent epidemic of the developing world', *Audiology Today*, vol. 17, no. 4, pp. 12–16.
- Swanepoel, D & Störbeck, C 2008, 'EHDI Africa: Advocating for infants with hearing loss in Africa', *International Journal of Audiology*, vol. 47, suppl. 1, pp. 1–2. <https://doi.org/10.1080/14992020802300912>
- Thomson, V & Yoshinaga-Itano, C 2018, 'The role of audiologists in assuring follow-up to outpatient screening in early hearing detection and intervention systems', *American Journal of Audiology*, vol. 27, no. 3, pp. 283–293. [https://doi.org/10.1044/2018\\_AJA-17-0113](https://doi.org/10.1044/2018_AJA-17-0113)
- Todd, NW 2006, 'Universal newborn hearing screening follow-up in two Georgia populations: Newborn, mother and system correlates', *International Journal of Pediatric Otorhinolaryngology*, vol. 70, no. 5, pp. 807–815. <https://doi.org/10.1016/j.ijporl.2005.09.019>
- Wake, M, Poulakis, Z, Hughes, EK, Carey-Sargeant, C & Rickards, FW 2005, 'Hearing impairment: A population study of age at diagnosis, severity, and language outcomes at 7–8 years', *Archives of Disease in Childhood*, vol. 90, no. 3, pp. 238–244. <https://doi.org/10.1136/adc.2003.039354>
- Watermeyer, J, Kanji, A & Cohen, A 2012, 'Caregiver recall and understanding of paediatric diagnostic information and assessment feedback', *International Journal of Audiology*, vol. 51, no. 12, pp. 864–869. <https://doi.org/10.3109/14992027.2012.721014>
- White, KR 2003, 'The current status of EHDI programs in the United States', *Mental Retardation and Developmental Disabilities Research Reviews*, vol. 9, no. 2, pp. 79–88. <https://doi.org/10.1002/mrdd.10063>
- World Bank 2005, *World development report 2006: Equity and development*, viewed 18 June 2019, <<https://documents.worldbank.org/en/publication/documents-reports/documentdetail/435331468127174418/world-development-report-2006-equity-and-development>>
- World Health Organization (WHO) 2002, *Future programme developments for prevention of deafness and hearing impairment: Report of the 4th informal consultation*, viewed 18 June 2019, <[http://whqlibdoc.who.int/hq/2002/WHO\\_PDH\\_02.1.pdf](http://whqlibdoc.who.int/hq/2002/WHO_PDH_02.1.pdf)>
- World Health Organization (WHO) 2010, *Monitoring the building blocks of health systems: A handbook of indicators and their measurement strategies*, World Health Organization, viewed 18 June 2019, <[https://web.archive.org/web/20220305184430/https://www.who.int/healthinfo/systems/WHO\\_MBHSS\\_2010\\_full\\_web.pdf](https://web.archive.org/web/20220305184430/https://www.who.int/healthinfo/systems/WHO_MBHSS_2010_full_web.pdf)>
- Yoshinaga-Itano, C 2003, 'From screening to early identification and intervention: Discovering predictors to successful outcomes for children with significant hearing loss', *Journal of Deaf Studies and Deaf Education*, vol. 8, no. 1, pp. 11–30. <https://doi.org/10.1093/deafed/8.1.11>
- Yoshinaga-Itano, C 2004, 'Levels of evidence: Universal newborn hearing screening (UNHS) and early hearing detection and intervention systems (EHDI)', *Journal of Communication Disorders*, vol. 37, no. 5, pp. 451–465. <https://doi.org/10.1016/j.jcomdis.2004.04.008>
- Yoshinaga-Itano, C 2020, 'Challenges to EHDI systems amid the COVID-19 crisis', *The Hearing Journal*, vol. 73, no. 5, pp. 43–44. <https://doi.org/10.1097/01.HJ.0000666452.15264.95>



- Yoshinaga-Itano, C & Gravel, JS 2001, 'The evidence for universal newborn hearing screening', *American Journal of Audiology*, vol. 10, no. 2, pp. 62–64. [https://doi.org/10.1044/1059-0889\(2001/013\)](https://doi.org/10.1044/1059-0889(2001/013))
- Young, A, Hunt, R, Carr, G, Hall, A-M, McCracken, W, Skipp, A & Tattersall, H 2005, 'Informed choice, deaf children and families-underpinning ideas and project development', *Electronic Journal of Research in Educational Psychology*, vol. 3, no. 3, pp. 253–272. <https://www.redalyc.org/pdf/2931/293121928013.pdf>

### Chapter 3

- Abrahams, K, Kathard, H, Harty, M & Pillay, M 2019, 'Inequity and the professionalisation of speech-language pathology', *Professions and Professionalism*, vol. 9, no. 3, pp. 1–16. <https://doi.org/10.7577/pp.3285>
- Abuur, NJ 2016, 'Communication training skill for improvement of oral/aural communication among learners with hearing impairments in primary schools for the deaf in western region of Kenya', *Academic Research International*, vol. 7, no. 1, pp. 305–315.
- Akçakaya, H & Tavşancıl, E 2016, 'Teacher opinions about auditory verbal therapy', *Journal of Qualitative Research in Education*, vol. 4, no. 2, pp. 1–25. <https://doi.org/10.14689/issn.2148-2624.1.4c2s1m>
- Alberg, J, Wilson, K & Roush, J 2006, 'State-wide collaboration in the delivery of EHDl services', *The Volta Review*, vol. 106, no. 3, pp. 259–274. <https://doi.org/10.17955/tvr.106.3.m.583>
- American Speech-Language-Hearing Association (ASHA) 2008, *Guidelines for audiologists providing informational and adjustment counseling to families of infants and young children with hearing loss birth to 5 years of age*, viewed 10 March 2018, <<https://www.asha.org/policy/GL2008-00289/>>
- American Speech-Language-Hearing Association (ASHA) 2015, 'Effects of hearing loss on development', *Audiology Information Series*, viewed 10 March 2018, <<https://www.asha.org/siteassets/ais/ais-hearing-loss-development-effects.pdf>>
- Auditory Verbal UK 2018, *A sound future: Raising expectations for children with deafness position paper 2018*, viewed 12 February 2019, <<https://www.avuk.org/Handlers/Download.ashx?IDMF=55c2082e-57b1-4caa-a6a3-6f3e8de845da>>
- Aurélio, FS & Tochetto, TM 2010, 'Newborn hearing screening: Experiences of different countries', *International Archives of Otorhinolaryngology*, vol. 14, no. 3, pp. 355–363.
- Balton, S, Uys, K & Alant, E 2019, 'Family-based activity settings of children in a low-income African context', *African Journal of Disability (Online)*, vol. 8, pp. 1–14. <https://doi.org/10.4102/ajod.v8i0.364>
- Baltussen, RMPM & Smith, A 2009, 'Cost-effectiveness of selected interventions for hearing impairment in Africa and Asia: A mathematical modelling approach', *International Journal of Audiology*, vol. 48, no. 3, pp. 144–158. <https://doi.org/10.1080/14992020802538081>
- Banda, FM, Powis, KM, Mokoka, AB, Mmapetla, M, Westmoreland, KD, David, T & Steenhoff, AP 2018, 'Hearing impairment among children referred to a public audiology clinic in Gaborone, Botswana', *Global Pediatric Health*, vol. 5, pp. 1–8. <https://doi.org/10.1177/2333794X18770079>
- Barratt, J, Khoza-Shangase, K & Msimang, K 2012, 'Speech-language assessment in a linguistically diverse setting: Preliminary exploration of the possible impact of informal "solutions" within the South African context', *South African Journal of Communication Disorders*, vol. 59, no. 1, pp. 34–44. <https://doi.org/10.4102/sajcd.v59i1.20>
- Bezuidenhout, JK, Khoza-Shangase, K, De Maayer, T & Strehlau, R 2018, 'Universal newborn hearing screening in public healthcare in South Africa: Challenges to implementation', *South African Journal of Child Health*, vol. 12, no. 4, pp. 159–163. <https://doi.org/10.7196/SAJCH.2018.v12i4.1522>
- Billieux, BJ, Smith, B & Nath, A 2016, 'Neurological complications of ebola virus infection', *Neurotherapeutics*, vol. 13, no. 3, pp. 461–470. <https://doi.org/10.1007/s13311-016-0457-z>

- Butler, I 2012, 'Identification and management of childhood hearing loss', *CME: Your SA Journal of CPD*, vol. 30, no. 9, pp. 314–317. <http://www.cmej.org.za/index.php/cmej/article/view/2448/2536>
- Campbell, W & Hyde, M 2010, 'eEHDl: Functions and challenges', in *Proceedings from a Sound Foundation through Early Amplification, International Pediatric Audiology Conference*, viewed 10 February 2019, <[https://www.phonakpro.com/content/dam/phonakpro/gc\\_hq/en/events/2010/pediatric\\_audiology\\_conference\\_chicago/Pho\\_Chap\\_06\\_Campbell\\_final.pdf](https://www.phonakpro.com/content/dam/phonakpro/gc_hq/en/events/2010/pediatric_audiology_conference_chicago/Pho_Chap_06_Campbell_final.pdf)>
- Casoojee, A, Kanji, A & Khoza-Shangase, K 2021, 'Therapeutic approaches to early intervention in audiology: A systematic review', *International Journal of Pediatric Otorhinolaryngology*, vol. 150, a110918. <https://doi.org/10.1016/j.ijporl.2021.110918>
- Centres for Disease Control and Prevention (CDC) 2017, 'Hearing loss in children, 2017 summary of hearing screening results', in *Annual data EHDl program*, viewed 20 January 2020, <<https://www.cdc.gov/ncbddd/hearingloss/2017-data/03-detailed-screening-results.html>>
- Chang, PF 2017, 'Breaking the sound barrier: Exploring parents' decision-making process of cochlear implants for their children', *Patient Education and Counselling*, vol. 100, no. 8, pp. 1544–1551. <https://doi.org/10.1016/j.pec.2017.03.005>
- Ching, TY, Dillon, H, Day, J, Crowe, K, Close, L, Chisholm, K & Hopkins, T 2009, 'Early language outcomes of children with cochlear implants: Interim findings of the NAL study on longitudinal outcomes of children', *Cochlear Implants International*, vol. 10, suppl. 1, pp. 28–32. <https://doi.org/10.1179/cim.2009.10.Supplement-1.28>
- Ching, TY, Dillon, H, Marnane, V, Hou, S, Day, J, Seeto, M, Crowe, K, Street, L, Thomson, J, Van Buynder, P, Zhang, V, Wong, A, Burns, L, Flynn, C, Cupples, L, Cowan, RSC, Leigh, G, Sjahalam-King, J & Yeh, A 2013, 'Outcomes of early-and late-identified children at 3 years of age: Findings from a prospective population-based study', *Ear and Hearing*, vol. 34, no. 5, a535. <https://doi.org/10.1179/cim.2009.10.Supplement-1.28>
- Ching, TY, Scarinci, N, Marnane, V, Sjahalam-King, J, Button, L & Whitfield, J 2018, 'Factors influencing parents' decisions about communication choices during early education of their child with hearing loss: A qualitative study', *Deafness and Education International*, vol. 20, no. 3–4, pp. 154–181. <https://doi.org/10.1080/14643154.2018.1512393>
- Ching, TYC, Dillon, H, Leigh, G & Cupples, L 2017, 'Learning from the longitudinal outcomes of children with hearing impairment (LOCHI) study: Summary of 5-year findings and implications', *International Journal of Audiology*, vol. 57, suppl. 2, pp. 1–7. <https://doi.org/10.1080/14992027.2017.1385865>
- Crowe, K, McLeod, S & Ching, TY 2012, 'The cultural and linguistic diversity of 3-year-old children with hearing loss', *Journal of Deaf Studies and Deaf Education*, vol. 17, no. 4, pp. 421–438. <https://doi.org/10.1093/deafed/ens028>
- Cupples, L, Ching, TYC, Button, L, Seeto, M, Zhang, V, Whitfield, J, Gunnourie, M, Martin, L & Marnane, V 2018, 'Spoken language and everyday functioning in 5-year-old children using hearing aids or cochlear implants', *International Journal of Audiology*, vol. 57, no. 2, pp. 55–69. <https://doi.org/10.1080/14992027.2017.1370140>
- Deng, X, Finitzo, T & Aryal, S 2018, 'Measuring early hearing detection and intervention (EHDl) quality across the continuum of care', *eGEMs*, vol. 6, no. 1, a239. <https://doi.org/10.5334/egems.239>
- Dettman, SJ, Dowell, RC, Choo, D, Arnott, W, Abrahams, Y, Davis, A, Dornan, D, Leigh, J, Constantinescu, G, Cowan, R & Briggs, RJ 2016, 'Long-term communication outcomes for children receiving cochlear implants younger than 12 months: A multicenter study', *Otology and Neurotology*, vol. 37, no. 2, pp. 82–95. <https://doi.org/10.1097/MAO.0000000000000915>
- Dollard, SC, Grosse, SD & Ross, DS 2007, 'New estimates of the prevalence of neurological and sensory sequelae and mortality associated with congenital cytomegalovirus infection', *Reviews in Medical Virology*, vol. 17, no. 5, pp. 355–363. <https://doi.org/10.1002/rmv.544>
- Ehlert, K & Coetzer, C 2020, 'Maternal knowledge and views regarding early hearing detection and intervention in children aged 0–5 years at a semi-urban primary care clinic in South Africa', *South African Journal of Communication Disorders*, vol. 67, no. 1, a544. <https://doi.org/10.1002/rmv.544>

- Engelman, D 2014, *The status of neonatal hearing screening in sub-Saharan Africa: A systematic review*, CUNY Academic Works, viewed 20 March 2019, <[https://academicworks.cuny.edu/gc\\_etds/650](https://academicworks.cuny.edu/gc_etds/650)>
- Estabrooks, W, MacIver-Lux, K & Rhoades, EA 2016, *Auditory verbal therapy for young children with hearing loss and their families, and the practitioners who guide them*, Plural Publishing Inc., San Diego.
- Exeter, DJ, Wu, B, Lee, AC & Searchfield, GD 2015, 'The projected burden of hearing loss in New Zealand (2011-2061) and the implications for the hearing health workforce', *New Zealand Medical Journal*, vol. 128, no. 1419, pp. 12-21.
- Fitzgibbons, J, Beswick, R & Driscoll, CJ 2021, 'Contextualisation of risk factors for hearing impairment', eds. K Khoza-Shangase & A Kanji, *Early detection and intervention in audiology: An African perspective*, Wits University Press, Johannesburg.
- Fitzpatrick, EM, Olds, J, Gaboury, I, McCrae, R, Schramm, D & Durieux-Smith, A 2012, 'Comparison of outcomes in children with hearing aids and cochlear implants', *Cochlear Implants International*, vol. 13, no. 1, pp. 5-15. <https://doi.org/10.1179/146701011X1295003811611>
- Flood, D & Rohloff, P 2018, 'Indigenous languages and global health', *The Lancet Global Health*, vol. 6, no. 2, pp. 134-135. [https://doi.org/10.1016/S2214-109X\(17\)30493-X](https://doi.org/10.1016/S2214-109X(17)30493-X)
- Fulcher, AN, Purcell, A, Baker, E & Munro, N 2015, 'Factors influencing speech and language outcomes of children with early identified severe/profound hearing loss: Clinician-identified facilitators and barriers', *International Journal of Speech-Language Pathology*, vol. 17, no. 3, pp. 325-333. <https://doi.org/10.3109/17549507.2015.1032351>
- Garrido-Nag, K & McCann, J 2020, 'Working with deaf and hard-of-hearing children from linguistically diverse backgrounds', *Cases on Communication Disorders in Culturally Diverse Populations*, vol. 2022, pp. 157-179. <https://doi.org/10.4018/978-1-7998-2261-5.ch008>
- Geers, AE 2006, 'Factors influencing spoken language outcomes in children following early cochlear implantation', *Cochlear and Brainstem Implants*, vol. 64, pp. 50-65. <https://doi.org/10.4018/978-1-7998-2261-5.ch008>
- Glantz, G 2016, 'Zika and hearing loss: The race for a cure continues', *The Hearing Journal*, vol. 69, no. 12, pp. 22-24. <https://doi.org/10.1097/01.HJ.0000511123.79295.d0>
- Gravel, JS & O'Gara, J 2003, 'Communication options for children with hearing loss', *Mental Retardation and Developmental Disabilities Research Reviews*, vol. 9, no. 4, pp. 243-251. <https://doi.org/10.1002/mrdd.10087>
- Guiberson, M 2013, 'Survey of Spanish parents of children who are deaf or hard of hearing: Decision-making factors associated with communication modality and bilingualism', *American Journal of Audiology*, vol. 22, no. 1, pp. 105-119. [https://doi.org/10.1044/1059-0889\(2012\)12-0042](https://doi.org/10.1044/1059-0889(2012)12-0042)
- Gullberg, M, De Bot, K & Volterra, V 2008, 'Gestures and some key issues in the study of language development', *Gesture*, vol. 8, no. 2, pp. 149-179. <https://doi.org/10.1075/gest.8.2.03gul>
- Harmer, L 1999, 'Health care delivery and deaf people: Practice, problems, and recommendations for change', *Journal of Deaf Studies and Deaf Education*, vol. 4, no. 2, pp. 73-110. <https://doi.org/10.1093/deafed/4.2.73>
- Hartley, S, Murira, G, Mwangoma, M, Carter, J & Newton, CR 2009, 'Using community/researcher partnerships to develop a culturally relevant intervention for children with communication disabilities in Kenya', *Disability and Rehabilitation*, vol. 31, no. 6, pp. 490-499. <https://doi.org/10.1080/09638280802061944>
- HPCSA 2018, *Audiological management of patients on treatment that includes ototoxic medication: Guidelines*, viewed 10 March 2020, <<https://www.hpcsa.co.za/Uploads/SLH/Guidelines%20for%20Audiological%20Management%20of%20Patients%20on%20Treatment%20that%20includes%20Ototoxic%20Medications.pdf>>
- Hear-it.org 2021, *The economic burden of hearing loss*, viewed 10 March 2019, <<https://www.hear-it.org/the-economic-burden-of-hearing-loss>>
- Hlayisi, VG & Ramma, L 2019, 'Rehabilitation for disabling hearing loss: Evaluating the need relative to provision of hearing aids in the public health care system', *Disability and Rehabilitation*, vol. 41, no. 22, pp. 2704-2707. <https://doi.org/10.1080/09638288.2018.1473507>



## References

- Hoffman, HJ, Dobie, RA, Ko, CW, Themann, CL & Murphy, WJ 2010, 'Americans hear as well or better today compared with 40 years ago: Hearing threshold levels in the unscreened adult population of the United States, 1959-1962 and 1999-2004', *Ear Hear*, vol. 31, no. 6, pp. 725-734. <https://doi.org/10.1097/AUD.0b013e3181e9770e>
- Houston, KT & Stredler-Brown, A 2012, 'A model of early intervention for children with hearing loss provided through telepractice', *Volta Review*, vol. 112, no. 3, pp. 283-296. <https://doi.org/10.17955/tvr.112.3.m.710>
- Hyde, M, Punch, R & Comesaroff, L 2010, 'Coming to a decision about cochlear implantation: Parents making choices for their deaf children', *Journal of Deaf Studies and Deaf Education*, vol. 15, no. 2, pp. 162-178. <https://doi.org/10.1093/deafed/enq004>
- Jacob, J, Kurien, M, Kumar, P & Krishnan, L 2020, 'Challenges of universal newborn hearing screening in a developing country-a double-edged sword', *Indian Journal of Otolaryngology and Head and Neck Surgery*, viewed 29 February 2021, <<http://link.springer.com/article/10.1007/s12070-020-02170-8>>
- Jatana, N & Currie, A 2020, *Hitting the targets: The case for ethical and empowering population policies to accelerate progress towards the sustainable development goals*, viewed 29 February 2021, <<https://populationmatters.org/sites/default/files/Hitting%20the%20Targets%20-%20Population%20and%20the%20SDGs.pdf>>
- Joint Committee on Infant Hearing (JCIH) 2019, 'Year 2019 position statement: Principles and guidelines for early hearing detection and intervention programs', *Journal of Early Hearing Detection and Intervention* vol. 9, no. 1, pp. 9-29. [https://doi.org/10.1044/1059-0889\(2000/005\)](https://doi.org/10.1044/1059-0889(2000/005))
- Kaipa, R & Danser, ML 2016, 'Efficacy of auditory-verbal therapy in children with hearing impairment: A systematic review from 1993 to 2015', *International Journal of Pediatric Otorhinolaryngology*, vol. 86, pp. 124-134. <https://doi.org/10.1016/j.ijporl.2016.04.033>
- Kanji, A 2016, 'Early hearing screening in South Africa-time to get real about context', *South African Journal of Child Health*, vol. 10, no. 4, a1298. <https://doi.org/10.7196/SAJCH.2016.v10i4.1298>
- Kanji, A 2021, 'Exploring early detection of hearing impairment in sub-Saharan Africa', in K Khoza-Shangase & A Kanji (eds.), *Early detection and intervention in audiology: An African perspective*, Wits University Press, Johannesburg.
- Kanji, A & Casoojee, A 2021, 'Approaches to early intervention for hearing impairment', in K Khoza-Shangase & A Kanji (eds.), *Early detection and intervention in audiology: An African perspective*, Wits University Press, Johannesburg, pp. 117-136.
- Kanji, A & Khoza-Shangase, K 2012, 'The occurrence of high-risk factors for hearing loss in very-low-birth-weight neonates: A retrospective exploratory study of targeted hearing screening', *South African Journal of Communication Disorders*, vol. 59, no. 1, pp. 3-7. <https://doi.org/10.4102/sajcd.v59i1.16>
- Kanji, A & Khoza-Shangase, K 2019, 'Early detection of hearing impairment in high-risk neonates: Let's talk about the high-risk registry in the South African context', *South African Journal of Child Health*, vol. 13, no. 2, pp. 53-55.
- Kathard, H & Pillay, M 2013, 'Promoting change through political consciousness: A South African speech-language pathology response to the world report on disability', *International Journal of Speech-Language Pathology*, vol. 15, no. 1, pp. 84-89. <https://doi.org/10.4102/sajcd.v44i1.232>
- Kathard, H, Pillay, M & Samuel, MA 1997, 'The curriculum of practice: A conceptual framework for speech-language therapy and audiology practice with a black African first language clientele', *South African Journal of Communication Disorders*, vol. 44, no. 44, a232. <https://doi.org/10.4102/sajcd.v44i1.232>
- Khoza-Shangase, K 2019, 'Early hearing detection and intervention in South Africa: Exploring factors compromising service delivery as expressed by caregivers', *International Journal of Pediatric Otorhinolaryngology*, vol. 118, pp. 73-78. <https://doi.org/10.1016/j.ijporl.2018.12.021>
- Khoza-Shangase, K 2021a, 'Confronting realities to early hearing detection in South Africa', eds. K Khoza-Shangase & A Kanji, *Early detection and intervention in audiology: An African perspective*, Wits University Press, Johannesburg, pp. 66-88.

- Khoza-Shangase, K 2021b, 'Continuity of care at school for the hearing-impaired child', eds. K Khoza-Shangase & A Kanji, *Early detection and intervention in audiology: An African perspective*, Wits University Press, Johannesburg.
- Khoza-Shangase, K 2021c, 'HIV/AIDS and the burden of disease in early hearing detection and intervention', eds. K Khoza-Shangase & A Kanji, *Early detection and intervention in audiology: An African perspective*, Wits University Press, Johannesburg.
- Khoza-Shangase, K & Anastasiou, J 2020, 'An exploration of recorded otological manifestations in South African children with HIV/AIDS: A pilot study', *International Journal of Pediatric Otorhinolaryngology*, vol. 133, a109960. <https://doi.org/10.1016/j.ijporl.2020.109960>
- Khoza-Shangase, K, Barratt, J & Jonosky, J 2010, 'Protocols for early audiology intervention services: Views from early intervention practitioners in a developing country', *South African Journal of Child Health*, vol. 4, no. 4, pp. 100-105. <https://doi.org/10.7196/sajch.271>
- Khoza-Shangase, K & Kanji, A 2021, 'Best practice in South Africa for early hearing detection and intervention', eds. K Khoza-Shangase & A Kanji, *Early detection and intervention in audiology: An African perspective*, Wits University Press, Johannesburg.
- Khoza-Shangase, K, Kanji, A & Ismail, F 2021a, 'What are the current practices employed by audiologists in early hearing detection and intervention in the South African healthcare context?', *International Journal of Pediatric Otorhinolaryngology*, vol. 141, a110587. <https://doi.org/10.1016/j.ijporl.2020.110587>
- Khoza-Shangase, K & Michal, G 2014, 'Early intervention in audiology: Exploring the current status from a developing country context', *Journal of Advances in Medicine and Medical Research*, vol. 4, no. 11, pp. 2238-2249. <https://doi.org/10.9734/BJMRR/2014/7322>
- Khoza-Shangase, K & Mophosho, M 2018, 'Language and culture in speech-language and hearing professions in South Africa: The dangers of a single story', *South African Journal of Communication Disorders*, vol. 65, no. 1, a594. <https://doi.org/10.4102/sajcd.v65i1.594>
- Khoza-Shangase, K & Mophosho, M 2021, 'Language and culture in speech-language and hearing professions in South Africa: Re-imagining practice', *South African Journal of Communication Disorders*, vol. 68, no. 1, a793. <https://doi.org/10.4102/sajcd.v68i1.793>
- Khoza-Shangase, K & Turnbull, T 2009, 'Hearing screening in a group of paediatric patients attending an HIV/AIDS clinic: A pilot study', *African Journal of Infectious Diseases*, vol. 3, no. 2, pp. 57-68. <https://doi.org/10.4314/ajid.v3i2.55082>
- Kluwin, TN & Gaustad, MG 1991, 'Predicting family communication choices', *American Annals of the Deaf*, vol. 136, no. 1, pp. 28-34. <https://doi.org/10.1353/aad.2012.0554>
- Knoors, H & Marschark, M 2014, *Teaching deaf learners: Psychological and developmental foundations*, Oxford University Press, Oxford, New York.
- Labaeka, AA, Tongo, OO, Ogunbosi, BO & Fasunla, JA 2018, 'Prevalence of hearing impairment among high-risk newborns in Ibadan, Nigeria', *Frontiers in Pediatrics*, vol. 6, a194. <https://doi.org/10.3389/fped.2018.00194>
- Lang-Roth, R 2014, 'Hearing impairment and language delay in infants: Diagnostics and genetics', *GMS Current Topics in Otorhinolaryngology – Head and Neck Surgery*, vol. 13, no. 5, n.p. <https://dx.doi.org/10.3205%2Fcto000108>
- Lederberg, AR, Schick, B & Spencer, PE 2013, 'Language and literacy development of deaf and hard-of-hearing children: Successes and challenges', *Developmental Psychology*, vol. 49, no. 1, pp. 15-30. <https://doi.org/10.1037/a0029558>
- Lew, J, Purcell, AA, Doble, M & Lim, LH 2014, 'Hear here: Children with hearing loss learn words by listening', *International Journal of Pediatric Otorhinolaryngology*, vol. 78, no. 10, pp. 1716-1725. <https://doi.org/10.1016/j.ijporl.2014.07.029>
- Lim, SYC & Simser, J 2005, 'Auditory-verbal therapy for children with hearing impairment', *Annals of the Academy of Medicine, Singapore*, vol. 34, no. 4, pp. 307-312.
- Lin, FR, Niparko, JK & Ferrucci, L 2011, 'Hearing loss prevalence in the United States', *Archives of Internal Medicine*, vol. 171, no. 20, pp. 1851-1852. <https://doi.org/10.1016/j.ijporl.2014.07.029>

## References

- Madu, BN 2016, 'Speech and language therapy techniques reported from developing and developed countries', *International Journal for Psychotherapy in Africa*, vol. 1, no. 1, pp. 130–139.
- Majid, AHA, Zakaria, MN, Abdullah, NAC, Hamzah, S & Mukari, SZS 2017, 'Determinants of caregivers' awareness of universal newborn hearing screening in Malaysia', *International Journal of Pediatric Otorhinolaryngology*, vol. 101, pp. 107–111. <https://doi.org/10.1016/j.ijporl.2017.07.036>
- Maluleke, NP 2022, 'Economic evaluation of EHDl programmes in South Africa: Putting EHDl on the political advocacy and resource allocation agenda', ed. K Khoza-Shangase, *Preventive audiology: An African perspective*, AOSIS Books, Cape Town, pp. 199–212. <https://doi.org/10.4102/aosis.2022.BK209.10>
- Maluleke, NP, Khoza-Shangase, K & Kanji, A 2019, 'Communication and school readiness abilities of children with hearing impairment in South Africa: A retrospective review of early intervention preschool records', *South African Journal of Communication Disorders*, vol. 66, no. 1, a604. <https://doi.org/10.4102/sajcd.v66i1.604>
- Maluleke, NP, Khoza-Shangase, K & Kanji, A 2021a, 'An integrative review of current practice models and/or process of family-centered early intervention for children who are deaf or hard of hearing', *Family and Community Health*, vol. 44, no. 1, pp. 59–71. <https://doi.org/10.1097/FCH.0000000000000276>
- Maluleke, NP, Khoza-Shangase, K & Kanji, A 2021b, "'Caregivers" experiences of the early hearing detection and intervention (EHDl) process from detection to intervention in South Africa', *BMC Health Services Research*, vol. 2021, n.p.
- Maluleke, NP, Khoza-Shangase, K & Kanji, A 2021c, 'School readiness and academic achievement of children with hearing impairment: A South African exploratory study', *South African Journal of Childhood Education*, vol. 11, no. 1, a898. <https://doi.org/10.4102/sajce.v11i1.898>
- Matkin, N 1998, 'The challenge of providing family-centered services', ed. FH Bess, *Children with hearing impairment: Contemporary trends*, Vanderbilt Bill Wilkerson Center Press, Nashville, pp. 299–304.
- Mdlalo, T, Flack, P & Joubert, R 2016, 'Are South African speech-language therapists adequately equipped to assess English additional language (EAL) speakers who are from an indigenous linguistic and cultural background? A profile and exploration of the current situation', *South African Journal of Communication Disorders*, vol. 63, no. 1, a130. <https://doi.org/10.4102/sajcd.v63i1.130>
- Mdlalo, T, Flack, PS & Joubert, RW 2019, 'The cat on a hot tin roof? Critical considerations in multilingual language assessments', *South African Journal of Communication Disorders*, vol. 66, no. 1, a610. <https://doi.org/10.4102/sajcd.v66i1.610>
- Moeller, MP 2000, 'Early intervention and language development in children who are deaf and hard of hearing', *Pediatrics*, vol. 106, a43. <https://doi.org/10.1542/peds.106.3.e43>
- Moodley, S & Störbeck, C 2015, 'Narrative review of EHDl in South Africa', *South African Journal of Communication Disorders*, vol. 62, no. 1, a126. <https://doi.org/10.4102/sajcd.v62i1.126>
- Moonsamy, S, Mupawose, A, Seedat, J, Mophosho, M & Pillay, D 2017, 'Speech-language pathology and audiology in South Africa: Reflections on transformation in professional training and practice since the end of apartheid', *Perspectives of the ASHA Special Interest Groups*, vol. 2, no. 17, pp. 30–41. <https://doi.org/10.1044/persp2.SIG17.30>
- Mophosho, M 2018, 'Speech-language therapy consultation practices in multilingual and multicultural healthcare contexts: Current training in South Africa', *African Journal of Health Professions Education*, vol. 10, no. 3, pp. 145–147. <https://doi.org/10.7196/AJHPPE.2018.v10i3.1045>
- Motasaddi-Zarandy, M, Rezai, H, Mahdavi-Arab, M & Golestan, B 2009, 'The scholastic achievement of profoundly deaf children with cochlear implants compared to their normal peers', *Archives of Iranian Medicine*, vol. 12, no. 5, pp. 441–447.
- Mukara, KB, Lilford, RJ, Tucci, DL & Waiswa, P 2017, 'Prevalence of middle ear infections and associated risk factors in children under 5 years in Gasabo district of Kigali city, Rwanda', *International Journal of Pediatrics*, vol. 2017, a4280583. <https://doi.org/10.1155/2017/4280583>
- Nelson, L, Bradham, TS & Houston, KT 2011, 'The EHDl and early intervention connection', *The Volta Review*, vol. 111, pp. 133–149. <https://doi.org/10.17955/tvr.111.2.m.666>

- Niparko, JK, Tobey, EA, Thal, DJ, Eisenberg, LS, Wang, NY, Quittner, AL, Fink, NE & CDaCI Investigative Team 2010, 'Spoken language development in children following cochlear implantation', *JAMA*, vol. 303, no. 15, pp. 1498–1506. <https://doi.org/10.1001/jama.2010.451>
- Northern, JL & Downs, MP 1991, *Hearing in children*, Williams & Wilkins, Baltimore.
- Novaes, BCAC, Versolato-Cavanaugh, MC, Figueiredo, RDSL & Mendes, BDCA 2012, 'Determinants of communication skills development in children with hearing impairment', *Jornal Da Sociedade Brasileira De Fonoaudiologia*, vol. 24, no. 4, pp. 335–341. <https://doi.org/10.1590/S2179-64912012000400008>
- Olsson, S, Dag, M & Kullberg, C 2021, 'Hard of hearing adults' interpersonal interactions and relationships in daily life', *Disabilities*, vol. 1, pp. 71–88. <https://doi.org/10.3390/disabilities1020007>
- Olusanya, B 2015, 'Screening for neonatal deafness in resource-poor countries: Challenges and solutions', *Research and Reports in Neonatology*, vol. 5, pp. 51–64. <https://doi.org/10.2147/RRN.S61862>
- Orji, A, Kamenov, K, Dirac, M, Davis, A, Chadha, S & Vos, T 2020, 'Global and regional needs, unmet needs and access to hearing aids', *International Journal of Audiology*, vol. 59, no. 3, pp. 166–172. <https://doi.org/10.1080/14992027.2020.1721577>
- Orrie, S & Motsosi, T 2018, 'Challenges experienced by healthcare workers in managing patients with hearing impairment at a primary health care setting: A descriptive case study', *South African Family Practice*, vol. 60, no. 6, a5014. <https://doi.org/10.4102/safp.v60i6.5014>
- Pascoe, M & Norman, V 2011, 'Contextually relevant resources in speech-language therapy and audiology in South Africa-Are there any?', *The South African Journal of Communication Disorders*, vol. 58, a35. <https://doi.org/10.4102/sajcd.v58i1.35>
- Paul, D & Roth, FP 2011, 'Guiding principles and clinical applications for speech-language pathology practice in early intervention', *Language, Speech and Hearing Services in Schools*, vol. 42, pp. 320–330. [https://doi.org/10.1044/0161-1461\(2010/09-0079\)](https://doi.org/10.1044/0161-1461(2010/09-0079))
- Pillay, M & Kathard, H 2015, 'Decolonizing health professionals' education: Audiology and speech therapy in South Africa', *African Journal of Rhetoric*, vol. 7, no. 1, pp. 193–227.
- Pillay, MA 1997, 'The curriculum of practice: A conceptual framework for speech-language therapy and audiology practice with a black African first language clientele', *South African Journal of Communication Disorders*, vol. 44, no. 1, pp. 109–117. <https://doi.org/10.4102/sajcd.v44i1.232>
- Pimperton, H & Kennedy, CR 2012, 'The impact of early identification of permanent childhood hearing impairment on speech and language outcomes', *Archives of Disease in Childhood*, vol. 97, pp. 648–653. <https://doi.org/10.1136/archdischild-2011-301501>
- Punch, R & Hyde, MB 2011, 'Communication, psychosocial, and educational outcomes of children with cochlear implants and challenges remaining for professionals and parents', *International Journal of Otolaryngology*, vol. 2011, a573280. <https://doi.org/10.1155/2011/573280>
- Rutherford, C & Petersen, L 2019, 'Amplification and aural rehabilitation in resource-constrained environments', *The Journal of Laryngology and Otolaryngology*, vol. 133, no. 1, pp. 26–33. <https://doi.org/10.1017/S0022215118001378>
- Sass-Lehrer, M 2004, *Early detection of hearing loss: Maintaining a family-centered perspective*, viewed 15 April 2019, <[https://www.researchgate.net/publication/247475644\\_Early\\_Detection\\_of\\_Hearing\\_Loss\\_Maintaining\\_a\\_Family-Centered\\_Perspective](https://www.researchgate.net/publication/247475644_Early_Detection_of_Hearing_Loss_Maintaining_a_Family-Centered_Perspective)>
- Sapp, C & Welsh, WC 2019, 'The pediatric audiologist in early hearing detection and intervention (EHDi)', *Audiology Today*, viewed 17 February 2020, <<https://www.audiologyonline.com/articles/pediatric-audiologist-in-early-hearing-25248>>
- Scarinci, N, Gehrke, M, Ching, TY, Marnane, V & Button, L 2018, 'Factors influencing caregiver decision making to change the communication method of their child with hearing loss', *Deafness and Education International*, vol. 20, no. 3–4, pp. 123–153. <https://doi.org/10.1080/14643154.2018.1511239>
- Scheepers, LJ, Swanepoel, DW & Le Roux, T 2014, 'Why parents refuse newborn hearing screening and default on follow-up rescreening: A South African perspective', *International*

## References

- Journal of Pediatric Otorhinolaryngology*, vol. 78, no. 4, pp. 652-658. <https://doi.org/10.1016/j.ijporl.2014.01.026>
- Schwartz, RG (ed.) 2017, *Handbook of child language disorders*, Psychology Press, London.
- Simões, EAF, Kiiro, F, Carosone-Link, PJ, Ndegwa, SN, Ayugi, J & Macharia, IM 2016, 'Otitis media and its sequelae in Kenyan school children', *Journal of the Pediatric Infectious Diseases Society*, vol. 5, no. 4, pp. 375-384. <https://doi.org/10.1093/jpids/piv038>
- Smith, A, Hennessy, S, O'Connor, A, O'Sullivan, PG & Gibson, L 2017, 'Permanent childhood hearing impairment: Aetiological evaluation of infants identified through the Irish newborn hearing screening programme', *Irish Medical Journal*, vol. 110, no. 10, p. 651.
- South African Speech-Language Hearing Association (SASLHA) 2011, *Early communication intervention: Guidelines for speech-language therapists and audiologists working in early communication intervention*, SASLHA, Durban.
- Storbeck, C & Young, A 2016, 'The HI HOPES data set of deaf children under the age of 6 in South Africa: Maternal suspicion, age of identification and newborn hearing screening', *BMC Pediatrics*, vol. 16, p. 45. <https://doi.org/10.1186/s12887-016-0574-1>
- Sugar, MK & Goldberg, DM 2015, 'Ethics rounds needs to consider evidence for listening and spoken language for deaf children', *Pediatrics*, vol. 136, no. 5, a1487. <https://doi.org/10.1542/peds.2015-3106A>
- Tjørnhøj-Thomsen, T & Philipsen, HH 2021, 'Hearing loss as a social problem: A study of hearing-impaired spouses and their hearing partners', *The Hearing Review*, viewed 10 January 2022, <<https://www.hearingreview.com/hearing-loss/patient-care/hearing-loss-as-a-social-problem>>
- Wonkam, A, Noubiap, JJN, Djomou, F, Fieggen, K, Njock, R & Toure, GB 2013, 'Aetiology of childhood hearing loss in Cameroon (sub-Saharan Africa)', *European Journal of Medical Genetics*, vol. 56, no. 1, pp. 20-25. <https://doi.org/10.1075/bct.28.03gul>
- World Health Organization (WHO) 2008, *The worldwide incidence of preterm birth: A systematic review of maternal mortality and morbidity*, WHO, Geneva.
- World Health Organization (WHO) 2010, *Monitoring the building blocks of health systems: A handbook of indicators and their measurement strategies*, viewed 28 April 2019, <<https://apps.who.int/iris/handle/10665/258734>>
- World Health Organization (WHO) 2016, *Childhood hearing loss*, viewed 28 April 2019, <[https://www.who.int/docs/default-source/imported2/childhood-hearing-loss--strategies-for-prevention-and-care.pdf?sfvrsn=cbbb3cc\\_0](https://www.who.int/docs/default-source/imported2/childhood-hearing-loss--strategies-for-prevention-and-care.pdf?sfvrsn=cbbb3cc_0)>
- World Health Organization (WHO) 2017, *Preferred profile for hearing-aid technology suitable for low-and-middle-income countries*, viewed 28 April 2019, <<https://mca.essensys.ro/publications/i/item/preferred-profile-for-hearing-aid-technology-suitable-for-low--and-middle-income-countries>>
- World Health Organization (WHO) 2018, *Deafness and hearing loss*, viewed 28 April 2019, <<https://www.who.int/news-room/fact-sheets/detail/deafness-and-hearing-loss>>
- World Health Organization (WHO) 2019, *Burden of disease: What is it and why is it important for safer food?*, viewed 03 March 2020, <[https://web.archive.org/web/20220308071536/https://www.who.int/foodsafety/foodborne\\_disease/Q%26A.pdf](https://web.archive.org/web/20220308071536/https://www.who.int/foodsafety/foodborne_disease/Q%26A.pdf)>
- Yanbay, E, Hickson, L, Scarinci, N, Constantinescu, G & Dettman, SJ 2014, 'Language outcomes for children with cochlear implants enrolled in different communication programs', *Cochlear Implants International*, vol. 15, no. 3, pp. 121-135. <https://doi.org/10.1179/1754762813Y.0000000062>
- Yoshinaga-Itano, C & Gravel, JS 2001, 'The evidence for universal newborn hearing screening', *American Journal of Audiology*, vol. 10, no. 2, pp. 62-64. [https://doi.org/10.1044/1059-0889\(2001/013\)](https://doi.org/10.1044/1059-0889(2001/013))
- Zhan, W, Cruickshanks, KJ & Klein, BE 2010, 'Generational differences in the prevalence of hearing impairment in older adults', *American Journal of Epidemiology*, vol. 171, no. 2, pp. 260-266. <https://doi.org/10.1093/aje/kwp370>



## Chapter 4

- Agyepong, IA, Sewankambo, N, Binagwaho, A, Coll-Seck, AM, Corrah, T, Ezeh, A, Fekadu, A, Kilonzo, N, Lamptey, P, Masiye, F, Mayosi, B, Mboup, S, Muyembe, J-J, Pate, M, Sidibe, M, Simons, B, Tlou, S, Gheorghe, A, Legido-Quigley, H, McManus, J, Ng, E, O'Leary, M, Enoch, J, Kassebaum, N & Piot P 2017, 'The path to longer and healthier lives for all Africans by 2030: The lancet commission on the future of health in sub-Saharan Africa', *The Lancet*, vol. 390, no. 10114, pp. 2803–2859. [https://doi.org/10.1016/S0140-6736\(17\)31509-X](https://doi.org/10.1016/S0140-6736(17)31509-X)
- Allinder, S & Fleischman, J 2019, *The world's largest HIV epidemic in crisis: HIV in South Africa*, viewed 10 January 2020, <<https://www.csis.org/analysis/worlds-largest-hiv-epidemic-crisis-hiv-south-africa>>
- Alyami, H, Soer, M, Swanepoel, A & Pottas, L 2016, 'Deaf or hard of hearing children in Saudi Arabia: Status of early intervention services', *International Journal of Pediatric Otorhinolaryngology*, vol. 86, pp. 142–149. <https://doi.org/10.1016/j.ijporl.2016.04.010>
- Ataguba, JE, Day, C & McIntyre, D 2015, 'Explaining the role of the social determinants of health on health inequality in South Africa', *Global Health Action*, vol. 8, pp. 1–11. <https://doi.org/10.3402/gha.v8.28865>
- Ataguba, JE & McIntyre, D 2018, 'The incidence of health financing in South Africa: Findings from a recent data set', *Health Economics Policy and Law*, vol. 13, no. 1, pp. 68–91. <https://doi.org/10.1017/S1744133117000196>
- Avert 2019, *Global information and education on HIV and AIDS*, viewed 10 January 2020, <<https://www.avert.org/professionals/hiv-around-world/sub-saharan-africa/overview>>
- Balton, S, Uys, K & Alant, E 2019, 'Family-based activity settings of children in a low-income African context', *African Journal of Disability*, vol. 8, a364. <https://doi.org/10.4102/ajod.v8i0.364>
- Bezuidenhout, JK, Khoza-Shangase, K, De Maayer, T & Strehlau, R 2018, 'Universal newborn hearing screening in public healthcare in South Africa: Challenges to implementation', *South African Journal of Child Health*, vol. 12, no. 4, pp. 159–163. <https://doi.org/10.7196/SAJCH.2018.v12i4.1522>
- Bezuidenhout, JK, Khoza-Shangase, K, De Maayer, T & Strehlau, R 2021, 'Outcomes of newborn hearing screening at an academic secondary level hospital in Johannesburg, South Africa', *South African Journal of Communication Disorders*, vol. 68, no. 1, a741. <https://doi.org/10.4102/sajcd.v68i1.741>
- Burger, R & Christian, C 2020, 'Access to health care in post-apartheid South Africa: Availability, affordability, acceptability', *Health Economics, Policy and Law*, vol. 15, no. 1, pp. 43–55. <https://doi.org/10.1017/S1744133118000300>
- Butler, IRT, Ceronio, D, Swart, T & Joubert, G 2015, 'Age of diagnosis of congenital hearing loss: Private v. public healthcare sector', *South African Medical Journal*, vol. 105, no. 11, pp. 927–929. <https://doi.org/10.7196/SAMJ.2015.v105i11.9576>
- De Kock, T, Swanepoel, DW & Hall, JW 2016, 'Newborn hearing screening at a community-based obstetric unit: Screening and diagnostic outcomes', *International Journal of Pediatric Otorhinolaryngology*, vol. 84, pp. 124–131. <https://doi.org/10.1016/j.ijporl.2016.02.031>
- Ehlert, K & Coetzer, C 2020, 'Maternal knowledge and views regarding early hearing detection and intervention in children aged 0–5 years at a semi-urban primary care clinic in South Africa', *South African Journal of Communication Disorders*, vol. 67, no. 1, a681. <https://doi.org/10.4102/sajcd.v67i1.681>
- Elpers, J, Lester, C, Shinn, J & Bush, M 2016, 'Rural family perspectives and experiences with early infant hearing detection and intervention: A qualitative study', *Journal of Community Health*, vol. 41, no. 2, pp. 226–233. <https://doi.org/10.1007/s10900-015-0086-1>
- Flood, D & Rohloff, P 2018, 'Indigenous languages and global health', *The Lancet Global Health*, vol. 6, no. 2, pp. 134–135. [https://doi.org/10.1016/S2214-109X\(17\)30493-X](https://doi.org/10.1016/S2214-109X(17)30493-X)
- Friderichs, N, Swanepoel, DW & Hall, JW 2012, 'Efficacy of a community-based infant hearing screening program utilizing existing clinic personnel in Western Cape, South Africa', *International Journal of Pediatric Otorhinolaryngology*, vol. 76, no. 4, pp. 552–559. <https://doi.org/10.1016/j.ijporl.2012.01.015>

## References

- Health Professions Council of South Africa (HPCSA) 2018, *Early hearing detection and intervention (EHDI) guidelines*, viewed 10 January 2019, <[https://www.hpcsa.co.za/Uploads/SLH/Guidelines%20for%20Early\\_Hearing\\_Detection\\_and\\_Intervention\\_\(EHDI\)\\_2018.pdf](https://www.hpcsa.co.za/Uploads/SLH/Guidelines%20for%20Early_Hearing_Detection_and_Intervention_(EHDI)_2018.pdf)>
- Hosegood, V & Madhavan, S 2010, 'Data availability on men's involvement in families in sub-Saharan Africa to inform family-centred programmes for children affected by HIV and AIDS', *Journal of the International AIDS Society*, vol. 13, no. S2, aS5. <https://doi.org/10.1186/1758-2652-13-S2-S5>
- Ingber, S & Dromi, E 2009, 'Actual versus desired family-centered practice in early intervention for children with hearing loss', *Journal of Deaf Studies and Deaf Education*, vol. 15, no. 1, pp. 59-71. <https://doi.org/10.1093/deafed/enp025>
- Irina, D 2011, 'A culture of human rights and the right to culture', *Journal for Communication and Culture*, vol. 2, no. 2, pp. 30-48. <https://kalanga.org/wp-content/uploads/2015/12/Human-Rights-and-Culture.pdf>
- Iversen, MD, Shimmel, JP, Ciacera, SL & Prabhakar, M 2003, 'Creating a family-centered approach to early intervention services: Perceptions of parents and professionals', *Pediatric Physical Therapy*, vol. 15, no. 1, pp. 23-31. <https://doi.org/10.1097/01.PEP.0000051694.10495.79>
- Jackson, CW, Wegner, JR & Turnbull, AP 2010, 'Family quality of life following early identification of deafness', *Language, Speech, and Hearing Services in Schools*, vol. 41, no. 2, pp. 194-205. [https://doi.org/10.1044/0161-1461\(2009/07-0093\)](https://doi.org/10.1044/0161-1461(2009/07-0093))
- Joint United Nations Programme on HIV/AIDS (UNAIDS) 2019, *UNAIDS data 2019*, UNAIDS, Geneva, viewed 10 March 2020, <[https://www.unaids.org/sites/default/files/media\\_asset/2019-UNAIDS-data\\_en.pdf](https://www.unaids.org/sites/default/files/media_asset/2019-UNAIDS-data_en.pdf)>
- Kanji, A 2016, 'Early hearing screening in South Africa: Time to get real about context', *South African Journal of Child Health*, vol. 10, no. 4, a1298. <https://doi.org/10.7196/SAJCH.2016.v10i4.1298>
- Kanji, A 2018, 'Early hearing detection and intervention: Reflections from the South African context', *South African Journal of Communication Disorders*, vol. 65, no. 1, a581. <https://doi.org/10.4102/sajcd.v65i1.581>
- Kanji, A 2021, 'Exploring early detection of hearing impairment in sub-Saharan Africa', eds. K Khoza-Shangase & A Kanji, *Early detection and intervention in audiology: An African perspective*, Wits University Press, Johannesburg.
- Kanji, A & Kara, R 2013, 'Pediatric physicians' referral of children aged 0-3 years for audiological evaluation in the public health care sector', *Audiology Research*, vol. 3, no. 1, pp. 48-51. <https://doi.org/10.4081/audiore.2013.e7>
- Kanji, A & Khoza-Shangase, K 2012, 'The occurrence of high-risk factors for hearing loss in very-low-birth-weight neonates: A retrospective exploratory study of targeted hearing screening', *The South African Journal of Communication Disorders*, vol. 59, pp. 3-7. <https://doi.org/10.4102/sajcd.v59i1.16>
- Kanji, A & Khoza-Shangase, K 2021a, 'A paradigm shift in early hearing detection and intervention in South Africa', eds. K Khoza-Shangase & A Kanji, *Early detection and intervention in audiology: An African perspective*, Wits University Press, Johannesburg.
- Kanji, A & Khoza-Shangase, K 2021b, 'Risk factors for hearing impairment in neonates in South Africa: Scoping the context for newborn hearing screening planning', *The Journal of Maternal-Fetal and Neonatal Medicine*, vol. 34, no. 13, pp. 2107-2116. <https://doi.org/10.1080/14767058.2019.1658732>
- Kanji, A, Khoza-Shangase, K & Ballot, D 2010, 'Hearing screening follow-up return rate in a very low birth weight project: A retrospective record review', *South African Journal of Child Health*, vol. 4, no. 4, pp. 95-99. <https://doi.org/10>
- Kanji, A, Khoza-Shangase, K, Petrocchi-Bartal, L & Harbinson, S 2018, 'Feasibility of infant hearing screening from a developing country context: The South African experience', *Hearing, Balance and Communication*, vol. 16, no. 4, pp. 263-270. <https://doi.org/10.1080/21695717.2018.1519144>

- Kaspar, A, Newton, O, Kei, J, Driscoll, C, Swanepoel, DW & Goulios, H 2017, 'Parental knowledge and attitudes to childhood hearing loss and hearing services in the Solomon Islands', *International Journal of Pediatric Otorhinolaryngology*, vol. 103, pp. 87-92. <https://doi.org/10.1016/j.ijporl.2017.10.003>
- Khan, NB & Joseph, L 2020, 'Healthcare practitioners' views about early hearing detection and intervention practices in KwaZulu-Natal, South Africa', *South African Journal of Child Health*, vol. 14, no. 4, pp. 200-207. <https://doi.org/10.7196/SAJCH.2020.v14i4.1708>
- Khan, NB, Joseph, L & Adhikari, M 2018, 'The hearing screening experiences and practices of primary health care nurses: Indications for referral based on high-risk factors and community views about hearing loss', *African Journal of Primary Health Care and Family Medicine*, vol. 10, no. 1, a1848. <https://doi.org/10.4102/phcfm.v10i1.1848>
- Khoza-Shangase, K 2019, 'Early hearing detection and intervention in South Africa: Exploring factors compromising service delivery as expressed by caregivers', *International Journal of Pediatric Otorhinolaryngology*, vol. 118, pp. 73-78. <https://doi.org/10.1016/j.ijporl.2018.12.021>
- Khoza-Shangase, K 2021, 'Confronting realities to early hearing detection in South Africa', eds. K Khoza-Shangase & A Kanji, *Early detection and intervention in audiology: An African perspective*, Wits University Press, Johannesburg, pp. 66-68.
- Khoza-Shangase, K 2022, 'Early hearing detection and intervention: Considering the role of caregivers as key co-drivers within the African context', in K Khoza-Shangase (ed.), *Preventive audiology: An African perspective*, AOSIS Books, Cape Town, pp. 157-177. <https://doi.org/10.4102/aosis.2022.BK209.08>
- Khoza-Shangase, K, Barratt, J & Jonosky, J 2010, 'Protocols for early audiology intervention services: Views from early intervention practitioners in a developing country', *South African Journal of Child Health*, vol. 4, no. 4, pp. 100-105. <https://doi.org/10.7196/sajch.271>
- Khoza-Shangase, K & Harbinson, S 2015, 'Evaluation of universal newborn hearing screening in South African primary care', *African Journal of Primary Health Care and Family Medicine*, vol. 7, no. 1, a769. <https://doi.org/10.4102/phcfm.v7i1.769>
- Khoza-Shangase, K, Kanji, A & Ismail, F 2021, 'What are the current practices employed by audiologists in early hearing detection and intervention in the South African healthcare context?', *International Journal of Pediatric Otorhinolaryngology*, vol. 141, a110587. <https://doi.org/10.1016/j.ijporl.2020.110587>
- Khoza-Shangase, K, Kanji, A, Petrocchi-Bartal, L & Farr, K 2017, 'Infant hearing screening in a developing-country context: Status in two South African provinces', *South African Journal of Child Health*, vol. 11, no. 4, pp. 159-163. <https://doi.org/10.7196/SAJCH.2017.v11i4.1267>
- Khoza-Shangase, K & Michal, G 2014, 'Early intervention in audiology: Exploring the current status from a developing country context', *British Journal of Medicine and Medical Research*, vol. 4, no. 11, pp. 2238-2249. <https://doi.org/10.9734/BJMRR/2014/7322>
- Khoza-Shangase, K & Mophosho, M 2018, 'Language and culture in speech-language and hearing professions in South Africa: The dangers of a single story', *South African Journal of Communication Disorders*, vol. 65, no. 1, a594. <https://doi.org/10.4102/sajcd.v65i1.594>
- Khoza-Shangase, K & Mophosho, M 2021, 'Language and culture in speech-language and hearing professions in South Africa: Re-imagining practice', *South African Journal of Communication Disorders*, vol. 68, no. 1, a793. <https://doi.org/10.4102/sajcd.v68i1.793>
- Krishnan, LA & Donaldson, LK 2013, 'Newborn hearing screening in developing countries: Understanding the challenges and complexities of implementation', *Perspectives on Global Issues in Communication Sciences and Related Disorders*, vol. 3, no. 2, pp. 54-61. <https://doi.org/10.1044/gics3.2.54>
- Lasisi, AO, Onakoya, PA, Lasisi, TJ, Akinola, MD & Tongo, O 2014, 'Neonatal hearing screening in a rural/sub-urban community in Nigeria, sub-Saharan Africa: A preliminary report', *International Journal of Pediatric Otorhinolaryngology*, vol. 78, no. 9, pp. 1452-1455. <https://doi.org/10.1016/j.ijporl.2014.06.003>
- Leeper, SC, Montague, BT, Friedman, JF & Flanigan, TP 2010, 'Lessons learned from family-centred models of treatment for children living with HIV: Current approaches and future directions', *Journal of the international AIDS Society*, vol. 13, no. S2, aS3. <https://doi.org/10.1186/1758-2652-13-S2-S3>



## References

- Luyirika, E, Towle, MS, Achan, J, Muhangi, J, Senyimba, C, Lule, F & Muhe, L 2013, 'Scaling up paediatric HIV care with an integrated, family-centred approach: An observational case study from Uganda', *PLoS One*, vol. 8, no. 8, a69548. <https://doi.org/10.1371/journal.pone.0069548>
- MacKean, GL, Thurston, WE & Scott, CM 2005, 'Bridging the divide between families and health professionals' perspectives on family-centred care', *Health Expectations*, vol. 8, no. 1, pp. 74-85. <https://doi.org/10.1111/j.1369-7625.2005.00319.x>
- Mackey, AR, Bussé, AML, Hoeve, HLJ, Goedegebure, A, Carr, G, Simonsz, HJ, Uhlén, IM & EUS€REEN Foundation 2021, 'Assessment of hearing screening programmes across 47 countries or regions II: Coverage, referral, follow-up and detection rates from newborn hearing screening', *International Journal of Audiology*, vol. 60, no. 11, pp. 1-10. <https://doi.org/10.1080/14992027.2021.1886351>
- Maluleke, NP, Chiwutsi, R & Khoza-Shangase, K 2021b, 'Family-centered early hearing detection and intervention', eds. K Khoza-Shangase & A Kanji, *Early hearing detection and intervention in audiology*, Wits University Press, Johannesburg, pp. 196-218.
- Maluleke, NP, Khoza-Shangase, K & Kanji, A 2018, 'Hearing impairment detection and intervention in children from centre-based early intervention programmes', *Journal of Child Health Care*, vol. 23, no. 2, pp. 232-241. <https://doi.org/10.1177/1367493518788477>
- Maluleke, NP, Khoza-Shangase, K & Kanji, A 2019, 'Communication and school readiness abilities of children with hearing impairment in South Africa: A retrospective review of early intervention preschool record', *South African Journal of Communication Disorders*, vol. 66, no. 1, a604. <https://doi.org/10.4102/sajcd.v66i1.604>
- Maluleke, NP, Khoza-Shangase, K & Kanji, A 2021a, 'An integrative review of current practice models and/or process of family-centered early intervention for children who are deaf or hard of hearing', *Family and Community Health*, vol. 44, no. 1, pp. 59-71. <https://doi.org/10.1097/FCH.0000000000000276>
- Maluleke, NP, Khoza-Shangase, K & Kanji, A 2021c, 'School readiness and academic achievement of children with hearing impairment: A South African exploratory study', *South African Journal of Childhood Education*, vol. 11, no. 1, a898. <https://doi.org/10.4102/sajce.v11i1.898>
- Maluleke, NP, Khoza-Shangase, K & Kanji, A 2021, 'Caregivers' experiences of the Early Hearing Detection and Intervention (EHDI) process from detection to intervention in South Africa', *BMC Health Services Research*, vol. 2021, n.p.
- Manus, M, Van Der Linde, J, Kuper, H, Olinger, R & Swanepoel, DW 2021, 'Community-based hearing and vision screening in schools in low-income communities using mobile health technologies', *Language, Speech, and Hearing Services in Schools*, vol. 52, no. 2, pp. 568-580. [https://doi.org/10.1044/2020\\_LSHSS-20-00089](https://doi.org/10.1044/2020_LSHSS-20-00089)
- McCarthy, M, Leigh, G & Arthur-Kelly, M 2019, 'Telepractice delivery of family-centred early intervention for children who are deaf or hard of hearing: A scoping review', *Journal of Telemedicine and Telecare*, vol. 25, no. 4, pp. 249-260. <https://doi.org/10.1177/1357633X18755883>
- McPherson, B 2012, 'Newborn hearing screening in developing countries: Needs & new directions', *The Indian Journal of Medical Research*, vol. 135, no. 2, n.p.
- McLaren, ZM, Ardington, C & Leibbrandt, M 2014, 'Distance decay and persistent health care disparities in South Africa', *BMC Health Services Research*, vol. 14, no. 1, pp. 1-9. <https://doi.org/10.1186/s12913-014-0541-1>
- Merugumala, SV, Pothula, V & Cooper, M 2017, 'Barriers to timely diagnosis and treatment for children with hearing impairment in a southern Indian city: A qualitative study of parents and clinic staff', *International Journal of Audiology*, vol. 56, no. 10, pp. 733-739. <https://doi.org/10.1080/14992027.2017.1340678>
- Meyer, ME & De Swanepoel, W 2011, 'Newborn hearing screening in the private health care sector: A national survey', *South African Medical Journal*, vol. 101, no. 9, pp. 665-667.
- Moeller, MP, Carr, G, Seaver, L, Stredler-Brown, A & Holzinger, D 2013, 'Best practices in family-centered early intervention for children who are deaf or hard of hearing: An international consensus statement', *Journal of Deaf Studies and Deaf Education*, vol. 18, no. 4, pp. 429-445. <https://doi.org/10.1093/deafed/ent034>

- Moodley, S & Storbeck, C 2015, 'Narrative review of EHDl in South Africa', *The South African Journal of Communication Disorders*, vol. 62, no. 1, a126. <https://doi.org/10.4102/sajcd.v62i1.126>
- Mophosho, M 2018, 'Speech-language therapy consultation practices in multilingual and multicultural healthcare contexts: Current training in South Africa', *African Journal of Health Professions Education*, vol. 10, no. 3, a1045. <https://doi.org/10.7196/AJHPE.2018.v10i3.1045>
- Nikolopoulos, TP 2015, 'Neonatal hearing screening: What we have achieved and what needs to be improved', *International Journal of Pediatric Otorhinolaryngology*, vol. 79, no. 5, pp. 635-637.
- Nkonki, LL, Chopra, M, Doherty, TM, Jackson, D & Robberstad, B 2011, 'Explaining household socio-economic related child health inequalities using multiple methods in three diverse settings in South Africa', *International Journal for Equity in Health*, vol. 10, no. 1, pp. 1-14. <https://doi.org/10.1186/1475-9276-10-13>
- Olugbenga, EO 2017, 'Workable social health insurance systems in sub-Saharan Africa: Insights from four countries', *Africa Development*, vol. 42, no. 1, pp. 147-175. <https://doi.org/10.7196/AJHPE.2018.v10i3.1045>
- Pascoe, M, Klop, D, Mdlalo, T & Ndhambi, M 2018, 'Beyond lip service: Towards human rights-driven guidelines for South African speech-language pathologists', *International Journal of Speech-Language Pathology*, vol. 20, no. 1, pp. 67-74. <https://doi.org/10.1080/17549507.2018.1397745>
- Patel, H, Feldman, M, Canadian Paediatric Society & Community Paediatrics Committee 2011, 'Universal newborn hearing screening', *Paediatrics and Child Health*, vol. 16, no. 5, pp. 301-305. <https://doi.org/10.1093/pch/16.5.301>
- Petersen, L & Ramma, L 2015, 'Screening for childhood hearing impairment in resourceconstrained settings: Opportunities and possibilities', *South African Medical Journal*, vol. 105, no. 11, pp. 901-902. <https://doi.org/10.7196/SAMJ.2015.v105i11.10082>
- Petrocchi-Bartal, L & Khoza-Shangase, K 2014, 'Factors influencing the implementation of newborn and infant hearing screening programmes at primary health care clinics in South Africa', *Advances in Research*, vol. 2, no. 12, pp. 935-949. <https://doi.org/10.9734/AIR/2014/11387>
- Petrocchi-Bartal, L & Khoza-Shangase, K 2016, 'Infant hearing screening at primary healthcare immunisation clinics in South Africa: The current status', *South African Journal of Child Health*, vol. 10, no. 2, pp. 139-143. <https://doi.org/10.7196/SAJCH.2016.v10i2.1114>
- Pillay, Y & Barron, P 2014, 'Progress towards the millennium development goals in SA', *South African Medical Journal*, vol. 104, no. 3, a7924. <https://doi.org/10.7196/SAMJ.7924>
- Pillay, M, Tiwari, R, Kathard, H & Chikte, U 2020, 'Sustainable workforce: South African audiologists and speech therapists', *Human Resources for Health*, vol. 18, no. 1, pp. 1-13. <https://doi.org/10.1186/s12960-020-00488-6>
- Sass-Lehrer, M, Porter, A & Wu, CL 2016, 'Families: Partnerships in practice', eds. M Sass-Lehrer, *Early intervention for deaf and hard-of-hearing infants, toddlers, and their families: interdisciplinary perspectives*, Oxford University Press, Oxford, pp. 65-104.
- Scheepers, LJ, Swanepoel, DW & Roux, TL 2014, 'Why parents refuse newborn hearing screening and default on follow-up rescreening: A South African perspective', *International Journal of Pediatric Otorhinolaryngology*, vol. 78, no. 4, pp. 652-658. <https://doi.org/10.1016/j.ijporl.2014.01.026>
- Simkins, C 2019, *The coming demographic crisis in sub-Saharan Africa*, viewed 10 February 2020, <<https://hsf.org.za/publications/hsf-briefs/the-coming-demographic-crisis-in-sub-saharan-africa>>
- Statistics South Africa (StatsSA) 1998, *Profiling South African middle-class households, 1998-2006*, viewed 10 March 2018, <<http://www.statssa.gov.za/publications/Report-03-03-01/Report-03-03-01.pdf>>
- StatisticsSouthAfrica(StatsSA)2018,*Generalhouseholdsurvey*,viewed10January2019,<[http://www.statssa.gov.za/publications/P0318/P03182018.pdf?\\_ga=2.79402518.347510329.1651729299-1159033596.1612509326](http://www.statssa.gov.za/publications/P0318/P03182018.pdf?_ga=2.79402518.347510329.1651729299-1159033596.1612509326)>

- Störbeck, C & Young, A 2016, 'The hi hopes data set of deaf children under the age of 6 in South Africa: Maternal suspicion, age of identification and newborn hearing screening', *BMC Pediatrics*, vol. 16, no. 1, pp. 1-10. <https://doi.org/10.1186/s12887-016-0574-1>
- Swanepoel, DW 2009, 'Early detection of infant hearing loss in South Africa', *South African Medical Journal*, vol. 99, no. 3, pp. 158-159.
- Theunissen, M & Swanepoel, D 2008, 'Early hearing detection and intervention services in the public health sector in South Africa', *International Journal of Audiology*, vol. 47, no. suppl\_1, pp. 23-29. <https://doi.org/10.1080/14992020802294032>
- United Nations 2015, *The millennium development goals report*, viewed 30 June 2018, <[https://www.undp.org/publications/millennium-development-goals-report-2015?c\\_src=CENTRAL&c\\_src2=GSR](https://www.undp.org/publications/millennium-development-goals-report-2015?c_src=CENTRAL&c_src2=GSR)>
- Vergunst, R, Swartz, L, Hem, KG, Eide, AH, Mannan, H, MacLachlan, M, Mji, G, Braathen, SH & Schneider, M 2017, 'Access to health care for persons with disabilities in rural South Africa', *BMC Health Services Research*, vol. 17, no. 1, pp. 1-8. <https://doi.org/10.1186/s12913-017-2674-5>
- Vetcho, S, Cooke, M & Ullman, AJ 2020, 'Family-centred care in dedicated neonatal units: An integrative review of international perspectives', *Journal of Neonatal Nursing*, vol. 26, no. 2, pp. 73-92. <https://doi.org/10.1016/j.jnn.2019.09.004>
- Watermeyer, J, Kanji, A & Sarvan, S 2017, 'The first step to early intervention following diagnosis: Communication in pediatric hearing aid orientation sessions', *American Journal of Audiology*, vol. 26, no. 4, pp. 576-582. [https://doi.org/10.1044/2017\\_AJA-17-0027](https://doi.org/10.1044/2017_AJA-17-0027)
- Woods, J, Wilcox, J, Friedman, MMT & Forum, C 2011, 'Collaborative consultation in natural family-centered supports and services', *Language, Speech, and Hearing Services in Schools*, vol. 42, no. 3, pp. 379-393. [https://doi.org/10.1044/0161-1461\(2011/10-0016\)](https://doi.org/10.1044/0161-1461(2011/10-0016))
- World Health Organization (WHO) 2022, *Control and prevention of blindness and deafness*, viewed 15 February 2022, <<http://www.emro.who.int/control-and-preventions-of-blindness-and-deafness/about-the-programme/about-the-programme.html>>
- Yoshinaga-Itano, C 2004, 'Levels of evidence: Universal newborn hearing screening (UNHS) and early hearing detection and intervention systems (EHDI)', *Journal of Communication Disorders*, vol. 37, no. 5, pp. 451-465. <https://doi.org/10.1016/j.jcomdis.2004.04.008>

## Chapter 5

- Akhtar, N, Haneef, M & Naeem, A 2020, 'Chronic suppurative otitis media contributory factors and their prevention', *Annals of Punjab Medical College*, vol. 14, no. 3, pp. 209-213. <https://doi.org/10.29054/apmc/2020.858>
- American Academy of Audiology (AAA) 2012, *Assessment of hearing in infants and young children*, viewed 20 March 2018, <[https://audiology-web.s3.amazonaws.com/migrated/201208\\_AudGuideAssessHear\\_youth.pdf\\_5399751b249593.36017703.pdf](https://audiology-web.s3.amazonaws.com/migrated/201208_AudGuideAssessHear_youth.pdf_5399751b249593.36017703.pdf)>
- Atkinson, K & Mabey, D 2019, 'The burden of communicable diseases in low-and middle-income countries', eds. K Atkinson & D Mabey, *Revolutionizing tropical medicine: Point-of-care tests, new imaging technologies and digital health*, Wiley-Blackwell, pp. 1-36.
- Avrunin, O, Kolisnyk, K, Nosova, Y, Tomashevskiy, R & Shushliapina, N 2020, 'Improving the methods for visualization of middle ear pathologies based on telemedicine services in remote treatment', in *2020 IEEE KhPI Week on Advanced Technology (KhPIWeek)*, IEEE, pp. 347-350, viewed 18 February 2021, <<https://ieeexplore.ieee.org/document/9250090>>
- Bakari, AA, Adoga, AA, Afolabi, OA, Kodiya, AM & Ahmad, BM 2010, 'Pattern of chronic suppurative otitis media at the national ear care centre Kaduna, Nigeria', *Journal of Medicine in the Tropics*, vol. 12, no. 1, pp. 22-25. <https://doi.org/10.4314/jmt.v12i1.69307>
- Barbara, M, Perotti, M, Gioia, B, Volpini, L & Monini, S 2013, 'Transcutaneous bone-conduction hearing device: Audiological and surgical aspects in a first series of patients with mixed hearing loss', *Acta Oto-Laryngologica*, vol. 133, no. 10, pp. 1058-1064. <https://doi.org/10.3109/O0016489.2013.799293>

- Bergmark, RW, Shaye, DA & Shrime, MG 2018, 'Surgical care and otolaryngology in global health', *Otolaryngologic Clinics of North America*, vol. 51, no. 3, pp. 501–513. <https://doi.org/10.1016/j.otc.2018.01.001>
- Bezuidenhout, JK, Khoza-Shangase, K, De Maayer, T & Strehlau, R 2018, 'Universal newborn hearing screening in public healthcare in South Africa: Challenges to implementation', *South African Journal of Child Health*, vol. 12, no. 4, pp. 159–163. <https://doi.org/10.7196/SAJCH.2018.v12i4.1522>
- Bezuidenhout, JK, Khoza-Shangase, K, De Maayer, T & Strehlau, R 2021, 'Outcomes of newborn hearing screening at an academic secondary level hospital in Johannesburg, South Africa', *South African Journal of Communication Disorders*, vol. 68, no. 1, a741. <https://doi.org/10.4102/sajcd.v68i1.741>
- Biagio, L, Swanepoel, DW, Adeyemo, A, Hall, III, JW & Vinck, B 2013, 'Asynchronous video-otoscopy with a telehealth facilitator', *Telemedicine and e-Health*, vol. 19, no. 4, pp. 252–258. <https://doi.org/10.1089/tmj.2012.0161>
- Biagio, L, Swanepoel, DW, Laurent, C & Lundberg, T 2014, 'Paediatric otitis media at a primary healthcare clinic in South Africa', *South African Medical Journal*, vol. 104, no. 6, pp. 431–435. <https://doi.org/10.7196/SAMJ.7534>
- Bing, D, Ying, J, Miao, J, Lan, L, Wang, D, Zhao, L, Yin, Z, Yu, L, Guan, J & Wang, Q 2018, 'Predicting the hearing outcome in sudden sensorineural hearing loss via machine learning models', *Clinical Otolaryngology*, vol. 43, no. 3, pp. 868–874. <https://doi.org/10.1111/coa.13068>
- Birman, C 2006, *Management of otitis media, modern medicine of South Africa*, viewed 02 December 2019, <[https://journals.co.za/doi/pdf/10.10520/AJA02599333\\_2792](https://journals.co.za/doi/pdf/10.10520/AJA02599333_2792)>
- Bluestone, CD 1998, 'Epidemiology and pathogenesis of chronic suppurative otitis media: Implications for prevention and treatment', *International Journal of Pediatric Otorhinolaryngology*, vol. 42, no. 3, pp. 207–223. [https://doi.org/10.1016/S0165-5876\(97\)00147-X](https://doi.org/10.1016/S0165-5876(97)00147-X)
- British Society of Audiology (BSA) 2013, *Recommended procedure: Tympanometry*, viewed 18 February 2020, <[http://www.thebsa.org.uk/wp-content/uploads/2014/04/BSA\\_RP\\_Tymp\\_Final\\_21Aug13\\_Final.pdf](http://www.thebsa.org.uk/wp-content/uploads/2014/04/BSA_RP_Tymp_Final_21Aug13_Final.pdf)>
- Campos, UDP, Sanches, SG, Hatzopoulos, S, Carvallo, RMM, Kochanek, K & Skarżyński, H 2012, 'Alteration of distortion product otoacoustic emission input/output functions in subjects with a previous history of middle ear dysfunction', *Medical Science Monitor*, vol. 18, no. 4, pp. 27–31. <https://doi.org/10.12659/MSM.882605>
- Chandrasekar, SS, Connelly, PE, Brahmabhatt, SS, Shah, CS, Kloster, PC & Beredes, S 2000, 'Otologic and audiologic evaluation of human immunodeficiency virus-infected patients', *American Journal of Otolaryngology*, vol. 21, no. 1, pp. 1–9. [https://doi.org/10.1016/S0196-0709\(00\)80117-9](https://doi.org/10.1016/S0196-0709(00)80117-9)
- Cordes, SR, Robbins, KT & Woodson, G 2018, 'Otolaryngology in low-resource settings: Practical and ethical considerations', *Otolaryngologic Clinics of North America*, vol. 51, no. 3, pp. 543–554. <https://doi.org/10.1016/j.otc.2018.01.003>
- Crowson, MG, Ranisau, J, Eskander, A, Babier, A, Xu, B, Kahmke, RR, Chen, JM & Chan, TCY 2020, 'A contemporary review of machine learning in otolaryngology: Head and neck surgery', *The Laryngoscope*, vol. 130, no. 1, pp. 45–51. <https://doi.org/10.1002/lary.27850>
- Cruz, JA & Wishart, DS 2006, 'Applications of machine learning in cancer prediction and prognosis', *Cancer Informatics*, vol. 2, a117693510600200030. <https://doi.org/10.1177/117693510600200030>
- De Jong, MA, Luder, A & Gross, M 2019, 'Main aspects of peripheral and central hearing system involvement in unexplained HIV-related hearing complaints', *Frontiers in Neurology*, vol. 10, a845. <https://doi.org/10.3389/fneur.2019.00845>
- De Silva, D, Ranasinghe, W, Bandaragoda, T, Adikari, A, Mills, N, Iddamalgoda, L, Alahakoon, D, Lawrentschuk, N, Persad, R, Osipov, E, Gray, R & Bolton, D 2018, 'Machine learning to support social media empowered patients in cancer care and cancer treatment decisions', *PLoS One*, vol. 13, no. 10, a0205855. <https://doi.org/10.1371/journal.pone.0205855>

## References

- Dimitrieska, S, Stankovsk, A & Efremova, T 2018, 'The Fourth Industrial Revolution: Advantages and disadvantages', *Economics and Management*, vol. 14, no. 2, pp. 182-187.
- Dubno, JR, Eckert, MA, Lee, FS, Matthews, LJ & Schmiedt, RA 2013, 'Classifying human audiometric phenotypes of age-related hearing loss from animal models', *Journal of the Association for Research in Otolaryngology*, vol. 14, no. 5, pp. 687-701. <https://doi.org/10.1007/s10162-013-0396-x>
- Emanuel, DC, Henson, OE & Knapp, RR 2012, 'Survey of audiological immittance practices', *American Journal of Audiology*, vol. 21, no. 1, pp. 60-70. [https://doi.org/10.1044/1059-0889\(2012/11-0037\)](https://doi.org/10.1044/1059-0889(2012/11-0037))
- Erkkola-Anttinen, N, Tähtinen, PA, Laine, MK & Ruohola, A 2014, 'Parental role in the diagnostics of otitis media: Can parents be taught to use tympanometry reliably?', *International Journal of Pediatric Otorhinolaryngology*, vol. 78, no. 7, pp. 1036-1039. <https://doi.org/10.1016/j.ijporl.2014.03.035>
- Fagan, JJ 2012, 'Developing world ENT: A global responsibility', *The Journal of Laryngology and Otology*, vol. 126, no. 6, pp. 544-547. <https://doi.org/10.1017/S0022215112000345>
- Fagan, JJ 2018, 'Workforce considerations, training, and diseases in Africa', *Otolaryngologic Clinics of North America*, vol. 51, no. 3, pp. 643-649. <https://doi.org/10.1016/j.otc.2018.01.009>
- Fagan, JJ & Jacobs, M 2009, 'Survey of ENT services in Africa: Need for a comprehensive intervention', *Global Health Action*, vol. 2, no. 1, a1932. <https://doi.org/10.3402/gha.v2i0.1932>
- Fang, SH, Tsao, Y, Hsiao, MJ, Chen, JY, Lai, YH, Lin, FC & Wang, CT 2019, 'Detection of pathological voice using cepstrum vectors: A deep learning approach', *Journal of Voice*, vol. 33, no. 5, pp. 634-641. <https://doi.org/10.1016/j.jvoice.2018.02.003>
- Farooq, M, Ghani, S & Hussain, S 2018, 'Prevalence of ear, nose and throat diseases and adequacy of ENT training among general physicians', *International Journal of Pathology*, vol. 20, pp. 113-115.
- Flood, D & Rohloff, P 2018, 'Indigenous languages and global health', *The Lancet Global Health*, vol. 6, no. 2, pp. 134-135. [https://doi.org/10.1016/S2214-109X\(17\)30493-X](https://doi.org/10.1016/S2214-109X(17)30493-X)
- Forde, C & Gallagher, S 2020, 'Postgraduate online teaching in healthcare: An analysis of student perspectives', *Online Learning*, vol. 24, no. 1, pp. 118-139. <https://doi.org/10.24059/olj.v24i1.1566>
- Gelfand, SA 2017, *Essentials of audiology*, Thieme Medical Publishers, Stuttgart.
- Ghebreyesus, TA 2017, 'All roads lead to universal health coverage', *Lancet Global Health*, vol. 5, no. 9, pp. 839-840. [https://doi.org/10.1016/S2214-109X\(17\)30295-4](https://doi.org/10.1016/S2214-109X(17)30295-4)
- Giger, ML 2018, 'Machine learning in medical imaging', *Journal of the American College of Radiology*, vol. 15, no. 3, pp. 512-520. <https://doi.org/10.1016/j.jacr.2017.12.028>
- Gina, A, Bednarczuk, NF, Jayawardena, A, Rea, P, Arshad, Q & Saman, Y 2021, 'Universal newborn hearing screening in South Africa: A single-centre study', *BMJ Paediatrics Open*, vol. 5, no. 1, a000976. <https://doi.org/10.1136/bmjpo-2020-000976>
- Goggin, LS, Eikelboom, RH & Atlas, MD 2007, 'Clinical decision support systems and computer-aided diagnosis in otology', *Otolaryngology - Head and Neck Surgery*, vol. 136, suppl. 4, pp. 21-26. <https://doi.org/10.1016/j.otohns.2007.01.028>
- Grewal, US, Terauchi, S & Beg, MS 2020, 'Tele-health and palliative care for cancer patients: Implications for the COVID-19 pandemic', *JMIR Cancer*, vol. 6, no. 2, a20288. <https://doi.org/10.2196/20288>
- Grossman-Kahn, R, Schoen, J, Mallett, JW, Brentani, A, Kaselitz, E & Heisler, M 2018, 'Challenges facing community health workers in Brazil's family health strategy: A qualitative study', *The International Journal of Health Planning and Management*, vol. 33, no. 2, pp. 309-320. <https://doi.org/10.1002/hpm.2456>
- Halicek, M, Lu, G, Little, JV, Wang, X, Patel, M, Griffith, CC, El-Deiry, MW, Chen, AY & Fei, B 2017, 'Deep convolutional neural networks for classifying head and neck cancer using hyperspectral imaging', *Journal of Biomedical Optics*, vol. 22, no. 6, a060503. <https://doi.org/10.1117/1.JBO.22.6.060503>
- Hancock, M, Hoa, M & Malekzadeh, S 2018, 'Educational resources for global health in otolaryngology', *Otolaryngologic Clinics of North America*, vol. 51, no. 3, pp. 563-574. <https://doi.org/10.1016/j.otc.2018.01.005>



- Hlayisi, VG, Petersen, L & Ramma, L 2019, 'High prevalence of disabling hearing loss in young to middle-aged adults with diabetes', *International Journal of Diabetes in Developing Countries*, vol. 39, no. 1, pp. 148-153. <https://doi.org/10.1007/s13410-018-0655-9>
- Howells, S, Cardell, EA, Waite, MC, Bialocerkowski, A & Tuttle, N 2019, 'A simulation-based learning experience in augmentative and alternative communication using telepractice: Speech pathology students' confidence and perceptions', *Advances in Simulation*, vol. 4, no. 1, pp. 1-11. <https://doi.org/10.1186/s41077-019-0113-x>
- Hunter, LL 2021, 'Recent advances in otoacoustic emissions', in *Advances in audiology and hearing sciences: Clinical protocols and hearing devices*, vol. 1, pp. 237-272, viewed 18 December 2021, <<https://zallib.org/book/5869934/99bd65?id=5869934&secret=99bd65&dsource=recommend>>
- Hunter, LL & Shahnaz, N 2013, *Acoustic immittance measures: Basic and advanced practice*, Plural Publishing, San Diego.
- Hunter, LL, Tubaugh, L, Jackson, A & Propes, S 2008, 'Wideband middle ear power measurement in infants and children', *Journal of American Academy of Audiology*, vol. 19, no. 4, pp. 309-324. <https://doi.org/10.3766/jaaa.19.4.4>
- Hussain, Z & Pei, R 2021, 'Necessities, opportunities, and challenges for tympanic membrane perforation scaffolding-based bioengineering', *Biomedical Materials*, vol. 16, no. 3, a032004. <https://doi.org/10.1088/1748-605X/abcf5d>
- Ibekwe, TS & Nwaorgu, OGB 2011, 'Classification and management challenges of otitis media in a resource-poor country', *Nigerian Journal of Clinical Practice*, vol. 14, no. 3, pp. 262-269. <https://doi.org/10.4103/1119-3077.86764>
- Ibraheem, WM 2014, 'Clinical diagnosis of middle ear disorders using wideband energy reflectance in adults', *Advanced Arab Academy of Audio-Vestibulology Journal*, vol. 1, no. 2, pp. 87-96. <https://doi.org/10.4103/2314-8667.149017>
- Institute for Health Metrics and Evaluation 2013, *The global burden of disease: Generating evidence, guiding policy*, viewed 10 March 2020, <[http://www.healthdata.org/sites/default/files/files/policy\\_report/2013/GBD\\_GeneratingEvidence/IHME\\_GBD\\_GeneratingEvidence\\_FullReport.pdf](http://www.healthdata.org/sites/default/files/files/policy_report/2013/GBD_GeneratingEvidence/IHME_GBD_GeneratingEvidence_FullReport.pdf)>
- Joint United Nations Program on AIDS/HIV 2020, *Global AIDS update*, viewed 07 January 2021, <[https://www.unaids.org/sites/default/files/media\\_asset/2020\\_global-aids-report\\_en.pdf](https://www.unaids.org/sites/default/files/media_asset/2020_global-aids-report_en.pdf)>
- Joubert, K & Botha, D 2019, 'Contributing factors to high prevalence of hearing impairment in the Elias Motsoaledi local municipal area, South Africa: A rural perspective', *South African Journal of Communication Disorders*, vol. 66, no. 1, a611. <https://doi.org/10.4102/sajcd.v66i1.611>
- Joubert, K, Sebothoma, B & Kgare, KS 2017, 'Public awareness of audiology, hearing and hearing health in the Limpopo province, South Africa', *South African Journal of Communication Disorders*, vol. 64, no. 1, a557. <https://doi.org/10.4102/sajcd.v64i1.557>
- Kaf, WA 2011, 'Wideband energy reflectance findings in presence of normal tympanogram in children with Down's syndrome', *International Journal of Pediatric Otorhinolaryngology*, vol. 75, no. 2, pp. 219-226. <https://doi.org/10.1016/j.ijporl.2010.11.004>
- Kamfwa, AM & Mwanakasale, V 2016, 'Pattern of pediatric ear, nose and throat diseases at Arthur Davison children's Hospital, Ndola, Zambia', *Asian Pacific Journal of Health Sciences*, vol. 3, no. 3, pp. 201-208. <https://docplayer.net/35061364-Pattern-of-pediatric-ear-nose-and-throat-diseases-at-arthur-davison-children-s-hospital-ndola-zambia.html>
- Kanji, A 2019, 'Ambient noise levels and hearing screening outcomes: Where technology meets clinical decision making', *Hearing, Balance and Communication*, vol. 17, no. 1, pp. 12-17. <https://doi.org/10.1080/21695717.2018.1540226>
- Kanji, A 2021, 'Exploring early detection of hearing impairment in sub-Saharan Africa', eds. K Khoza-Shangase & A Kanji, *Early detection and intervention in audiology: An African perspectives*, Wits University Press, Johannesburg, pp. 15-32.
- Kanji, A & Khoza-Shangase, K 2018, 'Objective hearing screening measures: An exploration of a suitable combination for risk-based newborn hearing screening', *Journal of the American Academy of Audiology*, vol. 29, no. 6, pp. 495-502. <https://doi.org/10.3766/jaaa.16155>

## References

- Kanji, A, Khoza-Shangase, K & Moroe, N 2018, 'Newborn hearing screening protocols and their outcomes: A systematic review', *International Journal of Pediatric Otorhinolaryngology*, vol. 115, pp. 104-109. <https://doi.org/10.1016/j.ijporl.2018.09.026>
- Keefe, DH, Sanford, CA, Ellison, JC, Fitzpatrick, DF & Gorga, MP 2012, 'Wideband aural acoustic absorbance predicts conductive hearing loss in children', *International Journal of Audiology*, vol. 51, no. 12, pp. 880-891. <https://doi.org/10.3109/14992027.2012.721936>
- Khemapech, I, Sansrimahachai, W & Toachodee, M 2019, 'Telemedicine - Meaning, challenges and opportunities', *Siriraj Medical Journal*, vol. 71, no. 3, pp. 246-252. <https://doi.org/10.33192/Smj.2019.38>
- Khoza, K & Ross, E 2002, 'Auditory function in a group of adults infected with HIV/AIDS in Gauteng, South Africa', *South African Journal of Communication Disorders*, vol. 49, no. 1, pp. 17-27. <https://doi.org/10.4102/sajcd.v49i1.214>
- Khoza-Shangase, K 2020, 'Burden of disease: A scoping review of HIV/AIDS and TB in occupational noise-induced hearing loss', *South African Journal of Communication Disorders*, vol. 67, no. 2, a669. <https://doi.org/10.4102/sajcd.v67i2.669>
- Khoza-Shangase, K 2021, 'HIV/AIDS and the burden of disease in early hearing detection and intervention', eds. K Khoza-Shangase & A Kanji, *Early detection and intervention in audiology: An African perspective*, Wits University Press, Johannesburg.
- Khoza-Shangase, K 2022, 'Preventive audiology: Ramping up efforts towards an ear and hearing healthy nation', ed. K Khoza-Shangase, *Preventive audiology: An African perspective*, AOSIS Books, Cape Town, pp. 1-20. <https://doi.org/10.4102/aosis.2022.BK209.01>
- Khoza-Shangase, K & Anastasiou, J 2020, 'An exploration of recorded otological manifestations in South African children with HIV/AIDS: A pilot study', *International Journal of Pediatric Otorhinolaryngology*, vol. 133, a109960. <https://doi.org/10.1016/j.ijporl.2020.109960>
- Khoza-Shangase, K & Kanji, A (eds.), 2021, *Early detection and intervention in audiology: An African perspective*, Wits University Press, Johannesburg.
- Khoza-Shangase, K & Mophosho, M 2018, 'Language and culture in speech-language and hearing professions in South Africa: The dangers of a single story', *South African Journal of Communication Disorders*, vol. 65, no. 1, a594. <https://doi.org/10.4102/sajcd.v65i1.594>
- Khoza-Shangase, K & Mophosho, M 2021, 'Language and culture in speech-language and hearing professions in South Africa: Re-imagining practice', *South African Journal of Communication Disorders*, vol. 68, no. 1, a793. <https://doi.org/10.4102/sajcd.v68i1.793>
- Khoza-Shangase, K & Moroe, N 2020, 'South African hearing conservation programmes in the context of tele-audiology: A scoping review', *South African Journal of Communication Disorders*, vol. 67, no. 2, a670. <https://doi.org/10.4102/sajcd.v67i2.670>
- Khoza-Shangase, K, Moroe, N & Neille, J 2021, 'Speech-language pathology and audiology in South Africa: Clinical training and service in the era of COVID-19', *International Journal of Telerehabilitation*, vol. 13, no. 1, a6376. <https://doi.org/10.5195/ijt.2021.6376>
- Khoza-Shangase, K & Sebothoma, B 2022, 'Tele-audiology and preventive audiology: A capacity versus demand challenge imperative in South Africa', ed. K Khoza-Shangase, *Preventive audiology: An African perspective*, AOSIS Books, Cape Town, pp. 21-40. <https://doi.org/10.4102/aosis.2022.BK209.02>
- Kolo, ES, Salisu, AD, Yaro, AM & Nwaorgu, OGB 2012, 'Sensorineural hearing loss in patients with chronic suppurative otitis media', *Indian Journal of Otolaryngology and Head and Neck Surgery*, vol. 64, no. 1, pp. 59-62. <https://doi.org/10.1007/s12070-011-0251-5>
- Kramer, S & Brown, DK 2019, *Audiology: Science to practice*, 3rd edn., Plural Publishing, San Diego.
- Lancet, T 2016, 'Hearing loss: An important global health concern', *The Lancet*, vol. 387, no. 10036, a2351. [https://doi.org/10.1016/S0140-6736\(16\)30777-2](https://doi.org/10.1016/S0140-6736(16)30777-2)
- Lao, Z, Shen, D, Xue, Z, Karacali, B, Resnick, SM & Davatzikos, C 2004, 'Morphological classification of brains via high-dimensional shape transformations and machine learning methods', *Neuroimage*, vol. 21, no. 1, pp. 46-57. <https://doi.org/10.1016/j.neuroimage.2003.09.027>

- Leach, AJ, Homøe, P, Chidziva, C, Gunasekera, H, Kong, K, Bhutta, MF, Jensen, R, Tamir, SO, Das, SK & Morris, P 2020, 'Panel 6: Otitis media and associated hearing loss among disadvantaged populations and low to middle-income countries', *International Journal of Pediatric Otorhinolaryngology*, vol. 130, no. suppl. 1, a109857. <https://doi.org/10.1016/j.ijporl.2019.109857>
- Lee, DH & Yeo, SW 2004, 'Clinical diagnostic accuracy of otitis media with effusion in children, and significance of myringotomy: Diagnostic or therapeutic?', *Journal of Korean Medical Science*, vol. 19, no. 5, pp. 739-743.
- Leha, A, Hellenkamp, K, Unsöld, B, Mushemi-Blake, S, Shah, AM, Hasenfuß, G & Seidler, T 2019, 'A machine learning approach for the prediction of pulmonary hypertension', *PLoS One*, vol. 14, no. 10, a0224453. <https://doi.org/10.1371/journal.pone.0224453>
- Libwea, JN, Kobela, M, Ndombo, PK, Sarjänen, RK, Huhtala, H, Fointanama, N, Koulla-Shiro, S, Nohynek, H, Nuorti, JP & Palmu, AA 2018, 'The prevalence of otitis media in 2-3 year old Cameroonian children estimated by tympanometry', *International Journal of Pediatric Otorhinolaryngology*, vol. 115, pp. 181-187. <https://doi.org/10.1016/j.ijporl.2018.10.007>
- Lieberthal, AS, Carroll, AE, Chonmaitree, T, Ganiats, TG, Hoberman, A, Jackson, MA, Joffe, MD, Miller, DT, Rosenfeld, RM, Sevilla, XD, Schwartz, RH, Thomas, PA & Tunkel, DE 2013, 'The diagnosis and management of acute otitis media', *Pediatrics*, vol. 131, no. 3, pp. 964-999. <https://doi.org/10.1542/peds.2012-3488>
- Liu, GS, Zhu, MH, Kim, J, Raphael, P, Applegate, BE & Oghalai, JS 2017, 'ELHnet: A convolutional neural network for classifying cochlear endolymphatic hydrops imaged with optical coherence tomography', *Biomedical Optics Express*, vol. 8, no. 10, pp. 4579-4594. <https://doi.org/10.1364/BOE.8.004579>
- Lukama, L, Kalinda, C & Aldous, C 2019, 'Africa's challenged ENT services: Highlighting challenges in Zambia', *BMC Health Services Research*, vol. 19, no. 1, pp. 1-9. <https://doi.org/10.1186/s12913-019-4267-y>
- Lundberg, T, De Jager, LB, Swanepoel, DW & Laurent, C 2017, 'Diagnostic accuracy of a general practitioner with video-otoscopy collected by a health care facilitator compared to traditional otoscopy', *International Journal of Pediatric Otorhinolaryngology*, vol. 99, pp. 49-53. <https://doi.org/10.1016/j.ijporl.2017.04.045>
- MacDonald, L & Green, WB 2001, 'A survey of Canadian audiological practices: Immittance measures', *Journal of Speech Language Pathology and Audiology*, vol. 25, no. 4, pp. 212-220.
- Maharjan, M, Phuyal, S, Shrestha, M & Bajracharya, R 2020, 'Chronic otitis media and subsequent hearing loss in children from the Himalayan region residing in Buddhist Monastic schools of Nepal', *Journal of Otolaryngology*, vol. 15, no. 4, pp. 144-148. DOI 10.1016/j.joto.2020.09.001
- Mahmood, R, Babier, A, McNiven, A, Diamant, A & Chan, TC 2018, 'Automated treatment planning in radiation therapy using generative adversarial networks', in *Machine learning for healthcare conference*, PMLR, pp. 484-499, viewed 10 February 2020, <<http://proceedings.mlr.press/v85/mahmood18a/mahmood18a.pdf>>
- Mahomed-Asmail, F, Swanepoel, DW & Eikelboom, RH 2016a, 'Referral criteria for school-based hearing screening in South Africa: Considerations for resource-limited contexts', *Health SA Gesondheid*, vol. 21, pp. 96-103. <https://doi.org/10.1016/j.hsag.2015.11.003>
- Mahomed-Asmail, F, Swanepoel, DW & Eikelboom, RH 2016b, 'Hearing loss in urban South African school children (grade 1 to 3)', *International Journal of Pediatric Otorhinolaryngology*, vol. 84, pp. 27-31. <https://doi.org/10.1016/j.ijporl.2016.02.021>
- Margolis, RH, Saly, GL & Keefe, DH 1999, 'Wideband reflectance tympanometry in normal adults', *The Journal of the Acoustical Society of America*, vol. 106, no. 1, pp. 265-280. <https://doi.org/10.1121/1.427055>
- Martin, FN & Clark, JG 2015, *Introduction to audiology*, 12th edn., Pearson Education Limited, New York.
- Martin, FN & Clark, JG 2019, *Introduction to audiology*, 13th edn., Pearson Education Limited, New York.



## References

- Master, A, Wilkinson, E & Wagner, R 2018, 'Management of chronic suppurative otitis media and otosclerosis in developing countries', *Otolaryngologic Clinics of North America*, vol. 51, no. 3, pp. 593-605. <https://doi.org/10.1016/j.otc.2018.01.017>
- Mazo, C, Alegre, E & Trujillo, M 2017, 'Classification of cardiovascular tissues using LBP based descriptors and a cascade SVM', *Computer Methods and Programs in Biomedicine*, vol. 147, pp. 1-10. <https://doi.org/10.1016/j.cmpb.2017.06.003>
- Mbatha, N, Street, RA, Ngcobo, M & Gqaleni, N 2012, 'Sick certificates issued by South African traditional health practitioners: Current legislation, challenges and the way forward', *South African Medical Journal*, vol. 102, no. 3, pp. 129-131. <https://doi.org/10.7196/SAMJ.5295>
- Min, J, Kim, Y, Lee, S, Jang, TW, Kim, I & Song, J 2019, 'The Fourth Industrial Revolution and its impact on occupational health and safety, worker's compensation and labor conditions', *Safety and Health at Work*, vol. 10, no. 4, pp. 400-408. <https://doi.org/10.1016/j.shaw.2019.09.005>
- Moberly, AC, Zhang, M, Yu, L, Gurcan, M, Senaras, C, Teknos, TN, Elmaraghy, CA, Taj-Schaal, N & Essig, GF 2018, 'Digital otoscopy versus microscopy: How correct and confident are ear experts in their diagnoses?', *Journal of Telemedicine and Telecare*, vol. 24, no. 7, pp. 453-459. <https://doi.org/10.1177/1357633X17708531>
- Ministry of Health Zambia 2017, *Zambia national health strategic plan 2017-2021*, viewed 10 March 2020, <[https://www.moh.gov.zm/?wpfb\\_dl=3](https://www.moh.gov.zm/?wpfb_dl=3)>
- Mokhele, T, Sewpaul, R, Sifunda, S, Weir-Smith, G, Dlamini, S, Mayaapelo, T, Naidoo, I, Parker, W-A, Dukhi, N, Jooste, S, Parker, S, Zuma, K, Moshabela, M, Mabaso, M & Reddy, SP 2021, 'Spatial analysis of perceived health system capability and actual health system capacity for COVID-19 in South Africa', *The Open Public Health Journal*, vol. 14, pp. 388-398. <https://doi.org/10.2174/1874944502114010388>
- Møller, AR 2012, *Hearing: Anatomy, physiology, and disorders of the auditory system*, Plural Publishing, San Diego.
- Monasta, L, Ronfani, L, Marchetti, F, Montico, M, Brumatti, LV, Bavcar, A, Grasso, D, Barbiero, C & Tamburlini, G 2012, 'Burden of disease caused by otitis media: Systematic review and global estimates', *PLoS One*, vol. 7, no. 4, a36226. <https://doi.org/10.1371/journal.pone.0036226>
- Muflih, S, Abuhammad, S, Karasneh, R, Al-Azzam, S, Alzoubi, KH & Muflih, M 2020, 'Online education for undergraduate health professional education during the COVID-19 pandemic: Attitudes, barriers, and ethical issues', *Research Square*, vol. 3, a42336. <https://doi.org/10.21203/rs.3.rs-42336/v1>
- Mukara, KB, Lilford, RJ, Tucci, DL & Waiswa, P 2017, 'Prevalence of middle ear infections and associated risk factors in children under 5 years in Gasabo district of Kigali city, Rwanda', *International Journal of Pediatrics*, vol. 2017, a4280583. <https://doi.org/10.1155/2017/4280583>
- Mulwafu, W, Ensink, R, Kuper, H & Fagan, J 2017a, 'Survey of ENT services in sub-Saharan Africa: Little progress between 2009 and 2015', *Global Health Action*, vol. 10, no. 1, a1289736. <https://doi.org/10.1080/16549716.2017.1289736>
- Mulwafu, W, Kuper, H, Viste, A & Gopen, FK 2017b, 'Feasibility and acceptability of training community health workers in ear and hearing care in Malawi: A cluster randomised controlled trial', *BMJ Open*, vol. 7, no. 10, a016457. <https://doi.org/10.1136/bmjopen-2017-016457>
- Murphy, DC 2019, 'A comprehensive review of otorhinolaryngological global health concerns', *The Journal of Laryngology and Otology*, vol. 133, no. 11, pp. 930-935. <https://doi.org/10.1017/S002221511900197X>
- Neille, J, George, K & Khoza-Shangase, K 2014, 'A study investigating sound sources and noise levels in neonatal intensive care units', *South African Journal of Child Health*, vol. 8, no. 1, pp. 6-10. [https://www.researchgate.net/publication/271183581\\_A\\_study\\_investigating\\_sound\\_sources\\_and\\_noise\\_levels\\_in\\_neonatal\\_intensive\\_care\\_units](https://www.researchgate.net/publication/271183581_A_study_investigating_sound_sources_and_noise_levels_in_neonatal_intensive_care_units)
- Obasineke, G, Amdi, FI, Ibeke, TS, Ezeanolue, BC & Ogisi, FO 2014, 'The effect of CD4 count level on the middle ear dynamics of HIV infected patients', *East African Medical Journal*, vol. 91, no. 1, pp. 29-32.
- O'Donovan, J, Verkerk, M, Winters, N, Chadha, S & Bhutta, MF 2019, 'The role of community health workers in addressing the global burden of ear disease and hearing loss: A systematic scoping review of the literature', *BMJ Global Health*, vol. 4, no. 2, a001141. <https://doi.org/10.1136/bmjgh-2018-001141>

- Olusanya, BO 2010, 'Ambient noise levels in infant hearing screening programs in developing countries: An observational report', *International Journal of Audiology*, vol. 49, no. 8, pp. 535–541. <https://doi.org/10.3109/14992021003717768>
- Ombuya, OD & Ishmael, NA 2016, 'Challenges faced by organizations in implementing telemedicine in developing countries: A literature review', *International Journal of Applied Information Systems*, vol. 11, no. 6, pp. 8–11. <https://doi.org/10.5120/ijais2016451616>
- Pearce, EC, Mainthia, R, Netterville, JL & Rohde, SL 2012, 'Impact of a yearly head and neck surgery trip to rural Kenya', *Otolaryngology – Head and Neck Surgery*, vol. 147, suppl. 2, a39. <https://doi.org/10.1177/0194599812451426a39>
- Phanguphangu, MC 2017, 'Otosopic examinations reveal high prevalence of outer and middle ear pathologies in peadiatrics in Limpopo, South Africa', *International Journal of Audiology*, vol. 56, no. 4, pp. 215–218. <https://doi.org/10.1080/14992027.2016.1244868>
- Pillay, D & Serooe, T 2019, 'Shifting and transforming the practice of audiology: The inclusion of traditional healing', *South African Journal of Communication Disorders*, vol. 66, no. 1, a635. <https://doi.org/10.4102/sajcd.v66i1.635>
- Pillay, M, Tiwari, R, Kathard, H & Chikte, U 2020, 'Sustainable workforce: South African audiologists and speech therapists', *Human Resources for Health*, vol. 18, no. 1, pp. 1–13. <https://doi.org/10.1186/s12960-020-00488-6>
- Prieve, B & Fitzgerald, T 2015, 'Otoacoustic emissions', eds. J Katz, M Chasin, KM English, LJ Hood & KL Tillery, *Handbook of clinical audiology*, 7th edn., Wolters Kluwer Health, Philadelphia, pp. 357–380.
- Ramma, L & Sebothoma, B 2016, 'The prevalence of hearing impairment within the cape town metropolitan area', *South African Journal of Communication Disorders*, vol. 63, no. 1, a105. <https://doi.org/10.4102/sajcd.v63i1.105>
- Rosado, P, Lequerica-Fernández, P, Villallain, L, Peña, I, Sanchez-Lasheras, F & De Vicente, JC 2013, 'Survival model in oral squamous cell carcinoma based on clinicopathological parameters, molecular markers and support vector machines', *Expert Systems with Applications*, vol. 40, no. 12, pp. 4770–4776. <https://doi.org/10.1016/j.eswa.2013.02.032>
- Rosenfeld, RM, Shin, JJ, Schwartz, SR, Coggins, R, Gagnon, L, Hackell, JM, Hoelting, D, Hunter, LL, Kummer, AW, Payne, SC, Poe, DS, Veling, M, Vila, PM, Walsh, SA & Corrigan, MD 2016, 'Clinical practice guideline: Otitis media with effusion update', *Otolaryngology – Head and Neck Surgery*, vol. 154, suppl. 1, pp. 1–41. <https://doi.org/10.1177/0194599815623467>
- Saadi, R, Goldenberg, D & Goldenberg, D 2018, 'Using technology in global otolaryngology', *Otolaryngologic Clinics of North America*, vol. 51, no. 3, pp. 555–561. <https://doi.org/10.1016/j.otc.2018.01.004>
- Schlauch, RS & Nelson, P 2015, 'Puretones evaluations', eds. J Katz, M Chasin, KM English, LJ Hood & KL Tillery, *Handbook of clinical audiology*, 7th edn., Wolters Kluwer Health, Philadelphia, pp. 29–48.
- Sebothoma, B 2020, 'Middle ear pathologies in adults within the mining industry: A systematic review', *South African Journal of Communication Disorders*, vol. 67, no. 2, a679. <https://doi.org/10.4102/sajcd.v67i2.679>
- Sebothoma, B & Khoza-Shangase, K 2018, 'A comparison between video otoscopy and standard tympanometry findings in adults living with human immunodeficiency virus (HIV) in South Africa', *South African Journal of Communication Disorders*, vol. 65, no. 1, a591. <https://doi.org/10.4102/sajcd.v65i1.591>
- Sebothoma, B & Khoza-Shangase, K 2020, 'Middle ear pathologies in adults living with human immunodeficiency virus: A systematic review', *Annals of Otolaryngology, Rhinology and Laryngology*, vol. 129, no. 8, pp. 821–828. <https://doi.org/10.1177/0003489420909847>
- Sebothoma, B & Khoza-Shangase, K 2021a, 'Investigation of the interaction between hearing function and comorbidities in adults living with human immunodeficiency virus', *International Journal of Environmental Research and Public Health*, vol. 18, no. 22, a12177. <https://doi.org/10.3390/ijerph182212177>

## References

- Sebothoma, B & Khoza-Shangase, K 2021b, 'Acoustic immittance measures and middle ear assessment: Current practice by South African audiologists', *South African Journal of Communication Disorders*, vol. 68, no. 1, a818. <https://doi.org/10.4102/sajcd.v68i1.818>
- Sebothoma, B & Khoza-Shangase, K 2022, 'Preventing middle ear pathologies in the South African context: A proposed programmatic approach', ed. K Khoza-Shangase, *Preventive audiology: An African perspective*, AOSIS Books, Cape Town, pp. 93-109. <https://doi.org/10.4102/aosis.2022.BK209.05>
- Sebothoma, B, Khoza-Shangase, K, Masege, D & Mol, D 2021a, 'The use of tele practice in assessment of middle ear function in adults living with HIV during the COVID-19 pandemic', *Indian Journal of Otolaryngology and Head and Neck Surgery*, vol. 2021, pp. 1-8. <https://doi.org/10.1007/s12070-021-02836-x>
- Sebothoma, B, Khoza-Shangase, K, Mol, D & Masege, D 2021b, 'The sensitivity and specificity of wideband absorbance measure in identifying pathologic middle ears in adults living with HIV', *South African Journal of Communication Disorders*, vol. 68, no. 1, a820. <https://doi.org/10.4102/sajcd.v68i1.820>
- Shahnaz, N 2021, 'Application of wideband acoustic immittance (WAI) in assessment of the middle ear in newborns, children, and adults', eds. S Hatzopoulos, A Ciorba & M Krumm, *Advances in audiology and hearing sciences: Clinical protocols and hearing devices*, Apple Academic Press, New York, vol. 1, pp. 51-101.
- Shahnaz, N, Bork, K, Polka, L, Longridge, N, Bell, D & Westerberg, BD 2009, 'Energy reflectance and tympanometry in normal and otosclerotic ears', *Ear and Hearing*, vol. 30, no. 2, pp. 219-233. <https://doi.org/10.1097/AUD.0b013e3181976a14>
- Shahnaz, N, Feeney, MP & Schairer, KS 2013, 'Wideband acoustic immittance normative data: Ethnicity, gender, aging, and instrumentation', *Ear and Hearing*, vol. 34, pp. 27-35. <https://doi.org/10.1097/AUD.0b013e31829d5328>
- Shahnaz, N & Polka, L 1997, 'Standard and multifrequency tympanometry in normal and otosclerotic ears', *Ear and Hearing*, vol. 8, no. 4, pp. 326-341. <https://doi.org/10.1097/00003446-199708000-00007>
- Sharma, N, Jaiswal, AA, Banerjee, PK & Garg, AK 2015, 'Complications of chronic suppurative otitis media and their management: A single institution 12 years experience', *Indian Journal of Otolaryngology and Head and Neck Surgery*, vol. 67, no. 4, pp. 353-360. <https://doi.org/10.1007/s12070-015-0836-5>
- Statistics South Africa (StatsSA) 2019, *Mid-year population estimates*, viewed 10 February 2018, <<http://www.statssa.gov.za/publications/PO302/PO3022019.pdf>>
- Swanepoel, DW 2015, 'Tele-audiology', eds. J Katz, M Chasin, KM English, LJ Hood & KL Tillery, *Handbook of clinical audiology*, 7th edn., Wolters Kluwer Health, Philadelphia.
- Tariq, Q, Daniels, J, Schwartz, JN, Washington, P, Kalantarian, H & Wall, DP 2018, 'Mobile detection of autism through machine learning on home video: A development and prospective validation study', *PLoS Medicine*, vol. 15, no. 11, a1002705. <https://doi.org/10.1371/journal.pmed.1002705>
- Terzi, SUAT, Özgür, A, Erdivanli, ÖÇ, Coskun, ZÖ, Ogurlu, M, Demirci, M & Dursun, E 2015, 'Diagnostic value of the wideband acoustic absorbance test in middle-ear effusion', *The Journal of Laryngology and Otolaryngology*, vol. 129, no. 11, a1078. <https://doi.org/10.1017/S0022215115002339>
- Tshifularo, M, Govender, L & Monama, G 2013, 'Otolaryngological and head and neck manifestations in HIV-infected patients seen at Steve Biko academic hospital in Pretoria, South Africa', *South African Medical Journal*, vol. 103, no. 7, pp. 464-466. <https://doi.org/10.7196/SAMJ.6786>
- Vajpayee, M, Negi, N & Kurapati, S 2013, 'The enduring tale of T cells in HIV immunopathogenesis', *The Indian Journal of Medical Research*, vol. 138, no. 5, a682.
- Van Der Westhuizen, Y, Swanepoel, DW, Heinze, B & Hofmeyr, LM 2013, 'Auditory and otological manifestations in adults with HIV/AIDS', *International Journal of Audiology*, vol. 52, no. 1, pp. 37-43. <https://doi.org/10.3109/14992027.2012.721935>
- Villa, PC & Zanchetta, S 2014, 'Auditory temporal abilities in children with history of recurrent otitis media in the first years of life and persistent in preschool and school ages', *CoDAS*, vol. 26, no. 6, pp. 494-502. <https://doi.org/10.1590/2317-1782/20142014008>

- Viscaino, M, Maass, JC, Delano, PH, Torrente, M, Stott, C & Auat Cheein, F 2020, 'Computer-aided diagnosis of external and middle ear conditions: A machine learning approach', *PLoS One*, vol. 15, no. 3, a0229226. <https://doi.org/10.1371/journal.pone.0229226>
- Vouloumanou, EK, Karageorgopoulos, DE, Kazantzi, MS, Kapaskelis, AM & Falagas, ME 2009, 'Antibiotics versus placebo or watchful waiting for acute otitis media: A meta-analysis of randomized controlled trials', *Journal of antimicrobial Chemotherapy*, vol. 64, no. 1, pp. 16–24. <https://doi.org/10.1093/jac/dkp166>
- Wang, D, Khosla, A, Gargeya, R, Irshad, H & Beck, AH 2016, 'Deep learning for identifying metastatic breast cancer', *arXiv preprint arXiv:1606.05718*. <https://doi.org/10.48550/arXiv.1606.05718>
- Wei, L, Yang, Y, Nishikawa, RM & Jiang, Y 2005, 'A study on several machine-learning methods for classification of malignant and benign clustered microcalcifications', *IEEE Transactions on Medical Imaging*, vol. 24, no. 3, pp. 371–380. <https://doi.org/10.1109/TMI.2004.842457>
- World Health Organization (WHO) 2004, *Chronic suppurative otitis media: Burden of illness and management options*, viewed 27 January 2020, <<https://apps.who.int/iris/handle/10665/42941>>
- World Health Organization (WHO) 2007, *Task shifting: Rational redistribution of tasks among Health workforce teams: Global recommendations and guidelines*, viewed 27 January 2020, <<https://apps.who.int/iris/handle/10665/43821>>
- World Health Organization (WHO) 2013, *Multi-country assessment of national capacity to provide hearing care*, viewed 27 January 2020, <<https://www.who.int/publications/i/item/9789241506571>>
- World Health Organization (WHO) 2018a, *Addressing the rising prevalence of hearing loss*, viewed 27 January 2020, <<http://apps.who.int/iris/bitstream/handle/10665/136874/9789241550260-eng.pdf;jsessionid=13FFE7CCEC3FE3335FD451FA5132CBD4?sequence=1>>
- World Health Organization (WHO) 2018b, *Country cooperation strategy at a glance*, viewed 27 January 2020, <[https://apps.who.int/iris/bitstream/handle/10665/136874/ccsbrief\\_zaf\\_en.pdf;jsessionid=E4076B95B82E47064DB7DB3E8F795799?sequence=1](https://apps.who.int/iris/bitstream/handle/10665/136874/ccsbrief_zaf_en.pdf;jsessionid=E4076B95B82E47064DB7DB3E8F795799?sequence=1)>
- World Health Organization (WHO) 2019, *Deafness and hearing loss*, viewed 27 January 2020, <<https://www.who.int/news-room/fact-sheets/detail/deafness-and-hearing-loss>>
- Zacharaki, EI, Wang, S, Chawla, S, Soo Yoo, D, Wolf, R, Melhem, ER & Davatzikos, C 2009, 'Classification of brain tumor type and grade using MRI texture and shape in a machine learning scheme', *Magnetic Resonance in Medicine*, vol. 62, no. 6, pp. 1609–1618. <https://doi.org/10.1002/mrm.22147>

## Chapter 6

- Ahmed, M, Mishra, A, Sawlani, KK, Verma, V, Garg, R, Singh, HP & Kumar, S 2016, 'Clinical predictors of streptomycin-vestibulotoxicity', *Indian Journal of Otolaryngology and Head & Neck Surgery*, vol. 68, no. 3, pp. 359–366. <https://doi.org/10.1007/s12070-015-0949-x>
- Ahmed, RM, Hannigan, IP, MacDougall, HG, Chan, RC & Halmagyi, GM 2012, 'Gentamicin ototoxicity: A 23-year selected case series of 103 patients', *Medical Journal of Australia*, vol. 196, no. 11, pp. 701–704. <https://doi.org/10.5694/mja11.10850>
- Alomar, M, Tawfiq, AM, Hassan, N & Palaian, S 2020, 'Post marketing surveillance of suspected adverse drug reactions through spontaneous reporting: Current status, challenges and the future', *Therapeutic Advances in Drug Safety*, vol. 11, a2042098620938595. <https://doi.org/10.1177/2042098620938595>
- American Speech-Language-Hearing Association (ASHA) 2016, *Expert panel recommendations on newborn hearing screening*, viewed 10 August 2018, <[www.asha.org](http://www.asha.org)>
- Arslan, E, Orzan, E & Santarelli, R 1999, 'Global problem of drug-induced hearing loss', *Annals of the New York Academy of Sciences*, vol. 884, no. 1, pp. 1–14. <https://doi.org/10.1111/j.1749-6632.1999.tb00277.x>

## References

- Association of Faculties of Medicine of Canada (AFMC) Primer, 2013, *AFMC primer on population health: A virtual textbook on public health concepts for clinicians*, AFMC Association of Faculties of Medicine of Canada, viewed 27 January 2020, <<https://phprimer.afmc.ca/en/>>
- Bardien, S, Jong, GD, Schaaf, HS, Harris, T, Fagan, J & Petersen, L 2009, 'Aminoglycoside-induced hearing loss: South Africans at risk', *South African Medical Journal*, vol. 99, no. 6, pp. 440-441. <http://www.samj.org.za/index.php/samj/article/viewFile/3365/2394>
- Bezuidenhout, JK, Khoza-Shangase, K, De Maayer, T & Strehlau, R 2018, 'Universal newborn hearing screening in public health care in South Africa: Challenges to implementation', *South African Journal of Child Health*, vol. 12, no. 4, pp. 159-163. <https://doi.org/10.7196/SAJCH.2018.v12i4.1522>
- Brooks, B & Knight, K 2018, 'Ototoxicity monitoring in children treated with platinum chemotherapy', *International Journal of Audiology*, vol. 57, Suppl. 4, pp. 62-68. <https://doi.org/10.1080/14992027.2017.1355570>
- Brummett, RE, Fox, KE, Jacobs, F, Kempton, JB, Stokes, Z & Allyson, B 1990, 'Augmented gentamicin ototoxicity induced by vancomycin in guinea pigs', *Archives of Otolaryngology - Head & Neck Surgery*, vol. 116, no. 1, pp. 61-64. <https://doi.org/10.1001/archotol.1990.01870010065019>
- Cheung, PY, Tyebkhan, JM, Peliowski, A, Ainsworth, W & Robertson, CM 1999, 'Prolonged use of pancuronium bromide and sensorineural hearing loss in childhood survivors of congenital diaphragmatic hernia', *The Journal of Pediatrics*, vol. 135, no. 2, pp. 233-239. [https://doi.org/10.1016/S0022-3476\(99\)70027-2](https://doi.org/10.1016/S0022-3476(99)70027-2)
- Cianfrone, G, Pentangelo, D, Cianfrone, F, Mazzei, F, Turchetta, R, Orlando, MP & Altissimi, G 2011, 'Pharmacological drugs inducing ototoxicity, vestibular symptoms and tinnitus: A reasoned and updated guide', *European Review for Medical and Pharmacological Sciences*, vol. 15, no. 6, pp. 601-636.
- De Andrade, V, Khoza-Shangase, K & Hajat, F 2009, 'Perceptions of oncologists at two state hospitals in Gauteng regarding the ototoxic effects of cancer chemotherapy: A pilot study', *African Journal of Pharmacy and Pharmacology*, vol. 3, no. 6, pp. 307-318.
- De Kock, T, Swanepoel, D & Hall III, JW 2016, 'Newborn hearing screening at a community-based obstetric unit: Screening and diagnostic outcomes', *International Journal of Pediatric Otorhinolaryngology*, vol. 84, pp. 124-131. <https://doi.org/10.1016/j.ijporl.2016.02.031>
- DiSogra, RM 2019, 'Pharmacology and ototoxicity', *Seminars in Hearing*, vol. 40, no. 2, pp. 85-86. <https://doi.org/10.1055/s-0039-1685161>
- Fagan, JJ 2012, 'Developing world ENT: A global responsibility', *The Journal of Laryngology & Otology*, vol. 126, no. 6, pp. 544-547. <https://doi.org/10.1017/S0022215112000345>
- Fagan, JJ 2018, 'Workforce considerations, training, and diseases in Africa', *Otolaryngologic Clinics of North America*, vol. 51, no. 3, pp. 643-649. <https://doi.org/10.1016/j.otc.2018.01.009>
- Fagan, JJ & Jacobs, M 2009, 'Survey of ENT services in Africa: Need for a comprehensive intervention', *Global Health Action*, vol. 2, pp. 1-7. <https://doi.org/10.3402/gha.v2i0.1932>
- Faillie, JL, Montastruc, F, Montastruc, JL & Pariente, A 2016, 'Pharmacoepidemiology and its input to pharmacovigilance', *Therapies*, vol. 71, no. 2, pp. 211-216. <https://doi.org/10.1016/j.therap.2016.02.016>
- Fligor, BJ 2019, 'Pediatric ototoxicity: Current trends and management', *Seminars in Hearing*, vol. 40, no. 2, a154. <https://doi.org/10.1055/s-0039-1684044>
- Fokouo, JVF, Vokwely, JEE, Noubiap, JJN, Nouthé, BE, Zafack, J, Ngom, ESM, Dalil, AB, Nyeki, A-RN, Bengono, G & Njock R 2015, 'Effect of HIV infection and highly active antiretroviral therapy on hearing function: A prospective case-control study from Cameroon', *JAMA Otolaryngology - Head & Neck Surgery*, vol. 141, no. 5, pp. 436-441. <https://doi.org/10.1001/jamaoto.2015.125>
- Ganesan, P, Schmiedge, J, Manchaiah, V, Swapna, S, Dhandayutham, S & Kothandaraman, PP 2018, 'Ototoxicity: A challenge in diagnosis and treatment', *Journal of Audiology & Otology*, vol. 22, no. 2, a360. <https://doi.org/10.7874/jao.2017.00360>
- Garinis, AC, Kempf, A, Tharpe, AM, Weitkamp, JH, McEvoy, C & Steyger, PS 2018, 'Monitoring neonates for ototoxicity', *International Journal of Audiology*, vol. 57, Suppl. 4, pp. 54-61. <https://doi.org/10.1080/14992027.2017.1339130>



- Govender, CD, Pillay, M, Paken, J & Sewram, V 2020, 'Perspectives and practices of ototoxicity monitoring', *South African Journal of Communication Disorders*, vol. 67, no. 1, a685. <https://doi.org/10.4102/sajcd.v67i1.685>
- Govender, M 2015, 'Audiological practices employed by audiologists in the management of adult patients with multi-drug resistant tuberculosis in South Africa', doctoral dissertation, University of KwaZulu-Natal, Durban.
- Gratton, MA & Kamen, BA 1990, 'Potentiation of cisplatin ototoxicity by noise', *Journal of Clinical Oncology*, vol. 8, no. 12, pp. 2091-2092. <https://doi.org/10.1200/JCO.1990.8.12.2091>
- Gratton, MA, Salvi, RJ, Kamen, BA & Saunders, SS 1990, 'Interaction of cisplatin and noise on the peripheral auditory system', *Hearing Research*, vol. 50, no. 1-2, pp. 211-223. [https://doi.org/10.1016/0378-5955\(90\)90046-R](https://doi.org/10.1016/0378-5955(90)90046-R)
- Gurney, JG, Bass, JK, Onar-Thomas, A, Huang, J, Chintagumpala, M, Bouffet, E, Hassall, T, Gururangan, S, Heath, JA, Kellie, S, Cohn, R, Fisher, MJ, Panandiker, AP, Merchant, TE, Srinivasan, A, Wetmore, C, Qaddoumi, I, Stewart, CF, Armstrong, GT, Broniscer, A & Gajjar, A 2014, 'Evaluation of amifostine for protection against cisplatin-induced serious hearing loss in children treated for average-risk or high-risk medulloblastoma', *Neuro-Oncology*, vol. 16, no. 6, pp. 848-855. <https://doi.org/10.1093/neuonc/not241>
- Halmagyi, GM, MacDougall, H, Curthoys, IS & McGarvie, LA 2012, 'Video head impulse test diagnoses vestibulotoxicity', *Otolaryngology - Head and Neck Surgery*, vol. 147, Suppl. 2, a187. <https://doi.org/10.1177/0194599812451438a187>
- Hartzema, AG, Porta, MS, Tilson, HH & Rogers, AS 1987, 'Adverse drug events: Identification and attribution', *Drug Intelligence & Clinical Pharmacy*, vol. 21, no. 11, pp. 915-920. <https://doi.org/10.1177/10600280870210114>
- Health Professions Council of South Africa (HPCSA) 2018, *Audiologic management of patients on treatment that includes ototoxic medications guidelines*, viewed 10 January 2019, <<https://www.hpcsa.co.za/Uploads/SLH/Guidelines%20for%20Audiological%20Management%20of%20Patients%20on%20Treatment%20that%20includes%20Ototoxic%20Medications.pdf>>
- Health Systems Trust 2017, *South African health review*, viewed 27 January 2020, <[www.hst.org.za/.../South%20African%20Health%20Reviews/HST%20SAHR%202017%20](http://www.hst.org.za/.../South%20African%20Health%20Reviews/HST%20SAHR%202017%20)>
- Hoffman, DW, Jones-King, KL, Whitworth, CA & Rybak, LP 1988, 'Potentiation of ototoxicity by glutathione depletion', *Annals of Otolaryngology, Rhinology & Laryngology*, vol. 97, no. 1, pp. 36-41. <https://doi.org/10.1177/000348948809700107>
- Hong, H, Dooley, KE, Starbird, LE, Francis, HW & Farley, JE 2019, 'Adverse outcome pathway for aminoglycoside ototoxicity in drug-resistant tuberculosis treatment', *Archives of Toxicology*, vol. 93, no. 5, pp. 1385-1399. <https://doi.org/10.1007/s00204-019-02407-8>
- Hunter, LL, Keefe, DH, Feeney, MP, Fitzpatrick, DF & Lin, L 2016, 'Longitudinal development of wideband reflectance tympanometry in normal and at-risk infants', *Hearing Research*, vol. 340, pp. 3-14. <https://doi.org/10.1016/j.heares.2015.12.014>
- Hunter-Adams, J & Rother, HA 2017, 'A qualitative study of language barriers between South African health care providers and cross-border migrants', *BMC Health Services Research*, vol. 17, no. 1, pp. 1-9. <https://doi.org/10.1186/s12913-017-2042-5>
- Ibrahim, H, Saad, A, Abdo, A & Eldin, AS 2016, 'Mining association patterns of drug-interactions using post marketing FDA's spontaneous reporting data', *Journal of Biomedical Informatics*, vol. 60, pp. 294-308. <https://doi.org/10.1016/j.jbi.2016.02.009>
- Joubert, K, Sebothoma, B & Kgare, KS 2017, 'Public awareness of audiology, hearing and hearing health in the Limpopo province, South Africa', *South African Journal of Communication Disorders*, vol. 64, no. 1, a557. <https://doi.org/10.4102/sajcd.v64i1.557>
- Kanji, A 2016, 'Early hearing screening in South Africa-Time to get real about context', *South African Journal of Child Health*, vol. 10, no. 4, a1298. <https://doi.org/10.7196/SAJCH.2016.v10i4.1298>
- Kanji, A, Khoza-Shangase, K & Ballot, D 2010, 'Hearing screening follow-up return rate in a very low birth weight project: A retrospective record review', *South African Journal of Child Health*, vol. 4, no. 4, pp. 95-99.

## References

- Kanji, A, Khoza-Shangase, K, Petrocchi-Bartal, L & Harbinson, S 2018, 'Feasibility of infant hearing screening from a developing country context: The South African experience', *Hearing, Balance and Communication*, vol. 16, no. 4, pp. 263–270. <https://doi.org/10.1080/21695717.2018.1519144>
- Khoza-Shangase, K 2010, 'Is there a need for ototoxicity monitoring in patients with HIV/AIDS?', *African Journal of Pharmacy and Pharmacology*, vol. 4, no. 9, pp. 574–579.
- Khoza-Shangase, K 2011, 'Highly active antiretroviral therapy: Does it sound toxic?', *Journal of Pharmacy and Bioallied Sciences*, vol. 3, no. 1, a142. <https://doi.org/10.4103/0975-7406.76494>
- Khoza-Shangase, K 2013, 'Ototoxicity in tuberculosis treatment in South Africa: Exploring the current status', *African Journal of Pharmacy and Pharmacology*, vol. 7, no. 30, a2141.
- Khoza-Shangase, K 2014, 'Pharmaco-audiology vigilance and highly active antiretroviral therapy (HAART) in South Africa: Ototoxicity monitoring pursued', *HSAO Journal of AIDS Clinical Research and STDs*, vol. 1, a001. DOI 10.24966/ACRS-7370/100001
- Khoza-Shangase, K 2017, 'Risk vs. benefit: Who assesses this in the management of patients on ototoxic drugs?', *Journal of Pharmacy and Bioallied Sciences*, vol. 9, no. 3, pp. 171–177. [https://doi.org/10.4103/jpbs.JPBS\\_17\\_17](https://doi.org/10.4103/jpbs.JPBS_17_17)
- Khoza-Shangase, K 2020a, 'Pharmaco-audiology vigilance in the treatment of adult patients with HIV/AIDS: Ototoxicity monitoring protocol recommendation', *Infectious Disorders-Drug Targets (Formerly Current Drug Targets-Infectious Disorders)*, vol. 20, no. 1, pp. 33–42. <https://doi.org/10.2174/1871526518666181016102102>
- Khoza-Shangase, K 2020b, 'Hearing function of gold miners with and without a history of tuberculosis treatment: A retrospective data review', *Brazilian Journal of Otorhinolaryngology*, vol. 86, no. 3, pp. 294–299. <https://doi.org/10.1016/j.bjorl.2018.12.002>
- Khoza-Shangase, K 2020c, 'Burden of disease: A scoping review of HIV/AIDS and TB in occupational noise-induced hearing loss', *South African Journal of Communication Disorders*, vol. 67, no. 2, a669. <https://doi.org/10.4102/sajcd.v67i2.669>
- Khoza-Shangase, K 2021, 'Confronting realities to early hearing detection in South Africa', eds. K Khoza-Shangase & A Kanji, *Early detection and intervention in audiology: An African perspective*, Wits University Press, Johannesburg, pp. 66–88.
- Khoza-Shangase, K 2022, 'Ototoxicity vigilance as a preventive audiology imperative within the African context: Pharmaco-audiology explored', ed. K Khoza-Shangase, *Preventive audiology: An African perspective*, AOSIS Books, Cape Town, pp. 111–136. <https://doi.org/10.4102/aosis.2022.BK209.06>
- Khoza-Shangase, K 2022, 'Preventive audiology: Ramping up efforts towards an ear and hearing healthy nation', ed. K Khoza-Shangase, *Preventive audiology: An African perspective*, AOSIS Books, Cape Town, pp. 1–20. <https://doi.org/10.4102/aosis.2022.BK209.01>
- Khoza-Shangase, K & Harbinson, S 2015, 'Evaluation of universal newborn hearing screening in South African primary care', *African Journal of Primary Health Care and Family Medicine*, vol. 7, no. 1, a769. <https://doi.org/10.4102/phcfm.v7i1.769>
- Khoza-Shangase, K & Jina, K 2013, 'Ototoxicity monitoring in general medical practice: Exploring perceptions and practices of general practitioners about drug-induced auditory symptoms', *Innovations in Pharmaceuticals and Pharmacotherapy*, vol. 1, no. 3, pp. 250–259.
- Khoza-Shangase, K & Kanji, A 2021, 'Best practice in South Africa for early hearing detection and intervention', eds. K Khoza-Shangase & A Kanji, *Early detection and intervention in audiology: An African perspective*, Wits University Press, Johannesburg.
- Khoza-Shangase, K & Masondo, N 2020, 'What are the current audiological practices for ototoxicity assessment and management in the South African health care context?', *International Journal of Environmental Research and Public Health*, vol. 17, no. 7, a2613. <https://doi.org/10.3390/ijerph17072613>
- Khoza-Shangase, K & Masondo, N 2021, 'In pursuit of preventive audiology in South Africa: Scoping the context for ototoxicity assessment and management', *Journal of Pharmacy and Bioallied Sciences*, vol. 13, no. 1, a46. [https://doi.org/10.4103/jpbs.JPBS\\_334\\_19](https://doi.org/10.4103/jpbs.JPBS_334_19)
- Khoza-Shangase, K & Mophosho, M 2018, 'Language and culture in speech-language and hearing professions in South Africa: The dangers of a single story', *South African Journal of Communication Disorders*, vol. 65, no. 1, a594. <https://doi.org/10.4102/sajcd.v65i1.594>



- Khoza-Shangase, K & Mophosho, M 2021, 'Language and culture in speech-language and hearing professions in South Africa: Re-imagining practice', *South African Journal of Communication Disorders*, vol. 68, no. 1, a792. <https://doi.org/10.4102/sajcd.v68i1.792>
- Khoza-Shangase, K, Kanji, A & Ismail, F 2021, 'What are the current practices employed by audiologists in early hearing detection and intervention in the South African health care context?', *International Journal of Pediatric Otorhinolaryngology*, vol. 141, a110587. <https://doi.org/10.1016/j.ijporl.2020.110587>
- Khoza-Shangase, K, Lecheko, L & Ntlhakana, L 2020a, 'The impact of medical interventions for reducing ototoxicity during treatment for multi-drug resistant tuberculosis', *Acta Otorrinolaringológica Española*, vol. 71, no. 6, pp. 349-357. <https://doi.org/10.1016/j.otorri.2019.12.003>
- Khoza-Shangase, K, Sebothoma, B & Seedat, T 2020b, 'Vestibular assessment and management in adults: South African audiologists' expressed level of confidence and knowledge explored', *Hearing, Balance and Communication*, vol. 18, no. 1, pp. 55-60. <https://doi.org/10.1080/21695717.2019.1630981>
- Khoza-Shangase, K & Stirk, M 2016, 'Audiological testing for ototoxicity monitoring in adults with tuberculosis in state hospitals in Gauteng, South Africa', *Southern African Journal of Infectious Diseases*, vol. 31, no. 2, pp. 44-49. <https://doi.org/10.1080/23120053.2016.1128143>
- Knight, KRG, Kraemer, DF & Neuwelt, EA 2005, 'Ototoxicity in children receiving platinum chemotherapy: Underestimating a commonly occurring toxicity that may influence academic and social development', *Journal of Clinical Oncology*, vol. 23, no. 34, pp. 8588-8596. <https://doi.org/10.1200/JCO.2004.00.5355>
- Kolinsky, DC, Hayashi, SS, Karzon, R, Mao, J & Hayashi, RJ 2010, 'Late onset hearing loss: A significant complication of cancer survivors treated with Cisplatin containing chemotherapy regimens', *Journal of Pediatric Hematology/Oncology*, vol. 32, no. 2, pp. 119-123. <https://doi.org/10.1097/MPH.0b013e3181cb8593>
- Konrad-Martin, D, Poling, GL, Garinis, AC, Ortiz, CE, Hopper, J, O'Connell Bennett, K & Dille, MF 2018, 'Applying US national guidelines for ototoxicity monitoring in adult patients: Perspectives on patient populations, service gaps, barriers and solutions', *International Journal of Audiology*, vol. 57, Suppl 4, pp. 3-18. <https://doi.org/10.1080/14992027.2017.1398421>
- Lafond, J 2016, 'Pharmacovigilance implemented by patients: A necessity in the 21st century', *Therapies*, vol. 71, no. 2, pp. 245-247. <https://doi.org/10.1016/j.therap.2016.02.007>
- Landier, W 2016, 'Ototoxicity and cancer therapy', *Cancer*, vol. 122, no. 11, pp. 1647-1658. <https://doi.org/10.1002/cncr.29779>
- Lautermann, J, McLaren, J & Schacht, J 1995, 'Glutathione protection against gentamicin ototoxicity depends on nutritional status', *Hearing Research*, vol. 86, no. 1-2, pp. 15-24. [https://doi.org/10.1016/0378-5955\(95\)00049-A](https://doi.org/10.1016/0378-5955(95)00049-A)
- Lestner, JM, Hill, LF, Heath, PT & Sharland, M 2016, 'Vancomycin toxicity in neonates: A review of the evidence', *Current Opinion in Infectious Diseases*, vol. 29, no. 3, pp. 237-247. <https://doi.org/10.1097/QCO.0000000000000263>
- Lin, CD, Kao, MC, Tsai, MH, Lai, CH, Wei, IH, Tsai, MH, Tang, CH, Lin, CW, Hsu, CJ & Lin, CY 2011, 'Transient ischemia/hypoxia enhances gentamicin ototoxicity via caspase-dependent cell death pathway', *Laboratory Investigation*, vol. 91, no. 7, pp. 1092-1106. <https://doi.org/10.1038/labinvest.2011.69>
- Maluleke, NP, Khoza-Shangase, K & Kanji, A 2020, 'An integrative review of current practice models and/or process of family-centered early intervention for children who are deaf or hard of hearing', *Family & Community Health*, vol. 44, no. 1, pp. 59-71. <https://doi.org/10.1097/FCH.0000000000000276>
- Manian, FA, Stone, WJ & Alford, RH 1990, 'Adverse antibiotic effects associated with renal insufficiency', *Reviews of Infectious Diseases*, vol. 12, no. 2, pp. 236-249. <https://doi.org/10.1093/clinids/12.2.236>
- Marshak, T, Steiner, M, Kaminer, M, Levy, L & Shupak, A 2014, 'Prevention of cisplatin-induced hearing loss by intratympanic dexamethasone: A randomized controlled study', *Otolaryngology - Head and Neck Surgery*, vol. 150, no. 6, pp. 983-990. <https://doi.org/10.1177/0194599814524894>

- Maru, D & Malky, GA 2018, 'Current practice of ototoxicity management across the United Kingdom UK', *International Journal of Audiology*, vol. 57, Suppl. 4, pp. 29-41. <https://doi.org/10.1080/14992027.2018.1460495>
- Masumoto, K, Nagata, K, Uesugi, T, Yamada, T & Taguchi, T 2007, 'Risk factors for sensorineural hearing loss in survivors with severe congenital diaphragmatic hernia', *European Journal of Pediatrics*, vol. 166, no. 6, pp. 607-612. <https://doi.org/10.1007/s00431-006-0300-3>
- Moonsamy, S, Mupawose, A, Seedat, J, Mophosho, M & Pillay, D 2017, 'Speech-language pathology and audiology in South Africa: Reflections on transformation in professional training and practice since the end of apartheid', *Perspectives of the ASHA Special Interest Groups*, vol. 2, no. 17, pp. 30-41. <https://doi.org/10.1044/persp2.SIG17.30>
- Moore, N 2001, 'The role of the clinical pharmacist in the management of adverse drug reactions', *Drug Safety*, vol. 24, no. 1, pp. 1-7. <https://doi.org/10.2165/00002018-200124010-00001>
- Morata, TC 2007, 'Promoting hearing health and the combined risk of noise-induced hearing loss and ototoxicity', *Audiological Medicine*, vol. 5, no. 1, pp. 33-40. <https://doi.org/10.1080/16513860601159018>
- Murphy, BM & Frigo, LC 1993, 'Development, implementation, and results of a successful multidisciplinary adverse drug reaction reporting program in a university teaching hospital', *Hospital Pharmacy*, vol. 28, no. 12, pp. 1199-1204.
- Nathan, LM, Tuomi, SK & Müller, AM 2008, 'Noise levels in a neonatal intensive care unit in the Cape Metropole', *South African Journal of Child Health*, vol. 2, no. 2, pp. 50-54.
- Neille, J, George, K & Khoza-Shangase, K 2014, 'A study investigating sound sources and noise levels in neonatal intensive care units', *South African Journal of Child Health*, vol. 8, no. 1, pp. 6-10. <https://doi.org/10.7196/sajch.676>
- Nhokwara, PT 2015, 'Factors that influence the utilisation of ototoxicity monitoring services for patients on treatment for drug-resistant tuberculosis', master's thesis, University of Cape Town, Cape Town.
- Nikolopoulos, TP 2015, 'Neonatal hearing screening: What we have achieved and what needs to be improved', *International Journal of Pediatric Otorhinolaryngology*, vol. 79, no. 5, pp. 635-637. <https://doi.org/10.1016/j.ijporl.2015.02.010>
- Norton, SJ, Gorga, MP, Widen, JE, Folsom, RC, Sininger, Y, Cone-Wesson, B, Vohr, BR, Mascher, K & Fletcher, K 2000, 'Identification of neonatal hearing impairment: Evaluation of transient evoked otoacoustic emission, distortion product otoacoustic emission, and auditory brain stem response test performance', *Ear and Hearing*, vol. 21, no. 5, pp. 508-528. <https://doi.org/10.1097/00003446-200010000-00013>
- Paken, J, Govender, CD, Pillay, M & Sewram, V 2016, 'Cisplatin-associated ototoxicity: A review for the health professional', *Journal of Toxicology*, vol. 2016, a1809394. <https://doi.org/10.1155/2016/1809394>
- Phanguphangu, M & Ramma, L 2018, 'High incidence of cisplatin-induced ototoxicity in paediatric patients in the Western Cape, South Africa', *South African Journal of Oncology*, vol. 2, no. 1, a41. <https://doi.org/10.4102/sajo.v2i0.41>
- Pillay, M 2020, 'Chemicals, noise and occupational hearing health in South Africa: A mapping study', *South African Journal of Communication Disorders*, vol. 67, no. 2, a693. <https://doi.org/10.4102/sajcd.v67i2.693>
- Pillay, M & Manning, WG 2020, 'A critical analysis of the current South African occupational health law and hearing loss', *South African Journal of Communication Disorders*, vol. 67, no. 2, a694. <https://doi.org/10.4102/sajcd.v67i2.694>
- Pillay, M, Tiwari, R, Kathard, H & Chikte, U 2020, 'Sustainable workforce: South African audiologists and speech therapists', *Human Resources for Health*, vol. 18, no. 1, pp. 1-13. <https://doi.org/10.1186/s12960-020-00488-6>
- Rakhetla, MME & Lubbe, W 2016, 'Neonatal intensive care units design: Implementation strategies in South Africa', *Newborn and Infant Nursing Reviews*, vol. 16, no. 4, pp. 245-250. <https://doi.org/10.1053/j.nainr.2016.09.032>

- Ramma, L, Hollander, C, Schellack, N & Mogole, O 2019, 'Knowledge of final year medicine, pharmacy, audiology and nursing students in South Africa on drug-induced ototoxicity: A pilot study', *South African Journal of Communication Disorders*, vol. 66, no. 1, a606. <https://doi.org/10.4102/sajcd.v66i1.606>
- Riga, MG, Chelis, L, Kakolyris, S, Papadopoulos, S, Stathakidou, S, Chamalidou, E, Xenidis, N, Amarantidis, K, Dimopoulos, P & Danielides, V 2013, 'Transtympanic injections of N-acetylcysteine for the prevention of cisplatin-induced ototoxicity: A feasible method with promising efficacy', *American Journal of Clinical Oncology*, vol. 36, no. 1, pp. 1-6. <https://doi.org/10.1097/COC.0b013e31822e006d>
- Rochon, PA & Gurwitz, JH 1997, 'Optimising drug treatment for elderly people: The prescribing cascade', *BMJ*, vol. 315, no. 7115, pp. 1096-1099. <https://doi.org/10.1136/bmj.315.7115.1096>
- Rogers, C & Petersen, L 2011, 'Aminoglycoside-induced balance deficits: A review of vestibulotoxicity', *South African Family Practice*, vol. 53, no. 5, pp. 419-424. <https://doi.org/10.1080/20786204.2011.10874126>
- Rubin, LG, Sánchez, PJ, Siegel, J, Levine, G, Saiman, L & Jarvis, WR 2002, 'Evaluation and treatment of neonates with suspected late-onset sepsis: A survey of neonatologists' practices', *Pediatrics*, vol. 110, no. 4, a42. <https://doi.org/10.1542/peds.110.4.e42>
- Sahu, RK, Yadav, R, Prasad, P, Roy, A & Chandrakar, S 2014, 'Adverse drug reactions monitoring: Prospects and impending challenges for pharmacovigilance', *Springerplus*, vol. 3, no. 1, pp. 1-9. <https://doi.org/10.1186/2193-1801-3-695>
- Schaal, NC 2019, 'Ototoxicants and hearing impairment: The challenge for occupational hygiene', *The Synergist*, vol. 30, no. 12, pp. 24-28.
- Sebothoma, B & Khoza-Shangase, K 2021, 'Acoustic immittance measures and middle ear assessment: Current practice by South African audiologists', *South African Journal of Communication Disorders*, vol. 68, no. 1, a818. <https://doi.org/10.4102/sajcd.v68i1.818>
- Seedat, T, Khoza-Shangase, K & Sebothoma, B 2018, 'Vestibular assessment and management in adults: Current practice by South African audiologists', *Hearing, Balance and Communication*, vol. 16, no. 2, pp. 88-100. <https://doi.org/10.1080/21695717.2018.1463757>
- Sharrar, RG & Dieck, GS 2013, 'Monitoring product safety in the postmarketing environment', *Therapeutic Advances in Drug Safety*, vol. 4, no. 5, pp. 211-219. <https://doi.org/10.1177/2042098613490780>
- Simdon, J, Watters, D, Bartlett, S & Connick, E 2001, 'Ototoxicity associated with use of nucleoside analog reverse transcriptase inhibitors: A report of 3 possible cases and review of the literature', *Clinical Infectious Diseases*, vol. 32, no. 11, pp. 1623-1627. <https://doi.org/10.1086/320522>
- Spelsberg, A, Prugger, C, Doshi, P, Ostrowski, K, Witte, T, Hüsgen, D & Keil, U 2017, 'Contribution of industry funded post-marketing studies to drug safety: Survey of notifications submitted to regulatory agencies', *BMJ*, vol. 356, aj337. <https://doi.org/10.1136/bmj.j337>
- Stucki, G, Cieza, A & Melvin, J 2007, 'The international classification of functioning, disability and health: A unifying model for the conceptual description of the rehabilitation strategy', *Journal of Rehabilitation Medicine*, vol. 39, no. 4, pp. 279-285. <https://doi.org/10.2340/16501977-0041>
- Tangiisuran, B, Wright, J, Van Der Cammen, T & Rajkumar, C 2009, 'Adverse drug reactions in elderly: Challenges in identification and improving preventative strategies', *Age and Ageing*, vol. 38, no. 4, pp. 358-389. <https://doi.org/10.1093/ageing/afp050>
- Van As, JW, Van Den Berg, H & Van Dalen, EC 2019, 'Medical interventions for the prevention of platinum-induced hearing loss in children with cancer', *Cochrane Database of Systematic Reviews*, vol. 5, aCD009219. <https://doi.org/10.1002/14651858.CD009219.pub5>
- Vasquez, R & Mattucci, KF 2003, 'A proposed protocol for monitoring ototoxicity in patients who take cochleo-or vestibulotoxic drugs', *Ear, Nose & Throat Journal*, vol. 82, no. 3, pp. 181-184. <https://doi.org/10.1177/014556130308200310>
- Vlahović-Palčevski, V & Mentzer, D 2011, 'Postmarketing surveillance', eds. HW Seyberth, A Rane & M Schwab, *Pediatric clinical pharmacology*, Springer, Berlin, pp. 339-351.

- Watts, KL 2019, 'Ototoxicity: Visualized in concept maps', *Seminars in Hearing*, vol. 40, no. 2, pp. 177-187. <https://doi.org/10.1055/s-0039-1684046>
- Williams, B 2001, 'Ototoxicity may be associated with protease inhibitor therapy', *Clinical Infectious Diseases*, vol. 33, no. 12, pp. 2100-2101. <https://doi.org/10.1086/324361>
- Wium, A & Gerber, B 2016, 'Ototoxicity management: An investigation into doctors' knowledge and practices, and the roles of audiologists in a tertiary hospital', *South African Journal of Communication Disorders*, vol. 63, no. 1, a174. <https://doi.org/10.4102/sajcd.v63i1.174>
- World Health Organization (WHO) 2010, *Monitoring the building blocks of health systems: A handbook of indicators and their measurement strategies*, viewed 27 January 2020, <<https://apps.who.int/iris/handle/10665/258734>>
- World Health Organization (WHO) 2020, *Health promotion and disease prevention through population-based interventions, including action to address social determinants and health inequity*, viewed 22 January 2021, <<http://www.emro.who.int/about-who/public-health-functions/health-promotion-disease-prevention.html>>
- Zimmerman, E & Lahav, A 2013, 'Ototoxicity in preterm infants: Effects of genetics, aminoglycosides, and loud environmental noise', *Journal of Perinatology*, vol. 33, no. 1, pp. 3-8. <https://doi.org/10.1038/jp.2012.105>

## Chapter 7

- Adeola, A 2016, *2,222 facts about Africa: A reference book to know more about Africa*, viewed 05 May 2018, <<https://books.google.co.uk/books?id=c2ppCwAAQBAJ>>
- Amedofu, GK 2002, 'Hearing-impairment among workers in a surface gold mining company in Ghana', *African Journal of Health Sciences*, vol. 9, no. 1, pp. 91-97. <https://doi.org/10.4314/ajhs.v9i1.30759>
- Amjad-Sardrudi, H, Dormohammadi, A, Golmohammadi, R & Poorolajal, J 2012, 'Effect of noise exposure on occupational injuries: A cross-sectional study', *Journal of Research in Health Sciences*, vol. 12, no. 2, pp. 101-104.
- AngloGold Ashanti 2012, *Country fact sheet South Africa*, viewed 27 January 2020, <<http://www.aga-reports.com/12/>>
- Annan, J-S, Addai, EK & Tulashie, SK 2015, 'A call for action to improve occupational health and safety in Ghana and a critical look at the existing legal requirement and legislation', *Safety and Health at Work*, vol. 6, no. 2, pp. 146-150. <https://doi.org/10.1016/j.shaw.2014.12.002>
- Basson, A, Le Roux, P & Strydom, E 2009, *Essential labour law*, Labour Law Publications, Centurion.
- Benson, L 2016, *Mining: South Africa's biggest success or apartheid's breeding ground?*, viewed 27 January 2020, <https://blogs.elon.edu/sasa/2016/01/22/mining-south-africas-biggest-success-or-apartheids-breeding-ground/>
- Bhunu, CP & Mushayabasa, S 2012, 'Assessing the effects of poverty in tuberculosis transmission dynamics', *Applied Mathematical Modelling*, vol. 36, no. 9, pp. 4173-4185. <https://doi.org/10.1016/j.apm.2011.09.022>
- Chadambuka, A, Mususa, F & Muteti, S 2013, 'Prevalence of noise induced hearing loss among employees at a mining industry in Zimbabwe', *African Health Sciences*, vol. 13, no. 4, pp. 899-906. <https://doi.org/10.4314/ahs.v13i4.6>
- Chen, KH, Su, SB & Chen, KT 2020, 'An overview of occupational noise-induced hearing loss among workers: Epidemiology, pathogenesis, and preventive measures', *Environmental Health and Prevention Medicine*, vol. 25, no. 1, a65. <https://doi.org/10.1186/s12199-020-00906-0>
- Chia, EM, Wang, JJ, Rochtchina, E, Cumming, RR, Newall, P & Mitchell, P 2007, 'Hearing impairment and health-related quality of life: The blue mountains hearing Study', *Ear and Hearing*, vol. 28, no. 2, pp. 187-195. <https://doi.org/10.1097/AUD.0b013e31803126b6>
- CJPME Foundation 2014, *Roots of apartheid: South Africa's mining industry*, viewed 27 January 2020, <<http://www.cjpmefoundation.org>>

- Copley, GJ & Friderichs, NB 2010, 'An approach to hearing loss in children', *South African Family Practice*, vol. 52, no. 1, pp. 34–39. <https://doi.org/10.1080/20786204.2010.10873928>
- Cullinan, K 2018, 'R1.4 billion settlement for miners with silicosis, TB', *Health24*, viewed 13 February 2019, <<https://www.news24.com/health24/news/public-health/r14-billion-settlement-for-miners-with-silicosis-tb-20180508>>
- Department of Minerals and Energy of South Africa (DME) 2003, *Guideline for the compilation of a mandatory code of practice for an occupational health program for noise*, viewed 17 January 2018, <[https://www.dmr.gov.za/Portals/0/Resource%20Center/Guidelines%20for%20the%20Mandatory%20Codes%20of%20Practice/DMR%2016324%20Occupational%20Hygiene/Occupational%20Health%20Programme%20for%20Noise\\_Distribute.pdf?ver=2018-03-13-013635-963](https://www.dmr.gov.za/Portals/0/Resource%20Center/Guidelines%20for%20the%20Mandatory%20Codes%20of%20Practice/DMR%2016324%20Occupational%20Hygiene/Occupational%20Health%20Programme%20for%20Noise_Distribute.pdf?ver=2018-03-13-013635-963)>
- Dugan, MB 2003, *Living with hearing loss*, Gallaudet University Press, Washington DC.
- Edwards, AL, Dekker, JJ, Franz, RM, Van Dyk, T & Banyini, A 2011, 'Profiles of noise exposure levels in South African mining', *Journal of the Southern African Institute of Mining and Metallurgy*, vol. 111, no. 5, pp. 315–322. <http://hdl.handle.net/10204/5220>
- Fabry, DA, Davila, EP, Arheart, KL, Serdar, B, Dietz, NA, Bandiera, FC & Lee, DJ 2010, 'Secondhand smoke exposure and the risk of hearing loss', *Tobacco Control*, vol. 20, no. 1, pp. 82–85. <https://doi.org/10.1136/tc.2010.035832>
- Gajigo, O, Mutambatsere, E & Ndiaye, G 2012, 'Fairer mining concessions in Africa: How can this be achieved?', *Africa Economic Brief*, vol. 3, no. 3, pp. 1–16.
- Graham, L & Mlatsheni, C 2015, 'Youth unemployment in South Africa: Understanding the challenge and working on solutions', *South African Child Gauge*, vol. 2, pp. 51–59.
- Grimshaw, JM, Eccles, MP, Lavis, JN, Hill, SJ & Squires, JE 2012, 'Knowledge translation of research findings', *Implementation Science*, vol. 7, a50. <https://doi.org/10.1186/1748-5908-7-50>
- Handelsman, SD 2002, *Human rights in the minerals industry*, International Institute for Environment and Development, viewed 05 March 2019, <<https://pubs.iied.org/sites/default/files/pdfs/migrate/G00531.pdf>>
- Hansia, MR & Dickinson, D 2010, 'Hearing protection device usage at a South African gold mine', *Occupational Medicine*, vol. 60, no. 1, pp. 72–74. <https://doi.org/10.1093/occmed/kqp114>
- Hermanus, MA 2007, 'Occupational health and safety in mining-status, new developments, and concerns', *Journal of the Southern African Institute of Mining and Metallurgy*, vol. 107, no. 8, pp. 531–538. <https://www.saimm.co.za/Journal/v107n08p531.pdf>
- Hessel, PA & Sluis-Cremer, GK 1987, 'Hearing loss in white South African goldminers', *South African Medical Journal*, vol. 71, no. 6, pp. 364–367.
- Hong, O, Kerr, MJ, Poling, GL & Dhar, S 2013, 'Understanding and preventing noise-induced hearing loss', *Disease-a-Month*, vol. 59, no. 4, pp. 110–118. <https://doi.org/10.1016/j.disamonth.2013.01.002>
- Ibrahim, AA & Cheri, L 2013, 'Democracy, political instability and the African crisis of underdevelopment', *Journal of Power, Politics & Governance*, vol. 1, no. 1, pp. 59–67.
- International Finance Corporation 2014, *Sustainable and responsible mining in Africa: A getting started guide*, World Bank Group, Nairobi, viewed 27 January 2020, <<https://www.ifc.org/wps/wcm/connect/14d1fb8c-8d63-47c9-acb7-35b20a488ff2/Sustainable+Mining+in+Africa.pdf?MOD=AJPERES&CVID=knWL6Rr>>
- Jamasmie, C 2021, *Most miners lag behind in human rights issues: Report*, viewed 28 November 2021, <<https://www.mining.com/most-miners-lag-behind-in-human-rights-issues-report/>>
- John, W, Sakwari, G & Mamuya, SH 2018, 'Noise exposure and self-reported hearing impairment among gas-fired electric plant workers in Tanzania', *Annals of Global Health*, vol. 84, no. 3, pp. 523–531. <https://doi.org/10.29024/aogh.2305>
- Kahan, E & Ross, E 1994, 'Knowledge and attitudes of a group of South African mine workers towards noise induced hearing loss and the use of hearing protective devices', *The South African Journal of Communication Disorders*, vol. 41, no. 1, pp. 37–47. <https://doi.org/10.4102/sajcd.v41i1.255>
- Kane-Berman, J 2017a, 'Diamonds and all that: The contribution of mining to South Africa', in *Mining in SA: Then, now, and into the future – IRR*, viewed 27 January 2020, <<http://www.politicsweb.co.za/archive/mining-in-sa-then-now-and-into-the-future--irr>>



## References

- Kane-Berman, J 2017b, 'Mining in SA: Then, now, and into the future – IRR', in *Politics web*, viewed 27 January 2020, <<https://www.politicsweb.co.za/documents/mining-in-sa-then-now-and-into-the-future--irr>>
- Kanji, A, Khoza-Shangase, K & Ntlhakana, L 2019, 'Noise-induced hearing loss: What South African mineworkers know', *International Journal of Occupational Safety and Ergonomics*, vol. 25, no. 2, pp. 305–310. <https://doi.org/10.1080/10803548.2017.1412122>
- Katz, EN 1994, *The white death: Silicosis on the witwatersrand gold mines 1886–1910*, Wits University Press, Johannesburg.
- Kheni, NA, Dainty, ARJ & Gibb, A 2008, 'Health and safety management in developing countries: A study of construction SMEs in Ghana', *Construction Management and Economics*, vol. 26, no. 11, pp. 1159–1169. <https://doi.org/10.1080/01446190802459916>
- Khoza-Shangase, K, Mupawose, A & Mlangeni, NP 2009, 'Ototoxic effects of tuberculosis treatments: How aware are patients?' *African Journal of Pharmacy and Pharmacology*, vol. 3, no. 8, pp. 391–399.
- Khoza-Shangase, K 2020a, 'Hearing function of gold miners with and without a history of tuberculosis treatment: A retrospective data review', *Brazilian Journal of Otorhinolaryngology*, vol. 86, no. 3, pp. 294–299. <https://doi.org/10.1016/j.bjorl.2018.12.003>
- Khoza-Shangase, K 2020b, 'Burden of disease: A scoping review of HIV/AIDS and TB in occupational noise-induced hearing loss', *South African Journal of Communication Disorders*, vol. 67, no. 2, a669. <https://doi.org/10.4102/sajcd.v67i2.669>
- Khoza-Shangase, K 2022, 'Occupational noise-induced hearing loss and preventive audiology: Using contemporary evidence to achieve zero ear harm in South African mines', ed. K Khoza-Shangase, *Preventive audiology: An African perspective*, AOSIS Books, Cape Town, pp. 235–251. <https://doi.org/10.4102/aosis.2022.BK209.12>
- Khoza-Shangase, K & Mophosho, M 2018, 'Language and culture in speech-language and hearing professions in South Africa: The dangers of a single story', *South African Journal of Communication Disorders*, vol. 65, no. 1, a594. <https://doi.org/10.4102/sajcd.v65i1.594>
- Khoza-Shangase, K & Mophosho, M 2021, 'Language and culture in speech-language and hearing professions in South Africa: Re-imagining practice', *South African Journal of Communication Disorders*, vol. 68, no. 1, a793. <https://doi.org/10.4102/sajcd.v68i1.793>
- Khoza-Shangase, K & Moroe, NF 2020, 'Risk versus benefit: Should not audiologists assess this in the context of occupational noise-induced hearing loss in the mining industry?', *South African Journal of Communication Disorders*, vol. 67, no. 2, a671. <https://doi.org/10.4102/sajcd.v67i2.671>
- Khoza-Shangase, K, Moroe, NF & Edwards, A 2020, 'Occupational hearing loss in Africa: An interdisciplinary view of the current status', *South African Journal of Communication Disorders*, vol. 67, no. 2, a700. <https://doi.org/10.4102/sajcd.v67i2.700>
- Kitcher, E, Ocansey, G, Abaidoo, B & Atule, A 2014, 'Occupational hearing loss of market mill workers in the city of Accra, Ghana', *Noise & Health*, vol. 16, no. 70, pp. 183–188. <https://doi.org/10.4103/1463-1741.134919>
- Le, TN, Straatman, LV, Lea, J & Westerberg, B 2017, 'Current insights in noise-induced hearing loss: A literature review of the underlying mechanism, pathophysiology, asymmetry, and management options', *Journal of Otolaryngology – Head and Neck Surgery*, vol. 46, no. 41, pp. 1–15. <https://doi.org/10.1186/s40463-017-0219-x>
- Lie, A, Skogstad, M, Johannessen, H, Tynes, T, Mehlum, IS, Nordby, K-C, Engdah, B & Tambs, K 2016, 'Occupational noise exposure and hearing: A systematic review', *International Archives of Occupational and Environmental Health*, vol. 89, pp. 351–372. <https://doi.org/10.1007/s00420-015-1083-5>
- Menon, S 2017, *SA's unemployment rate at its highest since 2003*, BL Premium, viewed 27 January 2020, <<https://www.businesslive.co.za/rdm/news/2017-06-01-sas-unemployment-rate-skyrockets-to-13-year-high/>>
- Miah, MS, Rubya, S & Kabir, MF 2014, 'Assessment of occupational noise induced hearing loss via a smartphone application', in *The 8th International Conference on Software, Knowledge, Information Management And Applications (SKIMA 2014)*, IEEE, pp. 1–5, viewed 18 June 2017, <<https://ieeexplore.ieee.org/abstract/document/7083543>>

- Momm, W & Geiecker, O 2009, 'Disability and work', in *Encyclopaedia of Occupational Health and Safety*, International Labour Office, viewed 13 July 2020, <<http://www.ilocis.org/documents/chpt17e.htm>>
- Moroe, NF 2018, *Occupational noise-induced hearing loss in South African large scale mines: From policy formulation to implementation and monitoring*, viewed 10 March 2019, <<https://hdl.handle.net/10539/27177>>
- Moroe, NF 2020a, 'Occupational noise-induced hearing loss in South African large-scale mines: Exploring hearing conservation programmes as complex interventions embedded in a realist approach', *International Journal of Occupational Safety and Ergonomics*, vol. 26, no. 4, pp. 753-761. <https://doi.org/10.1080/10803548.2018.1498183>
- Moroe, NF 2020b, 'Occupational noise-induced hearing loss in the mining sector of South Africa: Perspectives of occupational health practitioners on how mineworkers are trained', *South African Journal of Communication Disorders*, vol. 67, no. 2, a676. <https://doi.org/10.4102/sajcd.v67i2.676>
- Moroe, N & Khoza-Shangase, K 2018a, 'Management of occupational noise induced hearing loss in the mining sector in South Africa: Where are the audiologists?', *Journal of Occupational Health*, vol. 60, no. 5, pp. 376-382. <https://doi.org/10.20944/preprints201810.0422.v1>
- Moroe, N, Khoza-Shangase, K, Kanji, A & Ntlhakana, L 2018, 'The management of occupational noise-induced hearing loss in the mining sector in Africa: A systematic review - 1994 to 2016', *Noise & Vibration Worldwide*, vol. 49, no. 5, pp. 181-190. <https://doi.org/10.1177/0957456518781860>
- Moroe, N, Khoza-Shangase, K, Madahana, M & Nyandoro, O 2019, 'A proposed preliminary model for monitoring hearing conservation programmes in the mining sector in South Africa', *Journal of the Southern African Institute of Mining and Metallurgy*, vol. 119, no. 7, pp. 671-679. <https://doi.org/10.17159/2411-9717/18/016/2019>
- Moroe, NF & Khoza-Shangase, K 2018b, 'Research into occupational noise induced hearing loss in South African large-scale mines: Access denied?', *AAS Open Research*, vol. 1, no. 4, p. 4. <https://doi.org/10.12688/aasopenres.12829.1>
- Moroe, NF & Khoza-Shangase, K 2020, 'Recent advances in hearing conservation programmes: A systematic review', *South African Journal of Communication Disorders*, vol. 67, no. 2, a675. <https://doi.org/10.4102/sajcd.v67i2.675>
- Mostaghaci, M, Mirmohammadi, SJ, Mehrparvar, AH, Bahaloo, M, Mollasadeghi, A & Davari, MH 2013, 'Effect of workplace noise on hearing ability in tile and ceramic industry workers in Iran: A 2-year follow-up study', *The Scientific World Journal*, vol. 2013, a923731. <https://doi.org/10.1155/2013/923731>
- Musiba, Z 2015, 'The prevalence of noise-induced hearing loss among Tanzanian miners', *Occupational Medicine*, vol. 65, no. 5, pp. 386-390. <https://doi.org/10.1093/ocmed/kqv046>
- Musiba, Z 2020, 'Classification of audiograms in the prevention of noise-induced hearing loss: A clinical perspective', *South African Journal of Communication Disorders*, vol. 67, no. 2, a691. <https://doi.org/10.4102/sajcd.v67i2.691>
- Nandi, SS & Dhatrik, SV 2008, 'Occupational noise-induced hearing loss in India', *Indian Journal of Occupational and Environmental Medicine*, vol. 12, no. 2, a53. <https://doi.org/10.4103/0019-5278.43260>
- Nelson, G 2013, 'Occupational respiratory diseases in the South African mining industry', *Global Health Action*, vol. 6, a19520. <https://doi.org/10.3402/gha.v6i0.19520>
- Nelson, DI, Nelson, RY, Concha-Barrientos, M & Fingerhut, M 2005, 'The global burden of occupational noise-induced hearing loss', *American Journal of Industrial Medicine*, vol. 48, no. 6, pp. 446-458. <https://doi.org/10.1002/ajim.20223>
- Nilsen, P 2015, 'Making sense of implementation theories, models and frameworks', *Implementation Science*, vol. 10, no. 1, n.p. <https://doi.org/10.1186/s13012-015-0242-0>
- Nkrumah, K 1963, *Africa must unite*, viewed 13 November 2019, <[https://www.academia.edu/43339071/Africa\\_Must\\_Unite\\_KWAME\\_NKRUMAH](https://www.academia.edu/43339071/Africa_Must_Unite_KWAME_NKRUMAH)>



## References

- Ntlhakana, L, Khoza-Shangase, K & Nelson, G 2020b, 'Occupational noise-induced hearing loss in platinum miners: What do the data tell us?', *Occupational Health Southern Africa*, vol. 26, no. 1, pp. 8-14. <https://doi.org/10.17159/2411-9717/1318/2021>
- Ntlhakana, L, Nelson, G & Khoza-Shangase, K 2020a, 'Estimating miners at risk for occupational noise-induced hearing loss: A review of data from a South African platinum mine', *South African Journal of Communication Disorders*, vol. 67, no. 2, a677. <https://doi.org/10.4102/sajcd.v67i2.677>
- Ntlhakana, L, Nelson, G, Khoza-Shangase, K & Dorkin, E 2021, 'Occupational hearing loss for platinum miners in South Africa: A case study of data sharing practices and ethical challenges in the mining industry', *International Journal of Environmental Research and Public Health*, vol. 19, no. 1, a1. <https://doi.org/10.3390/ijerph19010001>
- Nyarubeli, IP, Tungu, AM, Bråtveit, M, Sunde, E, Kayumba, AV & Moen, BE 2018, 'Variability and determinants of occupational noise exposure among iron and steel factory workers in Tanzania', *Annals of Work Exposures and Health*, vol. 62, no. 9, pp. 1109-1122. <https://doi.org/10.1093/annweh/wxy071>
- Nyarubeli, IP, Tungu, AM, Moen, BE & Bråtveit, M 2019, 'Prevalence of noise-induced hearing loss among Tanzanian iron and steel workers: A cross-sectional study', *International Journal of Environmental Research and Public Health*, vol. 16, no. 8, a1367. <https://doi.org/10.3390/ijerph16081367>
- Ologe, FE, Akande, TM & Olajide, TG 2005, 'Noise exposure, awareness, attitudes and use of hearing protection in a steel rolling mill in Nigeria', *Occupational Medicine*, vol. 55, no. 6, pp. 487-489. <https://doi.org/10.1093/occmed/kqi089>
- Ologe, FE, Olajide, TG, Nwawolo, CC & Oyejola, BA 2008, 'Deterioration of noise-induced hearing loss among bottling factory workers', *The Journal of Laryngology and Otology*, vol. 122, no. 8, pp. 786-794. <https://doi.org/10.1017/S0022215107000242>
- Oluwajodu, F, Blaauw, D, Greyling, L & Kleynhans, EPJ 2015, 'Graduate unemployment in South Africa: Perspectives from the banking sector', *SA Journal of Human Resource Management*, vol. 13, no. 1, a656. <https://doi.org/10.4102/sajhrm.v13i1.656>
- Ooi, CY, Ng, CJ, Sales, AE & Lim, HM 2020, 'Implementation strategies for web-based apps for screening: Scoping review', *Journal of Medical Internet Research*, vol. 22, no. 7, a15591. <https://doi.org/10.2196/15591>
- Picard, M, Girard, SA, Simard, M, Larocque, R, Leroux, T & Turcotte, F 2008, 'Association of work-related accidents with noise exposure in the workplace and noise-induced hearing loss based on the experience of some 240,000 person-years of observation', *Accident Analysis & Prevention*, vol. 40, no. 5, pp. 1644-1652. <https://doi.org/10.1016/j.aap.2008.05.013>
- Pillay, M 2013, 'Can the subaltern speak? Visibility of international migrants with communication and swallowing disabilities in the world report on disability', *International Journal of Speech-Language Pathology*, vol. 15, no. 1, pp. 79-83. <https://doi.org/10.3109/17549507.2012.757708>
- Pillay, M 2020, 'Chemicals, noise and occupational hearing health in South Africa: A mapping study', *South African Journal of Communication Disorders*, vol. 67, no. 2, a693. <https://doi.org/10.4102/sajcd.v67i2.693>
- Powell, BJ, Waltz, TJ, Chinman, MJ, Damschroder, LJ, Smith, JL, Matthieu, MM, Proctor, EK & Kirchner, JE 2015, 'A refined compilation of implementation strategies: Results from the expert recommendations for implementing change (ERIC) project', *Implementation Science*, vol. 10, no. 1, a21. <https://doi.org/10.1186/s13012-015-0209-1>
- Reddy, M & Swanepoel, B 2006, *Cutting the Cost of HIV*, viewed 30 June 2022, <<https://hbr.org/2006/09/cutting-the-cost-of-hiv>>
- Reiprich, G, Van Zyl, A, Govender, V, Kamadu, A, Askham, L & Reddy, C n.d., *TB in the mining sector in Southern Africa (TIMS)*, Health Focus, viewed 17 March 2021, <<https://www.timssa.co.za/Documents/Studies/Legislation%20and%20Regulations%20Review%20-%20Health%20Focus.pdf>>
- Reuters 2013, 'How much is a living wage for miners?', *Fin24*, viewed 27 January 2020, <<http://www.fin24.com/Economy/How-much-is-a-living-wage-for-miners-20130711>>

- Ritzel, DO & McCrary-Quarles, AR 2008, 'Hearing loss prevention and noise control', *Umwelt und Gesundheit*, vol. 1, pp. 22-29.
- Roberts, J 2009, *The hidden epidemic amongst former miners: Silicosis, tuberculosis and the occupational diseases in mines and works act in the Eastern Cape, South Africa*, Health Systems Trust, Westville.
- Shkempi, A & Neitzel, RL 2022, 'Noise as a risk factor for COVID-19 transmission: Comment on Zhang: "Estimation of differential occupational risk of COVID-19 by comparing risk factors with case data by occupational group"', *American Journal of Industrial Medicine*, vol. 65, no. 6, pp. 512-513. <https://doi.org/10.1002/ajim.23349>
- Simons, HJ 1960, 'Death in South African mines', *Africa South*, vol. 5, no. 4, pp. 41-55.
- Smit, AC & Mji, A 2012, 'Assessment of numeracy levels of mine workers in South African chrome mine', *Numeracy*, vol. 5, no. 2, a4. <https://doi.org/10.5038/1936-4660.5.2.4>
- Sohn, LB 1973, 'The stockholm declaration on the human environment', *Harvard International Law Journal*, vol. 14, no. 3, pp. 432-515. <https://wedocs.unep.org/20.500.11822/28247>
- Stamos, TD, Shaltoni, H, Girard, SA, Parrillo, JE & Calvin, JE 2001, 'Effectiveness of chart prompts to improve physician compliance with the national cholesterol education program guidelines', *American Journal of Cardiology*, vol. 88, no. 12, pp. 1420-1423. [https://doi.org/10.1016/S0002-9149\(01\)02125-7](https://doi.org/10.1016/S0002-9149(01)02125-7)
- Stanton, DW 2003, 'Report of the commission of inquiry into safety and health in the mining industry', *The South African OHS Commissions*, vol. 1, no. 1, pp. 1-192.
- Stevens, G, Flaxman, S, Brunskill, E, Mascarenhas, M, Mathers, CD & Finucane, M 2013, 'Global and regional hearing impairment prevalence: An analysis of 42 studies in 29 countries', *The European Journal of Public Health*, vol. 23, no. 1, pp. 146-152. <https://doi.org/10.1093/eurpub/ckr176>
- Stuckler, D, Basu, S, McKee, M & Lurie, M 2011, 'Mining and risk of tuberculosis in sub-Saharan Africa', *American Journal of Public Health*, vol. 101, no. 3, pp. 524-530. <https://doi.org/10.2105/AJPH.2009.175646>
- Stuckler, D, Steele, S, Lurie, M & Basu, S 2013, 'Introduction: "Dying for gold": The effects of mineral mining on HIV, tuberculosis, silicosis, and occupational diseases in southern Africa', *International Journal of Health Services: Planning, Administration, Evaluation*, vol. 43, no. 4, pp. 639-649. <https://doi.org/10.2190/HS.43.4.c>
- Suzuki, JI, Kobayashi, T & Koga, K (eds.), 2012, *Hearing impairment: An invisible disability how you can live with a hearing impairment*, Springer Verlag, Tokyo.
- Teke, Z 2017, 'Probe into struggles of ex-miners', *Sunday Tribune*, viewed 27 January 2020, <<https://web.archive.org/web/20210506160748/https://www.iol.co.za/sunday-tribune/news/probe-into-struggles-of-ex-miners-11515422>>
- Thorne, PR 2006, *Best practice in noise-induced hearing loss management and prevention: A review of literature, practices and policies for the New Zealand context*, Accident Compensation Corporation, viewed 27 November 2021, <<https://dspace.nal.gov.au/xmlui/bitstream/handle/123456789/481/Best%20practice%20in%20noise%20-%20induced%20hearing%20loss%20management%20and%20prevention.pdf?sequence=1&isAllowed=y>>
- Thorne, PR, Ameratunga, SN, Stewart, J, Reid, N, Williams, W, Purdy, SC, Dodd, G & Wallaart, J 2008, 'Epidemiology of noise-induced hearing loss in New Zealand', *New Zealand Medical Journal* vol. 121, no. 1280, pp. 33-44.
- Tompa, E, Mofidi, A, Van Den Heuvel, S, Van Bree, T, Michaelsen, F, Jung, Y, Porsch, L & Van Emmerik, M 2021, 'Economic burden of work injuries and diseases: A framework and application in five European union countries', *BMC Public Health*, vol. 21, no. 1, pp. 1-10. <https://doi.org/10.1186/s12889-020-10050-7>
- Tshoose, C 2014, 'Placing the right to occupational health and safety within a human rights framework: Trends and challenges for South Africa', *The Comparative and International Law Journal of Southern Africa*, vol. 47, no. 2, pp. 276-272. <http://www.jstor.org/stable/24585872>
- Tye-Murray, N 2009, *Foundations of aural rehabilitation: Children, adults, and their family members*, 3rd edn., Delmar Cengage Learning, Clifton Park.

- Wilson, F 1972, *Migrant labour: Report to the South African council of churches*, South African Council of Churches and SPRO-CAS, Johannesburg.
- World Health Organization (WHO) 2018, *Addressing the rising prevalence of hearing loss*, viewed 27 January 2020, <<https://apps.who.int/iris/bitstream/handle/10665/260336/9789241550260-eng.pdf>>
- Yadav, M, Yadav, KS, Netterwala, A, Khan, B & Desai, NS 2015, 'Noise-induced hearing loss (NIHL) and its correlation with audiometric observations in heavy vehicle operators suffering with metabolic disorders', *International Journal of Medical and Clinical Research*, vol. 6, no. 1, pp. 315-320.
- Yongbing, S & Martin, WH 2013, 'Noise induced hearing loss in China: A potentially costly public health issue', *Journal of Otolaryngology*, vol. 8, no. 1, pp. 51-56. [https://doi.org/10.1016/S1672-2930\(13\)50007-9](https://doi.org/10.1016/S1672-2930(13)50007-9)
- Zhang, M 2021, 'Estimation of differential occupational risk of COVID-19 by comparing risk factors with case data by occupational group', *American Journal of Industrial Medicine*, vol. 64, no. 1, pp. 39-47.

## Chapter 8

- Alvidrez, J, Nápoles, AM, Bernal, G, Lloyd, J, Cargill, V, Godette, D, Cooper, L, Heart, MYHB, Das, R & Farhat, T 2019, 'Building the evidence base to inform planned intervention adaptations by practitioners serving health disparity populations', *American Journal of Public Health*, vol. 109, no. S1, pp. 94-101. <https://doi.org/10.2105/AJPH.2018.304915>
- Annan, J-S, Addai, EK & Tulashie, SK 2015, 'A call for action to improve occupational health and safety in Ghana and a critical look at the existing legal requirement and legislation', *Safety and Health at Work*, vol. 6, no. 2, pp. 146-150. <https://doi.org/10.1016/j.shaw.2014.12.002>
- Bird, L, Arthur, A & Cox, K 2011, "'Did the trial kill the intervention?' experiences from the development, implementation and evaluation of a complex intervention", *BMC Medical Research Methodology*, vol. 11, no. 1, pp. 1-8. <https://doi.org/10.1186/1471-2288-11-24>
- Booyens, Y 2013, 'Noise induced hearing loss worrying - CoM', *Creamer Media: Mining Weekly*, viewed 13 October 2020, <<http://www.miningweekly.com/article/noise-induced-hearing-loss-worrying-com-2013-05-20>>
- Boyko, JA, Riley, BL, Willis, CD, Stockton, L, Zummach, D, Kerner, J, Robinson, K & Chia, M 2018, 'Knowledge translation for realist reviews: A participatory approach for a review on scaling up complex interventions', *Health Research Policy and Systems*, vol. 16, no. 1, a101. <https://doi.org/10.1186/s12961-018-0374-1>
- Brits, J, Strauss, S, Eloff, Z, Becker, PJ & Swanepoel, DW 2012, 'Hearing profile of gold miners with and without tuberculosis', *Occupational and Environmental Medicine*, vol. 69, no. 4, pp. 243-249. <https://doi.org/10.1136/oemed-2011-100106>
- Brown, I, Bradley, A, Ng, CJ, Colwell, B & Mathers, N 2014, 'Investigating active ingredients in a complex intervention: A nested study within the patient and decision aids (PANDAs) randomised controlled trial for people with type 2 diabetes', *BMC Research Notes*, vol. 7, no. 1, pp. 1-9. <https://doi.org/10.1186/1756-0500-7-347>
- Chadambuka, A, Mususa, F & Muteti, S 2013, 'Prevalence of noise induced hearing loss among employees at a mining industry in Zimbabwe', *African Health Science*, vol. 13, no. 4, pp. 899-906. <https://doi.org/10.4314/ahs.v13i4.6>
- Cohn, S, Clinch, M, Bunn, C & Stronge, P 2013, 'Entangled complexity: why complex interventions are just not complicated enough', *Journal of Health Services Research & Policy*, vol. 18, no. 1, pp. 40-43. <https://doi.org/10.1258/jhsrp.2012.012036>
- Cooper, C, Lhussier, M, Shucksmith, J & Carr, SM 2017, 'Protocol for a realist review of complex interventions to prevent adolescents from engaging in multiple risk behaviours', *BMJ Open*, vol. 7, no. 9, a015477. <https://doi.org/10.1136/bmjopen-2016-015477>

- Craig, P, Dieppe, P, Macintyre, S, Michie, S, Nazareth, I & Petticrew, M 2008, 'Developing and evaluating complex interventions: The new medical research council guidance', *BMJ*, vol. 337, a1655. <https://doi.org/10.1136/bmj.a1655>
- Datta, J & Petticrew, M 2013, 'Challenges to evaluating complex interventions: A content analysis of published papers', *BMC Public Health*, vol. 13, no. 568, pp. 1-18. <https://doi.org/10.1186/1471-2458-13-568>
- Edwards, AL & Kritzingert, D 2012, 'Noise-induced hearing loss milestones: Past and future', *Journal of the Southern African Institute of Mining and Metallurgy*, vol. 112, pp. 865-869.
- Greenhalgh, T & Papoutsi, C 2018, 'Studying complexity in health services research: Desperately seeking an overdue paradigm shift', *BMC Medicine*, vol. 16, no. 1, a95. <https://doi.org/10.1186/s12916-018-1089-4>
- Grobler, LM, Swanepoel, DW, Strauss, S, Becker, P & Eloff, Z 2020, 'Occupational noise and age: A longitudinal study of hearing sensitivity as a function of noise exposure and age in South African gold mine workers', *South African Journal of Communication Disorders*, vol. 67, no. 2, a687. <https://doi.org/10.4102/sajcd.v67i2.687>
- Hailemariam, M, Bustos, T, Montgomery, B, Barajas, R, Evans, LB & Drahota, A 2019, 'Evidence-based intervention sustainability strategies: A systematic review', *Implementation Science*, vol. 14, no. 1, a57. <https://doi.org/10.1186/s13012-019-0910-6>
- Hawe, P 2015, 'Lessons from complex interventions to improve health', *Annual Review of Public Health*, vol. 36, no. 1, pp. 307-323. <https://doi.org/10.1146/annurev-publhealth-031912-114421>
- Hawe, P, Shiell, A & Riley, T 2009, 'Theorising interventions as events in systems', *American Journal of Community Psychology*, vol. 43, no. 3-4, pp. 267-276. <https://doi.org/10.1007/s10464-009-9229-9>
- Hessel, PA & Sluis-Cremer, GK 1987, 'Hearing loss in white South African goldminers', *South African Medical Journal*, vol. 71, no. 6, pp. 354-367.
- Holmboe, ES 2018, 'Competency-based medical education and the ghost of Kuhn: Reflections on the messy and meaningful work of transformation', *Academic Medicine*, vol. 93, no. 3, pp. 350-353. <https://doi.org/10.1097/ACM.0000000000001866>
- Hong, O, Kerr, MJ, Poling, GL & Dhar, S 2013, 'Understanding and preventing noise-induced hearing loss', *Disease-a-Month*, vol. 59, no. 4, pp. 110-118. <https://doi.org/10.1016/j.disamonth.2013.01.002>
- Ibrahim, AA & Cheri, L 2013, 'Democracy, political instability and the African crisis of underdevelopment', *Journal of Power, Politics & Governance*, vol. 1, no. 1, pp. 59-67.
- Kahan, E & Ross, E 1994, 'Knowledge and attitudes of a group of South African mine workers towards noise induced hearing loss and the use of hearing protective devices', *The South African Journal of Communication Disorders*, vol. 41, no. 1, pp. 37-47. <https://doi.org/10.4102/sajcd.v41i1.255>
- Kane-Berman, J 2017, 'Diamonds and all that: The contribution of mining to South Africa', *Mining in SA: Then, now, and into the future - IRR*, viewed 13 October 2020, <<http://www.politicsweb.co.za/archive/mining-in-sa-then-now-and-into-the-future--irr>>
- Kanji, A, Khoza-Shangase, K & Ntlhakana, L 2019, 'Noise-induced hearing loss: What South African mineworkers know', *International Journal of Occupational Safety and Ergonomics*, vol. 25, no. 2, pp. 305-310. <https://doi.org/10.1080/10803548.2017.1412122>
- Kheni, NA, Dainty, ARJ & Gibb, A 2008, 'Health and safety management in developing countries: A study of construction SMEs in Ghana', *Construction Management and Economics*, vol. 26, no. 11, pp. 1159-1169. <https://doi.org/10.1080/01446190802459916>
- Khoza-Shangase, K 2010, 'Is there a need for ototoxicity monitoring in patients with HIV/AIDS?', *African Journal of Pharmacy & Pharmacology*, vol. 4, no. 9, pp. 574-579.
- Khoza-Shangase, K 2010a, 'HIV/AIDS and auditory function in adults: the need for intensified research in the developing world', *African Journal of AIDS Research*, vol. 9, no. 1, pp. 1-9. <https://doi.org/10.2989/16085906.2010.484531>

## References

- Khoza-Shangase, K 2011, 'Highly active antiretroviral therapy: Does it sound toxic?', *Journal of Pharmacy & Bioallied Sciences*, vol. 3, no. 1, pp. 142–153. <https://doi.org/10.4103/0975-7406.76494>
- Khoza-Shangase, K 2017, 'Risk versus benefit: Who assesses this in the management of patients on ototoxic drugs?' *Journal of Pharmacy & Bioallied Sciences*, vol. 9, no. 3, pp. 171–177. [https://doi.org/10.4103/jpbs.JPBS\\_17\\_17](https://doi.org/10.4103/jpbs.JPBS_17_17)
- Khoza-Shangase, K 2020a, 'Burden of disease: A scoping review of HIV/AIDS and TB in occupational noise-induced hearing loss', *South African Journal of Communication Disorders*, vol. 67, no. 2, a669. <https://doi.org/10.4102/sajcd.v67i2.669>
- Khoza-Shangase, K 2020b, 'Hearing function of gold miners with and without a history of tuberculosis treatment: A retrospective data review', *Brazilian Journal of Otorhinolaryngology*, vol. 86, no. 3, pp. 294–299. <https://doi.org/10.1016/j.bjorl.2018.12.003>
- Khoza-Shangase, K 2022, 'Confronting realities to hearing conservation programmes in South African mines', eds. K Khoza-Shangase & NF Moroe, *Occupational noise-induced hearing loss: An African perspective*, AOSIS Books, Cape Town, pp. 17–38. <https://doi.org/10.4102/aosis.2022.BK249.02>
- Khoza-Shangase, K & Moroe, N 2020, 'Risk versus benefit: Should not audiologists assess this in the context of occupational noise-induced hearing loss in the mining industry?', *South African Journal of Communication Disorders*, vol. 67, no. 2, a671. <https://doi.org/10.4102/sajcd.v67i2.671>
- Khoza-Shangase, K, Moroe, N & Edwards, A 2020, 'Occupational hearing loss in Africa: An interdisciplinary view of the current status', *South African Journal of Communication Disorders*, vol. 67, no. 2, a700. <https://doi.org/10.4102/sajcd.v67i2.700>
- Kilbourne, AM, Neumann, MS, Pincus, HA, Bauer, MS & Stall, R 2007, 'Implementing evidence-based interventions in health care: Application of the replicating effective programs framework', *Implementation Science*, vol. 2, no. 1, a42. <https://doi.org/10.1186/1748-5908-2-42>
- Lazo-Porras, M, Perez-Leon, S, Cardenas, MK, Pesantes, MA, Miranda, JJ, Suggs, LS, Chappuis, F, Perel, P & Beran, D 2020, 'Lessons learned about co-creation: Developing a complex intervention in rural Peru', *Global Health Action*, vol. 13, no. 1, a1754016. <https://doi.org/10.1080/16549716.2020.1754016>
- Mayo, NE & Scott, S 2011, 'Evaluating a complex intervention with a single outcome may not be a good idea: An example from a randomised trial of stroke case management', *Age and Ageing*, vol. 40, no. 6, pp. 718–724. <https://doi.org/10.1093/ageing/afr061>
- McKibbin, KA 1998, 'Evidence-based practice', *Bulletin of the Medical Library Association*, vol. 86, no. 3, pp. 396–401.
- Medical Research Council (MRC) 2000, *A framework for development and evaluation of RCTs for complex interventions to improve health*, viewed 13 October 2020, <<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1118564/>>
- Medical Research Council (MRC) 2008, *Developing and evaluating complex interventions: New guidance*, viewed 13 October 2020, <<https://webarchive.nationalarchives.gov.uk/ukgwa/20220207162925/http://mrc.ukri.org/documents/pdf/complex-interventions-guidance/>>
- Mills, A, Gilson, L, Hanson, K, Palmer, N & Lagarde, M 2008, 'What do we mean by rigorous health-systems research?', *The Lancet*, vol. 372, no. 9649, pp. 1527–1529. [https://doi.org/10.1016/S0140-6736\(08\)61633-5](https://doi.org/10.1016/S0140-6736(08)61633-5)
- Moir, T 2018, 'Why is implementation science important for intervention design and evaluation within educational settings?', *Frontiers in Education*, vol. 3, no. 61, pp. 1–9. <https://doi.org/10.3389/educ.2018.00061>
- Moore, GF, Audrey, S, Barker, M, Bond, L, Bonell, C, Hardeman, W, Moore, L, O'Cathain, A, Tinati, T, Wight, D & Baird, J 2015, 'Process evaluation of complex interventions: Medical research council guidance', *BMJ*, vol. 350, ah1258. <https://doi.org/10.1136/bmj.h1258>
- Moroe, NF 2022, 'Hearing conservation programmes in the context of occupational health and safety in Africa', in K Khoza-Shangase & NF Moroe (eds.), *Occupational noise-induced hearing loss: An African perspective*, AOSIS Books, AOSIS Publishing (Pty) Ltd, Cape Town, pp. 139–148. <https://doi.org/10.4102/aosis.2022.BK249.08>



- Moroe, N & Khoza-Shangase, K 2018a, 'Management of occupational noise induced hearing loss in the mining sector in South Africa: Where are the audiologists?', *Journal of Occupational Health*, vol. 60, no. 5, pp. 376-382. <https://doi.org/10.1539/joh.2018-0020-OA>
- Moroe, N, Khoza-Shangase, K, Kanji, A & Ntlhakana, L 2018, 'The management of occupational noise-induced hearing loss in the mining sector in Africa: A systematic review - 1994 to 2016', *Noise & Vibration Worldwide*, vol. 49, no. 5, pp. 181-190. <https://doi.org/10.1177/0957456518781860>
- Moroe, NF 2020, 'Occupational noise-induced hearing loss in South African large-scale mines: Exploring hearing conservation programmes as complex interventions embedded in a realist approach', *International Journal of Occupational Safety and Ergonomics*, vol. 26, no. 4, pp. 753-761. <https://doi.org/10.1080/10803548.2018.1498183>
- Moroe, NF & Khoza-Shangase, K 2018b, 'Research into occupational noise induced hearing loss in South African large-scale mines: Access denied?', *AAS Open Research*, vol. 1, no. 4, a4. <https://doi.org/10.12688/aasopenres.12829.1>
- Moroe, NF, Khoza-Shangase, K, Madahana, M & Nyandoro, O 2020, 'Feedback-based noise management matrix in action', *South African Journal of Communication Disorders*, vol. 67, no. 2, a678. <https://doi.org/10.4102/sajcd.v67i2.678>
- Mothiba, TM, Malema, RN & Muthelo, L 2019, 'Perceptions about factors contributing to noise-induced hearing loss amongst mine workers at a platinum mine in Limpopo province, South Africa', *Occupational Health Southern Africa*, vol. 25, no. 1, pp. 11-6. <https://hdl.handle.net/10520/EJC-13e70baca4>
- Musiba, Z 2020, 'Classification of audiograms in the prevention of noise-induced hearing loss: A clinical perspective', *South African Journal of Communication Disorders*, vol. 67, no. 2, a691. <https://doi.org/10.4102/sajcd.v67i2.691>
- National Institute for Occupational Safety and Health (NIOSH) 2016, *Hierarchy of controls*, viewed 23 October 2021, <<https://www.cdc.gov/niosh/topics/hierarchy/>>
- Ntlhakana, L, Kanji, A & Khoza-Shangase, K 2015, 'The use of hearing protection devices in South Africa: Exploring the current status in a gold and a non-ferrous mine', *Occupational Health Southern Africa*, vol. 21, no. 2, pp. 10-15.
- Ntlhakana, L, Khoza-Shangase, K & Nelson, G 2020a, 'Occupational noise-induced hearing loss in platinum miners: What do the data tell us?', *Occupational Health Southern Africa*, vol. 26, no. 1, pp. 8-14. <https://doi.org/10.17159/2411-9717/1318/2021>
- Ntlhakana, L, Nelson, G & Khoza-Shangase, K 2020b, 'Estimating miners at risk for occupational noise-induced hearing loss: A review of data from a South African platinum mine', *South African Journal of Communication Disorders*, vol. 67, no. 2, a677. <https://doi.org/10.4102/sajcd.v67i2.677>
- Pawson, R 2006, *Evidence-based policy: A realist perspective*, Sage, Newbury Park.
- Pawson, R, Greenhalgh, T, Harvey, G & Walshe, K 2005, 'Realist review - a new method of systematic review designed for complex policy interventions', *Journal of Health Services Research & Policy*, vol. 10, no. 1, pp. 21-34. <https://doi.org/10.1258/1355819054308530>
- Peterson, S 2010, 'Assessing the scale-up of child survival interventions', *The Lancet*, vol. 375, no. 9714, pp. 530-531. [https://doi.org/10.1016/S0140-6736\(09\)62193-0](https://doi.org/10.1016/S0140-6736(09)62193-0)
- Pillay, M 2020, 'Chemicals, noise and occupational hearing health in South Africa: A mapping study', *South African Journal of Communication Disorders*, vol. 67, no. 2, a693. DOI 10.4102/sajcd.v67i2.693
- Pillay, M & Manning, WG 2020, 'A critical analysis of the current South African occupational health law and hearing loss', *South African Journal of Communication Disorders*, vol. 67, no. 2, a694. <https://doi.org/10.4102/sajcd.v67i2.694>
- Plsek, PE & Greenhalgh, T 2001, 'Complexity science: The challenge of complexity in health care', *BMJ*, vol. 323, no. 7313, pp. 625-628. <https://doi.org/10.1136/bmj.323.7313.625>

## References

- Rashaad Hansia, M & Dickinson, D 2010, 'Hearing protection device usage at a South African gold mine', *Occupational Medicine*, vol. 60, no. 1, pp. 72-74. <https://doi.org/10.1093/occmed/kqp114>
- Reeve, J, Cooper, L, Harrington, S, Rosbottom, P & Watkins, J 2016, 'Developing, delivering and evaluating primary mental health care: The co-production of a new complex intervention', *BMC Health Services Research*, vol. 16, no. 1, pp. 1-13. <https://doi.org/10.1186/s12913-016-1726-6>
- Republic of South Africa (RSA) 1996, *Mine health and safety act, 1996. No. 29 of 1996 (967)*, Mine Health and Safety, viewed 10 July 2018, <<http://www.kznhealth.gov.za/occhealth/17242.pdf>>
- Reynolds, J, DiLiberto, D, Mangham-Jefferies, L, Ansah, EK, Lal, S, Mbakilwa, H, Bruxvoort, K, Webster, J, Vestergaard, LS, Yeung, S, Leslie, T, Hutchinson, E, Reyburn, H, Lalloo, DG, Schellenberg, D, Cundill, B, Staedke, SG, Wiseman, V, Goodman, C & Chandler, CIR 2014, 'The practice of "doing" evaluation: Lessons learned from nine complex intervention trials in action', *Implementation Science*, vol. 9, no. 1, pp. 1-12. <https://doi.org/10.1186/1748-5908-9-75>
- Rycroft-Malone, J, McCormack, B, Hutchinson, AM, DeCorby, K, Bucknall, TK, Kent, B, Schultz, A, Snelgrove-Clarke, E, Stetler, CB, Titler, M, Wallin, L & Wilson, V 2012, 'Realist synthesis: Illustrating the method for implementation research', *Implementation Science*, vol. 7, no. 1, a33. <https://doi.org/10.1186/1748-5908-7-33>
- Shendell, DG, Barnett, C & Boese, S 2004, 'Science-based recommendations to prevent or reduce potential exposure to biological, chemical, and physical agents in schools', *Journal of School Health*, vol. 74, no. 10, pp. 390-396. <https://doi.org/10.1111/j.1746-1561.2004.tb06603.x>
- Shiell, A, Hawe, P & Gold, L 2008, 'Complex interventions or complex systems? Implications for health economic evaluation', *British Medical Journal*, vol. 336, no. 7656, pp. 1281-1283. <https://doi.org/10.1136/bmj.39569.510521.AD>
- Smith, R, Wood, J, Jones, F, Turner, S & Hurley, M 2019, 'A qualitative study exploring therapists' experiences of implementing a complex intervention promoting meaningful activity for residents in care homes', *Clinical Rehabilitation*, vol. 33, no. 3, pp. 575-583. <https://doi.org/10.1177/0269215518815233>
- South African Mine Health and Safety Council (MHSC) 2014, 'Every mine worker returning from work unharmed every day: Striving for zero harm', in *Proceedings of the 10th Anniversary of the 2003 Occupational Health and Safety Milestones*, Woodmead, Johannesburg, pp. 1-11.
- Spillane, V, Byrne, MC, Byrne, M, Leathem, CS, O'Malley, M & Cupples, ME 2007, 'Monitoring treatment fidelity in a randomized controlled trial of a complex intervention', *Journal of Advanced Nursing*, vol. 60, no. 3, pp. 343-352. <https://doi.org/10.1111/j.1365-2648.2007.04386.x>
- Stanton, DW 2003, 'Report of the commission of inquiry into safety and health in the mining industry', *The South African OHS Commissions*, vol. 1, no. 1, pp. 1-192.
- Stewart, JM & Malatji, SM 2018, 'Development of the MOSH leading practice adoption system - a science-based system for managing behaviour change', *Journal of the Southern African Institute of Mining and Metallurgy*, vol. 118, pp. 259-277. <https://doi.org/10.17159/2411-9717/2018/v118n3a9>
- Sturmberg, JP & Martin, CM 2013, 'Complexity in health: An introduction', in JP Sturmberg & CM Martin (eds.), *Handbook of systems and complexity in health*, Springer, New York, pp. 1-17.
- Tabak, RG, Khoong, EC, Chambers, DA & Brownson, RC 2012, 'Bridging research and practice: Models for dissemination and implementation research' *American Journal of Preventive Medicine*, vol. 43, no. 3, pp. 337-350. <https://doi.org/10.1016/j.amepre.2012.05.024>
- Tee, A, Calzavacca, P, Licari, E, Goldsmith, D & Bellomo, R 2008, 'Bench-to-bedside review: The MET syndrome - the challenges of researching and adopting medical emergency teams', *Critical Care*, vol. 12, no. 1, pp. 1-6. <https://doi.org/10.1186/cc6199>
- Tinetti, ME & Fried, T 2004, 'The end of the disease era', *The American Journal of Medicine*, vol. 116, no. 3, pp. 179-185. <https://doi.org/10.1016/j.amjmed.2003.09.031>
- Treweek, S 2005, 'Complex interventions and the chamber of secrets: understanding why they work and why they do not', *Journal of the Royal Society of Medicine*, vol. 98, no. 12, a553. <https://doi.org/10.1177/014107680509801218>
- Van Herck, P, Vanhaecht, K, Deneckere, S, Bellemans, J, Panella, M, Barbieri, A & Sermeus, W 2010, 'Key interventions and outcomes in joint arthroplasty clinical pathways: A systematic review', *Journal of Evaluation in Clinical Practice*, vol. 16, no. 1, pp. 39-49. <https://doi.org/10.1111/j.1365-2753.2008.01111.x>



- Wilson, PM 2008, 'The UK expert patients program: Lessons learned and implications for cancer survivors' self-care support programs', *Journal of Cancer Survivorship*, vol. 2, no. 1, pp. 45–52. <https://doi.org/10.1007/s11764-007-0040-z>
- World Health Organization (WHO) 2018, *Country cooperation strategy at a Glance*, viewed 13 October 2020, <[https://apps.who.int/iris/bitstream/handle/10665/136874/ccsbrief\\_zaf\\_en.pdf;jsessionid=E4076B95B82E47064DB7DB3E8F795799?sequence=1](https://apps.who.int/iris/bitstream/handle/10665/136874/ccsbrief_zaf_en.pdf;jsessionid=E4076B95B82E47064DB7DB3E8F795799?sequence=1)>

## Chapter 9

- Agarwal, G, Nagpure, PS, Pal, KS, Kaushal, AK & Kumar, M 2015, 'Audiometric notching at 4 kHz: Good screening test for assessment of early onset of occupational hearing loss', *Indian Journal of Otology*, vol. 21, no. 4, pp. 270–273. <https://doi.org/10.4103/0971-7749.164552>
- Amedofu, GK 2007, 'Effectiveness of hearing conservation program at a large surface gold mining company in Ghana', *African Journal of Health Sciences*, vol. 14, no. 1, pp. 49–53. <https://doi.org/10.4314/ajhs.v14i1.30846>
- Anglo-American 2018, *Sustainability report 2018*, viewed 07 November 2020, <[www.angloamerican.com](http://www.angloamerican.com)>
- AngloGold 2018, *Sustainable development report*, viewed 07 November 2020, <[www.aga-reports.com/17/download/AGA-SD17-employee-community-health.pdf](http://www.aga-reports.com/17/download/AGA-SD17-employee-community-health.pdf)>
- Anglo Platinum 2018, *Sustainability report 2018*, viewed 20 January 2021, <<https://www.angloamerican.com/-/media/Files/A/Anglo-American-Group/PLC/investors/annual-reporting/2019/aa-sustainability-report-2018.pdf>>
- Ayessaki, W-Y & Smallwood, J 2015, *The impact of noise on construction workers in South Africa*, EPPM, viewed n.d., <<http://www.ppml.url.tw/EPPM/conferences/2015/download/The%20Impact%20of%20Noise%20on%20Construction%20Workers%20in%20South%20Africa.pdf>>
- Begley, A 2006, *Development of internet-based mining industry database for audiograms*, viewed 07 November 2020, <<http://solsoft.co.za/ebook/documents/final-project-report/pdf/full.pdf>>
- Brits, J, Strauss, S, Eloff, Z, Becker, PJ & Swanepoel, DW 2012, 'Hearing profile of gold miners with and without tuberculosis', *Occupational and Environmental Medicine*, vol. 69, no. 4, pp. 243–249. <https://doi.org/10.1136/oemed-2011-100106>
- Campo, P, Morata, TC & Hong, O 2013, 'Chemical exposure and hearing loss', *Disease-a-Month*, vol. 59, no. 4, a119. <https://doi.org/10.1016/j.disamonth.2013.01.003>
- Chadambuka, A, Mususa, F & Muteti, S 2013, 'Prevalence of noise induced hearing loss among employees at a mining industry in Zimbabwe', *African Health Sciences*, vol. 13, no. 4, pp. 899–906. <https://doi.org/10.4314/ahs.v13i4.6>
- Chang, YS, Park, H, Hong, SH, Chung, WH, Cho, YS & Moon, IJ 2019, 'Predicting cochlear dead regions in patients with hearing loss through a machine learning-based approach: A preliminary study', *PLoS One*, vol. 14, no. 6, a0217790. <https://doi.org/10.1371/journal.pone.0217790>
- Char, DS, Shah, NH & Magnus, D 2018, 'Implementing machine learning in health care – addressing ethical challenges', *New England Journal of Medicine*, vol. 378, no. 11, pp. 981–983. <https://doi.org/10.1056/NEJMp1714229>
- Chen, F, Cao, Z, Grais, EM & Zhao, F 2021, 'Contributions and limitations of using machine learning to predict noise-induced hearing loss', *International Archives of Occupational and Environmental Health*, vol. 94, no. 5, pp. 1097–1111. <https://doi.org/10.1007/s00420-020-01648-w>
- Compensation for Occupational Injuries and Diseases Act No. 130 of 1993. Circular instruction no. 171. The determination of permanent disablement resulting from hearing loss caused by exposure to excessive noise and trauma*, viewed 07 November 2020, <[https://www.gov.za/sites/default/files/gcis\\_document/201409/22296.pdf](https://www.gov.za/sites/default/files/gcis_document/201409/22296.pdf)>
- De Jager M 2017, *Environmental noise impact assessment for vlakvarkfontein extensions east of delmas*, Enviro-Acoustic Research CC, Pretoria.

## References

- Department of Labor 1996, 'Occupational safety and health administration', in *Occupational noise exposure*, vol. Regulations; Standards, Code of Federal Regulations (CFR) 29, Department of Labor, viewed 07 November 2020, <<https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.95>>
- Department of Labour 2001, *Compensation for Occupational Injuries and Diseases Act No. 130 of 1993. Circular instruction no. 171. The determination of permanent disablement resulting from hearing loss caused by exposure to excessive noise and trauma; 2001*, viewed 10 March 2020, <[https://www.gov.za/sites/default/files/gcis\\_document/201409/22296.pdf](https://www.gov.za/sites/default/files/gcis_document/201409/22296.pdf)>
- Department of Minerals and Energy of South Africa 2003, *Guideline for the compilation of a mandatory code of practice for an occupational health program for noise*, viewed 07 November 2020, <[https://www.dmr.gov.za/Portals/0/Resource%20Center/Guidelines%20for%20the%20Mandatory%20Codes%20of%20Practice/DMR%2016324%20Occupational%20Hygiene/Occupational%20Health%20Programme%20for%20Noise\\_Distribute.pdf?ver=2018-03-13-013635-963](https://www.dmr.gov.za/Portals/0/Resource%20Center/Guidelines%20for%20the%20Mandatory%20Codes%20of%20Practice/DMR%2016324%20Occupational%20Hygiene/Occupational%20Health%20Programme%20for%20Noise_Distribute.pdf?ver=2018-03-13-013635-963)>
- Department of Minerals and Energy of South Africa 2008, *Presidential mine health and safety audit*, viewed 24 January 2020, <<http://www.klasslooch.com/Presidential%20Audit%20Report.pdf>>
- Edwards, AL, Dekker, JJ, Franz, RM, Van Dyk, T & Banyini, A 2011, 'Profiles of noise exposure levels in South African mining', *Journal of the Southern African institute of Mining and Metallurgy*, vol. 111, no. 5, pp. 315-322, viewed 07 November 2020, <<http://hdl.handle.net/10204/5220>>
- Edwards, AL, Malanzi, M, Khoza, NN & Zungu, LI 2015, 'Evaluation of the current practices of noise induced hearing loss awareness training in the South African mining industry', *Occupational Health Southern Africa*, vol. 21, no. 1, p. 5.
- Expert-System 2020, *Machine learning*, viewed 07 July 2021, <<https://expertsystem.com/machine-learning-definition/>>
- Flite, CA & Harman, LB 2013, 'Code of ethics: Principles for ethical leadership', *Perspectives in Health Information Management/AHIMA*, vol. 10, a1.
- Franz, RM & Phillips, JJ 2001, 'Noise and vibration', eds. R Guild, RI Ehrlich, JR Johnston & MH Ross, *Handbook of occupational health practice in the South African mining industry*, The Safety in Mines Research Advisory Committee (SAMRAC), Johannesburg, pp. 195-232.
- Gates, GA, Schmid, P, Kujawa, SG, Nam, BH & D'Agostino, R 2000, 'Longitudinal threshold changes in older men with audiometric notches', *Hearing Research*, vol. 141, no. 1-2, pp. 220-228.
- Grobler, LM, Swanepoel, DW, Strauss, S & Eloff, PBZ 2020, 'Occupational noise and age: A longitudinal study of hearing sensitivity as a function of noise exposure and age in South African gold mine workers', *South African Journal of Communication Disorders*, vol. 67, no. 2, a687. <https://doi.org/10.4102/sajcd.v67i2.687>
- Hansia, M & Dickinson, D 2010, 'Hearing protection device usage at a South African gold mine', *Society of Occupational Medicine*, vol. 60, no. 1, pp. 72-74. <https://doi.org/10.1093/occmed/kqp114>
- Health Professions Council of South Africa (HPCSA) 1974, *Ethical rules of conduct for practitioners registered under the health professions act*, Health Professions Council of South Africa, Pretoria.
- Health Professions Council of South Africa (HPCSA) 2016, *Guidelines for good practice in the health care professions - guidelines on the keeping of patient records: Booklet 9*, Health Professions Council of South Africa, Pretoria.
- Heiberg, T & Reid, H 2020, *South African mines record 320 COVID-19 cases ahead of lockdown easing*, Reuters, viewed 07 January 2021, <<https://www.reuters.com/article/us-health-coronavirus-safrica-mining-idUSKBN23326W>>
- Heyer, N, Morata, TC, Pinkerton, LE, Brueck, SE, Stancescu, D, Panaccio, MP, Kim, H, Sinclair, JS, Waters, MA, Estill, CF & Franks, JR 2011, 'Use of historical data and a novel metric in the evaluation of the effectiveness of hearing conservation program components', *Occupational and Environmental Medicine*, vol. 68, no. 7, pp. 510-517. <https://doi.org/10.1136/oem.2009.053801>
- Hong, SI, Lee, YM, Park, KH & Kim, SH 2014, 'Is the sensitivity of the QuantiFERON-TB gold in-tube test lower than that of T-SPOT.TB in patients with miliary tuberculosis?', *Clinical Infectious Diseases*, vol. 59, no. 1, a142.

- Kanji, A, Khoza-Shangase, K & Ntlhakana, L 2019, 'Noise-induced hearing loss: What South African mineworkers know', *International Journal of Occupational Safety and Ergonomics*, vol. 25, no. 2, pp. 305–310. <https://doi.org/10.1080/10803548.2017.1412122>
- Khoza-Shangase, K 2020a, 'Hearing function of gold miners with and without a history of tuberculosis treatment: A retrospective data review', *Brazilian Journal of Otorhinolaryngology*, vol. 86, no. 3, pp. 294–299. <https://doi.org/10.1016/j.bjorl.2018.12.003>
- Khoza-Shangase, K 2020b, 'Burden of disease: A scoping review of HIV/AIDS and TB in occupational noise-induced hearing loss', *South African Journal of Communication Disorders*, vol. 67, no. 2, a669. <https://doi.org/10.4102/sajcd.v67i2.669>
- Khoza-Shangase, K 2022, 'Risk factors for occupational noise-induced hearing loss in African mines: Arguing for contextualisation', eds. K Khoza-Shangase & NF Moroe, *Occupational noise-induced hearing loss: An African perspective*, AOSIS Books, Cape Town, pp. 39–57. <https://doi.org/10.4102/aosis.2022.BK249.03>
- Khoza-Shangase, K 2022, 'Preventive audiology: Ramping up efforts towards an ear and hearing healthy nation', ed. Khoza-Shangase, *Preventive audiology: An African perspective*, AOSIS Books, Cape Town, pp. 1–20. <https://doi.org/10.4102/aosis.2022.BK209.01>
- Khoza-Shangase, K & Moroe, NF 2020a, 'Risk versus benefit: Should not audiologists assess this in the context of occupational noise-induced hearing loss in the mining industry?', *South African Journal of Communication Disorders*, vol. 67, no. 2, a671. <https://doi.org/10.4102/sajcd.v67i2.671>
- Khoza-Shangase, K & Moroe, N 2020b, 'South African hearing conservation programmes in the context of tele-audiology: A scoping review', *South African Journal of Communication Disorders*, vol. 67, no. 2, a670. <https://doi.org/10.4102/sajcd.v67i2.670>
- Khoza-Shangase, K, Moroe, NF & Edwards, A 2020, 'Occupational hearing loss in Africa: An interdisciplinary view of the current status', *South African Journal of Communication Disorders*, vol. 67, no. 2, a700. <https://doi.org/10.4102/sajcd.v67i2.700>
- Lie, A, Skogstad, M, Johannessen, HA, Tynes, T, Mehlum, IS, Nordby, KC, Engdahl B & Tambs K 2016, 'Occupational noise exposure and hearing: A systematic review', *International Archives of Occupational and Environmental Health*, vol. 89, no. 3, pp. 351–372. <https://doi.org/10.1007/s00420-015-1083-5>
- Madahana, MC, Nyandoro, OT & Moroe, NF 2020, 'Engineering noise control for mines: Lessons from the world', *South African Journal of Communication Disorders*, vol. 67, no. 2, a684. <https://doi.org/10.4102/sajcd.v67i2.684>
- Masterson, EA, Themann, CL, Luckhaupt, SE, Li, J & Calvert, GM 2016, 'Hearing difficulty and tinnitus among US workers and non-workers in 2007', *American Journal of Industrial Medicine*, vol. 59, no. 4, pp. 290–300. <https://doi.org/10.1002/ajim.22565>
- Mine Health Safety & Council 2015, "'Every mine worker returning from work unharmed every day. Striving for zero harm" – 2014 occupational health and safety summit milestones', *Journal of Occupational Health Southern Africa*, vol. 20, no. 1, p. 2.
- Mine Health Safety and Inspectorate 2017, *Department of mineral resources annual report*, viewed 07 November 2018, <<https://www.mineralscouncil.org.za/work/health-and-safety>>
- Moroe, N, Khoza-Shangase, K, Kanji, A & Ntlhakana, L 2018, 'The management of occupational noise - induced hearing loss in the mining sector in Africa: A systematic review - 1994 to 2016', *Noise & Vibration Worldwide*, vol. 49, no. 5, pp. 181–190. <https://doi.org/10.1177/0957456518781860>
- Moroe, N, Khoza-Shangase, K, Madahana, M & Nyandoro, O 2019, 'A proposed preliminary model for monitoring hearing conservation programmes in the mining sector in South Africa', *Journal of the Southern African Institute of Mining and Metallurgy*, vol. 119, no. 7, pp. 671–679. <https://doi.org/10.17159/2411-9717/18/016/2019>
- Moroe, NF 2018, 'Occupational noise-induced hearing loss in South African large scale mines: From policy formulation to implementation and monitoring', PhD publication, University of the Witwatersrand, Wits University, viewed 27 November 2018, <<https://hdl.handle.net/10539/27177>>
- Moroe, NF 2020a, 'Occupational noise-induced hearing loss in South African large-scale mines: Exploring hearing conservation programmes as complex interventions embedded in a realist approach', *International Journal of Occupational Safety and Ergonomics*, vol. 26, no. 4, pp. 753–761. <https://doi.org/10.1080/10803548.2018.1498183>

## References

- Moroe, NF 2020b, 'Occupational noise-induced hearing loss in the mining sector of South Africa: Perspectives of occupational health practitioners on how mineworkers are trained', *South African Journal of Communication Disorders*, vol. 67, no. 2, a676. <https://doi.org/10.4102/sajcd.v67i2.676>
- Moroe, NF & Khoza-Shangase, K 2018, 'Research into occupational noise induced hearing loss in South Africa large-scale mines: Access denied?', *AAS Open Research*, vol. 1, no. 4, pp. 1-21. <https://doi.org/10.12688/aasopenres.12829.1>
- Moroe, NF, Khoza-Shangase, K, Madahana, M & Nyandoro, O 2020, 'Feedback-based noise management matrix in action', *South African Journal of Communication Disorders*, vol. 67, no. 2, a678. <https://doi.org/10.4102/sajcd.v67i2.678>
- Musiba, Z 2015, 'The prevalence of noise induced hearing loss among Tanzanian miners', *Occupational Medicine*, vol. 65, no. 5, pp. 386-390. <https://doi.org/10.1093/occmed/kqv046>
- Musiba, Z 2020, 'Classification of audiograms in the prevention of noise-induced hearing loss: A clinical perspective', *South African Journal of Communication Disorders*, vol. 67, no. 2, a691. <https://doi.org/10.4102/sajcd.v67i2.691>
- Nelson, DI, Nelson, RY, Concha-Barrientos, M & Fingerhut, M 2005, 'The global burden of occupational noise-induced hearing loss', *American Journal of Industrial Medicine*, vol. 48, no. 6, pp. 446-458. <https://doi.org/10.1002/ajim.20223>
- Ntlhakana, L, Kanji, A & Khoza-Shangase, K 2015, 'The use of hearing protection devices in South Africa: Exploring the current status in a gold and a non-ferrous mine', *Occupational Health Southern Africa*, vol. 21, no. 2, pp. 10-15.
- Ntlhakana, L, Khoza-Shangase, K & Nelson, G 2020a, 'Occupational noise-induced hearing loss in platinum miners: What do the data tell us?', *Occupational Health Southern Africa*, vol. 26, no. 1, pp. 8-14. <https://doi.org/10.17159/2411-9717/1318/2021>
- Ntlhakana, L, Nelson, G & Khoza-Shangase, K 2020b, 'Estimating miners at risk for occupational noise-induced hearing loss: A review of data from a South African platinum mine', *South African Journal of Communication Disorders*, vol. 67, no. 2, a677. <https://doi.org/10.4102/sajcd.v67i2.677>
- Ntlhakana, L, Nelson, G, Khoza-Shangase, K & Dorkin, E 2021a, 'Occupational hearing loss for platinum miners in South Africa: A case study of data sharing practices and ethical challenges in the mining industry', *International Journal of Environmental Research and Public Health*, vol. 19, no. 1, a1. <https://doi.org/10.3390/ijerph19010001>
- Ntlhakana, L, Nelson, G, Khoza-Shangase, K & Maposa, I 2021b, 'Predicting standard threshold shifts for occupational hearing loss among miners at a large-scale platinum mine in South Africa', *Journal of the Southern African Institute of Mining and Metallurgy*, vol. 121, no. 8, pp. 397-404. <https://doi.org/10.17159/2411-9717/1318/2021>
- Oliveira, A, Cacodcar, J & Motghare, DD 2014, 'Morbidity among iron ore mine workers in Goa', *Indian Journal of Public Health*, vol. 58, no. 1, a57. <https://doi.org/10.4103/0019-557X.128171>
- Pillay, M 2020, 'Chemicals, noise and occupational hearing health in South Africa: A mapping study', *South African Journal of Communication Disorders*, vol. 67, no. 2, pp. 1-11. <https://doi.org/10.4102/sajcd.v67i2.693>
- Rand Mutual Assurance 2018, *Annual Integrated Report*, viewed 20 January 2021, <[https://randmutual.co.za/Portals/O/Documents/Downloads/2019%20Annual%20General%20Meeting/RMA\\_IntegratedReport2018.pdf](https://randmutual.co.za/Portals/O/Documents/Downloads/2019%20Annual%20General%20Meeting/RMA_IntegratedReport2018.pdf)>
- Republic of South Africa 1974, *Health Professions Act No. 56 of 1974*, Government Printers, Pretoria.
- Republic of South Africa (RSA) 2003, *The National Health Act 61 of 2003*, viewed 24 January 2020, <<https://www.gov.za/documents/national-health-act>>
- Republic of South Africa (RSA) 2013, *Protection of Personal Information Act, 2013*, viewed 24 January 2020, <[https://www.gov.za/sites/default/files/gcis\\_document/201409/3706726-11act4of2013protectionofpersonalinforcorrect.pdf](https://www.gov.za/sites/default/files/gcis_document/201409/3706726-11act4of2013protectionofpersonalinforcorrect.pdf)>
- Rikhotso, O, Harmse, JL & Engelbrecht, JC 2018, 'Evaluation of passive hearing-protection device selection outcomes as a chemical manufacturing company', *Occupational Health Southern Africa*, vol. 23, no. 6, pp. 177-186.

- Samantra, C, Datta, S & Mahapatra, SS 2017, 'Analysis of occupational health hazards and associated risks in fuzzy environment: A case research in an Indian underground coal mine', *International Journal of Injury Control and Safety Promotion*, vol. 24, no. 3, pp. 311-327. <https://doi.org/10.1080/17457300.2016.1178298>
- Sebothoma, B 2020, 'Middle ear pathologies in adults within the mining industry: A systematic review', *South African Journal of Communication Disorders*, vol. 67, no. 2, a679. <https://doi.org/10.4102/sajcd.v67i2.679>
- South African National and Standards (SANS) 2013, *The measurement and assessment of occupational noise for hearing conservation purposes*, South African National Standards, Pretoria, vol. 10083, a2013.
- Strauss, S, Swanepoel, DW, Becker, P, Eloff, Z & Hall III, JW 2014, 'Noise and age-related hearing loss: A study of 40 123 gold miners in South Africa', *International Journal of Audiology*, vol. 53, Suppl. 2, pp. 66-75. <https://doi.org/10.3109/14992027.2013.865846>
- Tan, HE, Lan, NSR, Knuiman, MW, Divitini, ML, Swanepoel, DW, Hunter, M, Brennan-Jones CG, Hung J, Eikelboom RH & Santa Maria PL 2018, 'Associations between cardiovascular disease and its risk factors with hearing loss: A cross-sectional analysis', *Clinical Otolaryngology*, vol. 43, no. 1, pp. 172-181. <https://doi.org/10.1111/coa.12936>
- Tao, L, Davis, R, Heyer, N, Yang, Q, Qiu, W, Zhu, L, Li N, Zhang H, Zeng L & Zhao Y 2013, 'Effect of cigarette smoking on noise-induced hearing loss in workers exposed to occupational noise in China', *Noise and Health*, vol. 15, no. 62, a67. <https://doi.org/10.4103/1463-1741.107159>
- Tikka, C, Verbeek, J, Kateman, E, Morata, TC, Dreschler, W & Ferrite, S 2020, 'Cochrane method for systematic review and meta-analysis of interventions to prevent occupational noise-induced hearing loss - abridged', *CoDAS*, vol. 32, no. 2, a20190127. <https://doi.org/10.1590/2317-1782/20192019127>
- Tomiazzi, JS, Pereira, DR, Judai, MA, Antunes, PA & Favareto, APA 2019, 'Performance of machine-learning algorithms to pattern recognition and classification of hearing impairment in Brazilian farmers exposed to pesticide and/or cigarette smoke', *Environmental Science and Pollution Research*, vol. 26, no. 7, pp. 6481-6491. <https://doi.org/10.1007/s11356-018-04106-w>
- World Health Organization (WHO) 2021, *World report on hearing*, viewed 07 November 2021, <<http://apps.who.int/iris>>
- Zhang, X, Ni, Y, Liu, Y, Zhang, L, Zhang, M, Fang, X, Yang, Z, Wang, Q, Li, H, Xia Y & Zhu Y 2019, 'Screening of noise-induced hearing loss (NIHL)-associated SNPs and the assessment of its genetic susceptibility', *Environmental Health*, vol. 18, no. 1, pp. 1-8. <https://doi.org/10.1186/s12940-019-0471-9>
- Zhao, Y, Li, J, Zhang, M, Lu, Y, Xie, H, Tian, Y, Qiu W 2019, 'Machine learning models for the hearing impairment prediction in workers exposed to complex industrial noise: A pilot study', *Ear and Hearing*, vol. 40, no. 3, a690. <https://doi.org/10.1097/AUD.0000000000000649>

## Chapter 10

- Abrahams, K, Kathard, H, Harty, M & Pillay, M 2019, 'Inequity and the professionalisation of speech-language pathology', *Professions and Professionalism*, vol. 9, no. 3, a3285. <https://doi.org/10.7577/pp.3285>
- Alegbeleye, BJ & Mohammed, RK 2020, 'Challenges of health care delivery in the context of COVID-19 pandemic in sub-Saharan Africa', *Iberoamerican Journal of Medicine*, vol. 2, no. 2, pp. 100-109. <https://doi.org/10.53986/ibjm.2020.0018>
- Alvarez, AE 2008, *An evaluation of the Virginia early hearing detection and intervention program*, viewed 07 April 2018, <[http://www.infanthearing.org/states/documents/evaluation\\_tools/Virginia%20VEHDIP\\_Evaluation\\_July2008.pdf](http://www.infanthearing.org/states/documents/evaluation_tools/Virginia%20VEHDIP_Evaluation_July2008.pdf)>
- Arlinger, S 2003, 'Negative consequences of uncorrected hearing loss: A review', *International Journal of Audiology*, vol. 42, Suppl. 2, pp. 17-20. <https://doi.org/10.3109/14992020309074639>



## References

- Association of Faculties of Medicine of Canada (AFMC) Primer 2013, *AFMC primer on population health: A virtual textbook on public health concepts for clinicians*, AFMC Association of Faculties of Medicine of Canada, viewed 07 November 2020, <<https://phprimer.afmc.ca/Part1-TheoryThinkingAboutHealth/Chapter4BasicConceptsInPreventionSurveillanceAndHealthPromotion/Thestagesofprevention>>
- Balton, S, Uys, K & Alant, E 2019, 'Family-based activity settings of children in a low-income African context', *African Journal of Disability*, vol. 8, a364. <https://doi.org/10.4102/ajod.v8i0.364>
- Banks, JA 2006, *Race, culture, and education: The selected works of James A. Banks*, Routledge, New York.
- Barratt, J, Khoza-Shangase, K & Msimang, K 2012, 'Speech-language assessment in a linguistically diverse setting: Preliminary exploration of the possible impact of informal "solutions" within the South African context', *South African Journal of Communication Disorders*, vol. 59, no. 1, pp. 34-44. <https://doi.org/10.4102/sajcd.v59i1.20>
- Bener, A, ElHakeem, AA & Abdulhadi, K 2005, 'Is there any association between consanguinity and hearing loss', *International Journal of Pediatric Otorhinolaryngology*, vol. 69, no. 3, pp. 327-333. <https://doi.org/10.1016/j.ijporl.2004.10.004>
- Bittles, AH & Black, ML 2010, 'Consanguinity, human evolution, and complex diseases', *Proceedings of the National Academy of Sciences*, vol. 107, Suppl. 1, pp. 1779-1786. <https://doi.org/10.1073/pnas.0906079106>
- Centeno, JG 2009, 'Issues and principles in service delivery to communicatively impaired minority bilingual adults in neurorehabilitation', *Seminars in Speech and Language*, vol. 30, no. 3, pp. 139-152.
- Commission on the Social Determinants of Health (CSDH) 2008, *Closing the gap in a generation: Health equity through action on the social determinants of health: Final report of the commission on social determinants of health*, World Health Organization, Geneva, viewed 07 November 2020, <[https://apps.who.int/iris/bitstream/handle/10665/43943/9789241563703\\_eng.pdf;jsessionid=0DBA3E46A7358C1C5506BECC269A826C?sequence=1](https://apps.who.int/iris/bitstream/handle/10665/43943/9789241563703_eng.pdf;jsessionid=0DBA3E46A7358C1C5506BECC269A826C?sequence=1)>
- Ekabua, J, Ekabua, K & Njoku, C 2011, 'Proposed framework for making focused antenatal care services accessible: A review of the Nigerian setting', *International Scholarly Research Notices*, vol. 2011, a253964. <https://doi.org/10.5402/2011/253964>
- Fitzgibbons, J, Beswick, R & Driscoll, CJ 2021, 'Contextualisation of risk factors for hearing impairment', eds. K Khoza-Shangase & A Kanji, *Early detection and intervention in audiology: An African perspective*, Wits University Press, Johannesburg.
- Flood, D & Rohloff, P 2018, 'Indigenous languages and global health', *The Lancet Global Health*, vol. 6, no. 2, pp. 134-135. [https://doi.org/10.1016/S2214-109X\(17\)30493-X](https://doi.org/10.1016/S2214-109X(17)30493-X)
- Geisinger, KF 1994, 'Cross-cultural normative assessment: Translation and adaptation issues influencing the normative interpretation of assessment instruments', *Psychological Assessment*, vol. 6, no. 4, pp. 304-312. <https://doi.org/10.1037/1040-3590.6.4.304>
- Graham, RJ, Amar-Dolan, LR, Roussin, CJ & Weinstock, PH 2019, 'Bridging the stressful gap between ICU and home: Medical simulation for pediatric patients and their families', *Pediatric Critical Care Medicine*, vol. 20, no. 4, pp. 221-224. <https://doi.org/10.1097/PCC.0000000000001869>
- Health Professions Council of South Africa (HPCSA) 2019, *Guidelines for practice in a culturally and linguistically diverse South Africa*, viewed 07 November 2020, <<https://www.hpcs.co.za/Uploads/SLH/Guidelines%20for%20practice%20in%20a%20culturally%20and%20linguistically%20divers---.pdf>>
- Henrard, K 2003, 'Language rights in education: The international framework', eds. P Cuvelier, T Du Plessis & L Teck, *Multilingualism, education and social integration*, Van Schaik, Hatfield, pp. 9-22.
- Hlatshwayo, MN 2020, 'Being Black in South African higher education: An intersectional insight', *Acta Academica*, vol. 52, no. 2, pp. 163-180. <https://doi.org/10.18820/24150479/aa52i2/9>
- Joint Committee on Infant Hearing (JCIH) 2019, 'Year 2019 position statement: Principles and guidelines for early hearing detection and intervention programs', *Journal of Early*

- Hearing Detection and Intervention*, vol. 9, no. 1, pp. 9–29. [https://doi.org/10.1044/1059-0889\(2000/005\)](https://doi.org/10.1044/1059-0889(2000/005))
- Kanji, A 2021, 'Approaches to early detection of hearing impairment in low and middle-income countries', eds. K Khoza-Shangase & A Kanji, *Early detection and intervention in audiology: An African perspective*, Wits University Press, Johannesburg.
- Kanji, A & Khoza-Shangase, K 2019a, 'Risk factors for hearing impairment in neonates in South Africa: Scoping the context for newborn hearing screening planning', *The Journal of Maternal-Fetal & Neonatal Medicine*, vol. 34, no. 13, pp. 2107–2116. <https://doi.org/10.1080/14767058.2019.1658732>
- Kanji, A & Khoza-Shangase, K 2019b, 'Early detection of hearing impairment in high-risk neonates: Let's talk about the high-risk registry in the South African context', *South African Journal of Child Health*, vol. 13, no. 2, pp. 53–55.
- Kathard, H, Naude, E, Pillay, M & Ross, E 2007, 'Improving the relevance of speech-language pathology and audiology research and practice', *South African Journal of Communication Disorders*, vol. 54, no. 1, a745. <https://doi.org/10.4102/sajcd.v54i1.745>
- Kathard, H & Pillay, M 2013, 'Promoting change through political consciousness: A South African speech-language pathology response to the world report on disability', *International Journal of Speech-Language Pathology*, vol. 15, no. 1, pp. 84–89. <https://doi.org/10.3109/17549507.2012.757803>
- Kathard, H, Pillay, M & Samuel, MA 1997, 'The curriculum of practice: A conceptual framework for speech-language therapy and audiology practice with a black African first language clientele', *South African Journal of Communication Disorders*, vol. 44, no. 44, a232. <https://doi.org/10.4102/sajcd.v44i1.232>
- Kautzky, K & Tollman, SM 2008, 'A perspective on primary health care in South Africa: Primary health care: In context', *South African Health Review*, vol. 2008, no. 1, pp. 17–30.
- Khoza-Shangase, K 2017, 'Risk versus benefit: Who assesses this in the management of patients on ototoxic drugs?', *Journal of Pharmacy and BioAllied Sciences*, vol. 9, no. 3, pp. 171–177. [https://doi.org/10.4103/jpbs.JPBS\\_17\\_17](https://doi.org/10.4103/jpbs.JPBS_17_17)
- Khoza-Shangase, K 2019, 'Intellectual and emotional toxicity: Where a cure does not appear to be imminent', eds. G Khunou, ED Phaswana, K Khoza-Shangase & H Canham, *Black academic voices: the South African experience*, HSRC, Cape Town, pp. 42–64.
- Khoza-Shangase, K 2020, 'Burden of disease: A scoping review of HIV/AIDS and TB in occupational noise-induced hearing loss', *South African Journal of Communication Disorders*, vol. 67, no. 2, a669. <https://doi.org/10.4102/sajcd.v67i2.669>
- Khoza-Shangase, K 2021a, 'Confronting realities to early hearing detection in South Africa', eds. K Khoza-Shangase & A Kanji, *Early detection and intervention in audiology: An African perspective*, Wits University Press, Johannesburg, pp. 66–88.
- Khoza-Shangase, K 2021b, 'HIV/AIDS and the burden of disease in early hearing detection and intervention', eds. K Khoza-Shangase & A Kanji, *Early detection and intervention in audiology: An African perspective*, Wits University Press, Johannesburg.
- Khoza-Shangase, K 2022a, 'Preventive audiology: Ramping up efforts towards an ear and hearing healthy nation', ed. K Khoza-Shangase, *Preventive audiology: An African perspective*, AOSIS Books, Cape Town, pp. 1–20. <https://doi.org/10.4102/aosis.2022.BK209.01>
- Khoza-Shangase, K 2022, 'Risk factors for occupational noise-induced hearing loss in African mines: Arguing for contextualisation', eds. K Khoza-Shangase & NF Moroe, *Occupational noise-induced hearing loss: An African perspective*, AOSIS Books, Cape Town, pp. 39–57. <https://doi.org/10.4102/aosis.2022.BK249.03>
- Khoza-Shangase, K & Kanji, A 2021, 'Best practice in South Africa for early detection and intervention', in *Early detection and intervention in audiology: An African perspective*, Wits University Press, viewed 30 May 2021, <<https://library.oapen.org/handle/20.500.12657/46214>>
- Khoza-Shangase, K, Kanji, A, Petrocchi-Bartal, L & Farr, K 2017, 'Infant hearing screening in a developing-country context: Status in two South African provinces', *South African Journal of Child Health*, vol. 11, no. 4, pp. 159–163.



## References

- Khoza-Shangase, K & Masondo, N 2021, 'In pursuit of preventive audiology in South Africa: Scoping the context for ototoxicity assessment and management', *Journal of Pharmacy and BioAllied Sciences*, vol. 13, no. 1, a46. [https://doi.org/10.4103/jpbs.JPBS\\_334\\_19](https://doi.org/10.4103/jpbs.JPBS_334_19)
- Khoza-Shangase, K & Mophosho, M 2018, 'Language and culture in speech-language and hearing professions in South Africa: The dangers of a single story', *South African Journal of Communication Disorders*, vol. 65, no. 1, a594. <https://doi.org/10.4102/sajcd.v65i1.594>
- Khoza-Shangase, K & Mophosho, M 2021, 'Language and culture in speech-language and hearing professions in South Africa: Re-imagining practice', *South African Journal of Communication Disorders*, vol. 68, no. 1, a793. <https://doi.org/10.4102/sajcd.v68i1.793>
- Khoza-Shangase, K, Moroe, N & Edwards, A 2020, 'Occupational hearing loss in Africa: An interdisciplinary view of the current status', *South African Journal of Communication Disorders*, vol. 67, no. 2, a700. <https://doi.org/10.4102/sajcd.v67i2.700>
- Khoza-Shangase, K, Moroe, N & Neille, J 2021, 'Speech-language pathology and audiology in South Africa: Clinical training and service in the era of COVID-19', *International Journal of Telerehabilitation*, vol. 13, no. 1, a6376. <https://doi.org/10.5195/ijt.2021.6376>
- Khoza-Shangase, K, Pillay, D & Moolla, A 2013, 'Diabetes and the audiologist: Is there need for concern regarding hearing function in diabetic adults?', *South African Journal of Diabetes and Vascular Disease*, vol. 10, no. 4, pp. 127-133.
- Khunou, G, Canham, H, Khoza-Shangase, K & Phaswana, ED 2019, 'Black in the academy: Reframing knowledge, the knower, and knowing', eds. G Khunou, ED Phaswana, K Khoza-Shangase & H Canham, *Black academic voices: The South African experience*, HSRC, Cape Town, pp. 1-10.
- Kirmayer, LJ 2012, 'Rethinking cultural competence', *Transcultural Psychiatry*, vol. 49, no. 2, pp. 149-164. <https://doi.org/10.1177/1363461512444673>
- Langdon, HW & Cheng, LL 2002, *Collaborating with interpreters and translators in communication disorders field*, Thinking Publications, Eau Claire.
- Langlois, EV, McKenzie, A, Schneider, H & Mecaskey, JW 2020, 'Measures to strengthen primary health-care systems in low-and middle-income countries', *Bulletin of the World Health Organization*, vol. 98, no. 11, a781. <https://doi.org/10.2471/BLT.20.252742>
- Levin, ME 2006, 'Different use of medical terminology and culture-specific models of disease affecting communication between Xhosa speaking patients and English-speaking doctors at a South African paediatric teaching hospital', *South African Medical Journal*, vol. 96, no. 10, a68594. <https://journals.co.za/doi/pdf/10.10520/EJC68594>
- Louw, C, Swanepoel, DW, Eikelboom, RH & Hugo, J 2018, 'Prevalence of hearing loss at primary health care clinics in South Africa', *African Health Sciences*, vol. 18, no. 2, pp. 313-320. <https://doi.org/10.4314/ahs.v18i2.16>
- Major, G & Napier, J 2012, 'Interpreting and knowledge mediation in the health care setting: What do we really mean by "accuracy"?', *Linguistica Antverpiensia*, vol. 11, no. 11, pp. 207-225. <https://doi.org/10.52034/lanstts.v11i.304>
- Makhoba, M & Joseph, N 2016, 'Practices and views of audiologists regarding aural rehabilitation services for adults with acquired hearing loss', *South African Journal of Communication Disorders*, vol. 63, no. 1, a155. <https://doi.org/10.4102/sajcd.v63i1.155>
- Malakoane, B, Heunis, JC, Chikobvu, P, Kigozi, NG & Kruger, WH 2020, 'Public health system challenges in the free state, South Africa: A situation appraisal to inform health system strengthening', *BMC Health Services Research*, vol. 20, no. 1, a58. <https://doi.org/10.1186/s12913-019-4862-y>
- Maluleke, NP, Chiwutsi, R & Khoza-Shangase, K 2021a, 'Family-centred early hearing detection and intervention', eds. K Khoza-Shangase & A Kanji, *Early detection and intervention in audiology: An African perspective*, Wits University Press, Johannesburg.
- Maluleke, NP, Khoza-Shangase, K & Kanji, A 2020, 'An integrative review of current practice models and/or process of family-centered early intervention for children who are deaf or hard of hearing', *Family & Community Health*, vol. 44, no. 1, pp. 59-71. <https://doi.org/10.1097/FCH.0000000000000276>

- Maluleke, NP, Khoza-Shangase, K & Kanji, A 2021b, 'An Integrative review of current practice models and/or process of family-centered early intervention for children who are deaf or hard of hearing', *Family & Community Health*, vol. 44, no. 1, pp. 59–71.
- Manyisa, ZM 2016, 'The current status of working conditions in public hospitals at a selected province, South Africa: Part 1', *Journal of Human Ecology*, vol. 56, no. 1-2, pp. 210–219. <https://doi.org/10.1080/09709274.2016.11907058>
- Matshego, L 2019, *How many languages of Africa are there?*, viewed 30 May 2021, <<https://www.africa.com/many-african-languages/>>
- Mbunge, E 2020, 'Effects of COVID-19 in South African health system and society: An explanatory study', *Diabetes & Metabolic Syndrome*, vol. 14, no. 6, pp. 1809–1814. <https://doi.org/10.1016/j.dsx.2020.09.016>
- Mdlalo, T, Flack, PS & Joubert, RW 2019, 'The cat on a hot tin roof? Critical considerations in multilingual language assessments', *South African Journal of Communication Disorders*, vol. 66, no. 1, a610. <https://doi.org/10.4102/sajcd.v66i1.610>
- Mdlalo, T, Flack, P & Joubert, R 2016, 'Are South African speech-language therapists adequately equipped to assess English additional language (EAL) speakers who are from an indigenous linguistic and cultural background? A profile and exploration of the current situation', *South African Journal of Communication Disorders*, vol. 63, no. 1, pp. 1-5. <https://doi.org/10.4102/sajcd.v63i1.130>
- Mignolo, WD 2009, *The idea of Latin America*, John Wiley & Sons, Hoboken.
- Miller, T 2009, 'From creative to cultural industries: Not all industries are cultural, and no industries are creative', *Cultural Studies*, vol. 23, no. 1, pp. 88–99. <https://doi.org/10.1080/09502380802326660>
- Mogobe, KD, Shaibu, S, Matshediso, E, Sabone, M, Ntsayagae, E, Nicholas, PK, Portillo, CJ, Corless, IB, Rose, CD, Johnson, MO, Webel, A, Cuca, Y, Rivero-Méndez, M, Solís Báez, SS, Nokes, K, Reyes, D, Kemppainen, J, Reid, P, Sanzero Eller, L, Lindgren, T, Holzemer, WL & Wantland D 2016, 'Language and culture in health literacy for people living with HIV: Perspectives of health care providers and professional care team members', *AIDS Research and Treatment*, vol. 2016, a5015707. <https://doi.org/10.1155/2016/5015707>
- Moonsamy, S, Mupawose, A, Seedat, J, Mophosho, M & Pillay, D 2017, 'Speech-language pathology and audiology in South Africa: Reflections on transformation in professional training and practice since the end of apartheid', *Perspectives of the ASHA Special Interest Groups*, vol. 2, no. 17, pp. 30–41. <https://doi.org/10.1044/persp2.SIG17.30>
- Mophosho, M 2018, 'Speech-language therapy consultation practices in multilingual and multicultural health care contexts: Current training in South Africa', *African Journal of Health Professions Education*, vol. 10, no. 3, pp. 145–147. <https://doi.org/10.7196/AJHPE.2018.v10i3.1045>
- Moroe, NF & Masuku, KP 2022, 'Preventive audiology in the context of deafblindness', ed. K Khoza-Shangase, *Preventive audiology: An African perspective*, AOSIS Books, Cape Town, pp. 179–197. <https://doi.org/10.4102/aosis.2022.BK209.09>
- National Language Policy Framework (NLPF) 2003, *Implementation plan: National language policy framework*, viewed 30 May 2021, <[http://www.dac.gov.za/sites/default/files/LPD\\_Implem%20Plan\\_10%20April%202003.pdf](http://www.dac.gov.za/sites/default/files/LPD_Implem%20Plan_10%20April%202003.pdf)>
- National Patients Rights' Charter (NPRC) 2002, *Booklet 13*, viewed 30 May 2021, <<https://web.archive.org/web/20100323235157/http://www.doh.gov.za/docs/legislation/patientsright/chartere.html>>
- Ndlovu, HL 2016, 'African beliefs concerning people with disabilities: Implications for theological education', *Journal of Disability & Religion*, vol. 20, no. 1-2, pp. 29–39. <https://doi.org/10.1080/23312521.2016.1152942>
- Ngxongo, TSP 2018, 'Basic antenatal care approach to antenatal care service provision', in *Selected topics in midwifery care*, IntechOpen, viewed 07 November 2020, <<https://www.intechopen.com/books/selected-topics-in-midwifery-care/basic-antenatal-care-approach-to-antenatal-care-service-provision>>
- Oleribe, OO, Momoh, J, Uzochukwu, BS, Mbofana, F, Adebisi, A, Barbera, T, Williams, R & Taylor-Robinson, SD 2019, 'Identifying key challenges facing health care systems in Africa and

## References

- potential solutions', *International Journal of General Medicine*, vol. 2019, no. 12, a395. <https://doi.org/10.2147/IJGM.S223882>
- Olusanya, BO 2008, 'Priorities for early hearing detection and intervention in sub-Saharan Africa', *International Journal of Audiology*, vol. 47, suppl. 1, pp. 3-13. <https://doi.org/10.1080/14992020802287143>
- Olusanya, BO 2011, 'Making targeted screening for infant hearing loss an effective option in less developed countries', *International Journal of Pediatric Otorhinolaryngology*, vol. 75, no. 3, pp. 316-321. <https://doi.org/10.1016/j.ijporl.2010.12.002>
- Pascoe, M & Norman, V 2011, 'Contextually relevant resources in speech-language therapy and audiology in South Africa-Are there any?', *The South African Journal of Communication Disorders*, vol. 58, no. 1, a35. <https://doi.org/10.4102/sajcd.v58i1.35>
- Pascoe, M, Rogers, C & Norman, V 2013, 'Are we there yet? On a journey towards more contextually relevant resources in speech-language therapy and audiology', *The South African Journal of Communication Disorders*, vol. 60, no. 1, a3. <https://doi.org/10.4102/sajcd.v60i1.3>
- Penn, C, Mupawose, A & Stein, J 2009, 'From pillars to posts: Some reflections on community service six years on', *South African Journal of Communication Disorders*, vol. 56, no. 1, pp. 8-16. <https://doi.org/10.4102/sajcd.v56i1.188>
- Penn, C, Watermeyer, J, Koole, T, De Picciotto, J, Ogilvy, D & Fisch, M 2010, 'Cultural brokerage in mediated health consultations: An analysis of interactional features and participant perceptions in an audiology context', *Journal of Interactional Research in Communication Disorders*, vol. 1, no. 1, pp. 135-156. <https://doi.org/10.1558/jircd.v1i1.135>
- Phaswana, ED 2019, 'The limits of being and knowledge in the academy', eds. G Khunou, ED Phaswana, K Khoza-Shangase & H Canham, *Black academic voices: The South African experience*, HSRC, Cape Town, pp. 178-194.
- Pillay, M & Kathard, H 2015, 'Decolonizing health professionals' education: Audiology & speech therapy in South Africa', *African Journal of Rhetoric*, vol. 7, no. 1, pp. 193-227.
- Pillay, M & Kathard, H 2018, 'Renewing our cultural borderlands', *Topics in Language Disorders*, vol. 38, no. 2, pp. 143-160. <https://doi.org/10.1097/TLD.0000000000000151>
- Pillay, M, Kathard, H & Samuel, M 1997, 'The curriculum of practice: A conceptual framework for speech-language therapy and audiology practice with a Black African first language clientele', *South African Journal of Communication Disorders*, vol. 44, no. 1, a232. <https://doi.org/10.4102/sajcd.v44i1.232>
- Pillay, M & Ramkissoon, I 2020, 'Civic responsibility and global health care: Audiology service learning in Africa', *Perspectives of the ASHA Special Interest Groups*, vol. 5, no. 4, pp. 1075-1084. [https://doi.org/10.1044/2020\\_PERSP-19-00161](https://doi.org/10.1044/2020_PERSP-19-00161)
- Pillay, M, Tiwari, R, Kathard, H & Chikte, U 2020, 'Sustainable workforce: South African audiologists and speech therapists', *Human Resources for Health*, vol. 18, no. 1, pp. 1-13. <https://doi.org/10.1186/s12960-020-00488-6>
- Purkey, WW 1999, *Creating safe schools through invitational education*, ERIC Digest, viewed 07 November 2020, <<http://www.ericdigest.org/2000-3/safe.htm>>
- Ramma, L & Sebothoma, B 2016, 'The prevalence of hearing impairment within the Cape Town metropolitan area', *South African Journal of Communication Disorders*, vol. 63, no. 1, a105. <https://doi.org/10.4102/sajcd.v63i1.105>
- Ross, E & Deverell, A 2004, *Psychosocial approaches to health, illness and disability*, Van Schaik Publishers, Hatfield, vol. 34, no. 3, pp. 506-512.
- Seabi, M, Seedat, J & Khoza-Shangase, K 2014, 'Experiences of university students regarding transformation in South Africa', *International Journal of Educational Management*, vol. 28, no. 1, pp. 66-81. <https://doi.org/10.1108/IJEM-01-2012-0017>
- Sebothoma, B, Khoza-Shangase, K, Mol, D & Masege, D 2021, 'The sensitivity and specificity of wideband absorbance measure in identifying pathologic middle ears in adults living with HIV', *South African Journal of Communication Disorders*, vol. 68, no. 1, a820. <https://doi.org/10.4102/sajcd.v68i1.820>

- Soderlund, N 1999, 'An essential hospital package for South Africa selection criteria, costs and affordability', *South African Medical Journal*, vol. 89, no. 7, pp. 757-765.
- Starfield, B, Shi, L & Macinko, J 2005, 'Contribution of primary care to health systems and health', *The Milbank Quarterly*, vol. 83, no. 3, pp. 457-502. <https://doi.org/10.1111/j.1468-0009.2005.00409.x>
- Statistics South Africa (StatsSA) 2017, *Mid-year population estimates*, viewed 07 November 2020, <<https://www.statssa.gov.za/publications/P0302/P03022017.pdf>>
- Steyn, M, Burnett, S & Ndzwayiba, N 2021, *Differences at work: Practicing critical diversity literacy*, Common Ground Research Networks, Champaign.
- Swanepoel, DW 2006, 'Audiology in South Africa: Audiología en sudáfrica', *International Journal of Audiology*, vol. 45, no. 5, pp. 262-266. <https://doi.org/10.1080/14992020500485650>
- Terralingua 2011, *Terralingua langscape: The case for linguistic diversity*, viewed 13 April 2020, <[https://terralingua.org/wp-content/uploads/2019/04/Lang\\_II\\_8.pdf](https://terralingua.org/wp-content/uploads/2019/04/Lang_II_8.pdf)>
- WorldAtlas 2022, *Map of Africa*, viewed 13 January 2022, <<https://www.worldatlas.com/webimage/countrys/af.htm>>
- Worldometers 2022, *Current world population*, viewed 13 January 2022, <<https://www.worldometers.info/world-population/>>
- World Health Organization (WHO) 2010a, *Monitoring the building blocks of health systems: A handbook of indicators and their measurement strategies*, World Health Organization, viewed 13 April 2020, <<https://apps.who.int/iris/handle/10665/258734>>
- World Health Organization (WHO) 2010b, *Community-based rehabilitation: CBR guidelines*, viewed 13 April 2020, <<https://www.ncbi.nlm.nih.gov/books/NBK310952/>>
- World Health Organization (WHO) 2013, *Millions of people in the world have hearing loss that can be treated or prevented*, viewed 13 April 2020, <[https://apps.who.int/mediacentre/news/notes/2013/hearing\\_loss\\_20130227/en/index.html](https://apps.who.int/mediacentre/news/notes/2013/hearing_loss_20130227/en/index.html)>
- World Health Organization (WHO) 2018, *Prevention of blindness and deafness*, viewed 13 April 2020, <<https://web.archive.org/web/20180105063850/https://www.who.int/pbd/publications/en/>>
- World Health Organization (WHO) 2020, *Health promotion and disease prevention through population-based interventions, including action to address social determinants and health inequity*, viewed 07 November 2020, <<http://www.emro.who.int/about-who/public-health-functions/health-promotion-disease-prevention.html>>

## Chapter 11

- Afolayan, FS 2004, *Culture and customs of South Africa*, Greenwood Press, Westport, CT.
- Allied Health Professions Council of South Africa 2018, *The allied health professions council of South Africa*, viewed 10 August 2020, <<https://ahpcs.co.za/>>
- Alves, RR & Rosa, IM 2007, 'Biodiversity, traditional medicine and public health: Where do they meet?', *Journal of Ethnobiology and Ethnomedicine*, vol. 3, no. 1, pp. 1-9. <https://doi.org/10.1186/1746-4269-3-14>
- Ataguba, JE & McIntyre, D 2012, 'Paying for and receiving benefits from health services in South Africa: Is the health system equitable?', *Health Policy and Planning*, vol. 27, Suppl. 1, pp. 35-45. <https://doi.org/10.1093/heapol/czs005>
- Ayer, WA 2005, *Psychology and dentistry: Mental health aspects of patient care*, Routledge, New York.
- Bandura, A 1998, 'Health promotion from the perspective of social cognitive theory', *Psychology and Health*, vol. 13, no. 4, pp. 623-649. <https://doi.org/10.1080/08870449808407422>
- Bandura, A 2001, 'Social cognitive theory: An agentic perspective', *Annual Review of Psychology*, vol. 52, no. 1, pp. 1-26. <https://doi.org/10.1146/annurev.psych.52.1.1>
- Bandura, A 2003, 'On the psychosocial impacts and mechanisms of spiritual modelling', *International Journal for the Psychology of Religion*, vol. 13, no. 3, a167.

## References

- Best, M, Butow, P & Olver, I 2016, 'Doctors discussing religion and spirituality: A systematic literature review', *Palliative Medicine*, vol. 30, no. 4, pp. 327-337. <https://doi.org/10.1177/0269216315600912>
- Blanchette, O, Imamichi, T & McLean, GF (eds.) 2001, *Philosophical challenges and opportunities of globalization*, CRVP, Washington, vol. 21.
- Bodeker, G & Burford, G 2007, *Traditional, complementary and alternative medicine: Policy and public health perspectives*, Imperial College Press, London, pp. 8-16.
- Bond, P 2003, *Against global apartheid: South Africa meets the World Bank, IMF and international finance*, Palgrave Macmillan, London.
- Bonser, W 1963, *The medical background of Anglo-Saxon England*, Wellcome Historical Medical Library, London.
- Boorse, C 1975, 'On the distinction between illness and disease', *Philosophy and Public Affairs*, vol. 5, no. 1, pp. 49-68. [https://www.jstor.org/stable/2265020?seq=1#metadata\\_info\\_tab\\_contents](https://www.jstor.org/stable/2265020?seq=1#metadata_info_tab_contents)
- Bornman, E 2006, 'National symbols and nation-building in the post-apartheid South Africa', *International Journal of Intercultural Relations*, vol. 30, no. 3, pp. 383-399. <https://doi.org/10.1016/j.ijintrel.2005.09.005>
- Bramadat, P, Coward, H & Stajduhar, KI 2013, *Spirituality in hospice palliative care*, SUNY Press, Albany.
- Bronfenbrenner, U 2009, *The ecology of human development*, Harvard University Press, Cambridge.
- Clarke, A 2013, *The sociology of healthcare*, Routledge, New York.
- Cloatre, E 2019, 'Law and biomedicine and the making of "genuine" traditional medicines in global health', *Critical Public Health*, vol. 29, no. 4, pp. 424-434. <https://doi.org/10.1080/09581596.2019.1594696>
- Collins Dictionary 2021, 'Hakim', viewed 19 January 2022, <<https://www.collinsdictionary.com/us/dictionary/english/hakim>>
- Constitution, SA & Devenish, G 2005, *South African Constitution*, Government Printers, Pretoria.
- Coombes, AE 2003, *History after apartheid: Visual culture and public memory in a democratic South Africa*, Duke University Press, Durham.
- Coovadia, H, Jewkes, R, Barron, P, Sanders, D & McIntyre, D 2009, 'The health and health system of South Africa: Historical roots of current public health challenges', *The Lancet*, vol. 374, no. 9692, pp. 817-834. [https://doi.org/10.1016/S0140-6736\(09\)60951-X](https://doi.org/10.1016/S0140-6736(09)60951-X)
- Dahlström, J & Frohm, H 2010, *Individual experiences of hearing loss in South Africa*, viewed 13 January 2021, <<http://www.diva-portal.se/smash/get/diva2:324023/FULLTEXT01.pdf>>
- De Andrade, V 2011, "'Traditional healers and modern doctors do not understand each other because they learn different things" South African traditional health practitioners training with regards to hearing impairment', *International Journal of Health Promotion and Education*, vol. 49, no. 3, pp. 120-127. <https://doi.org/10.1080/14635240.2011.10708218>
- De Andrade, V & Ross, E 2005, 'Beliefs and practices of Black South African traditional healers regarding hearing impairment', *International Journal of Audiology*, vol. 44, no. 9, pp. 489-499. <https://doi.org/10.1080/14992020500188999>
- De Gruchy, JW 1986, 'The revitalization of Calvinism in South Africa: Some reflections on Christian belief, theology, and social transformation', *The Journal of Religious Ethics*, vol. 14, no. 1, pp. 22-47.
- De Man, J, Mayega, RW, Sarkar, N, Waweru, E, Leys, M, Van Olmen, J & Criel B 2016, 'Patient-centered care and people-centered health systems in sub-Saharan Africa: Why so little of something so badly needed?', *International Journal of Person Centered Medicine*, vol. 6, no. 3, pp. 162-173. <https://doi.org/10.5750/ijpcm.v6i3.591>
- Department of Health (DoH) 1997, 'White paper for the transformation of the health system in South Africa', *Government Gazette*, viewed 26 January 2019, <[https://www.gov.za/sites/default/files/gcis\\_document/201409/17910gen6670.pdf](https://www.gov.za/sites/default/files/gcis_document/201409/17910gen6670.pdf)>



- Dubos, R 1987, *Mirage of health*, Rutgers University Press, New Brunswick.
- Du Toit, A 1985, 'Puritans in Africa? Afrikaner "Calvinism" and Kuyperian Neo-Calvinism in late nineteenth-century South Africa', *Comparative Studies in Society and History*, vol. 27, no. 2, pp. 209–240. <https://doi.org/10.1017/S0010417500011336>
- Ellison, CG & Levin, JS 1998, 'The religion-health connection: Evidence, theory, and future directions', *Health Education & Behavior*, vol. 25, pp. 700–720. <https://doi.org/10.1177/109019819802500603>
- Enquist, R 1979, 'A Tillichian analysis of Afrikanerdom', *Dialog*, vol. 18, no. 1, pp. 125–131. <https://doi.org/10.1111/j.1540-6385.1979.tb00890.x>
- Ferrans, CE 1990, 'Quality of Life: Conceptual issues', *Seminars in Oncology Nursing*, vol. 6, no. 4, pp. 248–254.
- Ferrans, CE 1996, 'Development of a conceptual model of quality of life', *Scholarly Inquiry for Nursing Practice*, vol. 10, no. 3, pp. 293–304.
- Ganiyu, BO, Fapohunda, JA & Haldenwang, R, vol. 2017, 'Sustainable housing financing model to reduce South Africa housing deficit', *International Journal of Housing Markets and Analysis*, vol. 10, no. 3, pp. 410–430. <https://doi.org/10.1108/IJHMA-07-2016-0051>
- Gavriilidis, G & Östergren, P 2012, 'Evaluating a traditional medicine policy in South Africa: Phase 1 development of a policy assessment tool', *Global Health Action*, vol. 5, no. 1, a17271. <https://doi.org/10.3402/gha.v5i0.17271>
- Gaynes, R 2017, 'The Discovery of Penicillin – New insights after more than 75 years of clinical use', *Emerging Infectious Diseases*, vol. 23, no. 5, pp. 849–853. <https://doi.org/10.3201/eid2305.161556>
- Ghebreyesus, TA 2019, *WHO global report on traditional and complementary medicine 2019*, World Health Organization, viewed 13 January 2021, <<https://apps.who.int/iris/handle/10665/312342>>
- Goodman, RD, Williams, JM, Chung, RC, Talleyrand, RM, Douglass, AM, McMahan, HG & Bemak, F 2015, 'Decolonizing traditional pedagogies and practices in counseling and psychology education: A move towards social justice and action', eds. RD Goodman & PC Gorski, *Decolonizing 'multicultural' counseling through social justice*, Springer, London, pp. 147–164.
- Govender, P, Chetty, V, Naidoo, D & Pefile, N 2018, 'Integrated decentralized training for health professions education at the university of KwaZulu-Natal, South Africa: Protocol for the I-DecT Project', *JMIR Research Protocols*, vol. 7, no. 1, a7551. <https://doi.org/10.2196/resprot.7551>
- Gruchy, JWD 1986, 'The church and the struggle for South Africa', *Theology Today*, vol. 43, no. 2, pp. 229–243. <https://doi.org/10.1177/004057368604300208>
- Guma, PM & Mokgoatšana, S 2020, 'The historical relationship between African indigenous healing practices and Western-orientated biomedicine in South Africa: A challenge to collaboration', *HTS Teologiese Studies/Theological Studies*, vol. 76, no. 4, a6104. <https://doi.org/10.4102/hts.v76i4.6104>
- Hangulu, L & Akintola, O 2017, 'Perspectives of policy-makers and stakeholders about health care waste management in community-based care in South Africa: A qualitative study', *BMC Health Services Research*, vol. 17, no. 1, pp. 1–13. <https://doi.org/10.1186/s12913-017-2236-x>
- Harris, B, Goudge, J, Ataguba, JE, McIntyre, D, Nxumalo, N, Jikwana, S & Chersich, M 2011, 'Inequities in access to health care in South Africa', *Journal of Public Health Policy*, vol. 32, no. 1, pp. 102–123. <https://doi.org/10.1057/jphp.2011.35>
- Health & Democracy 2010, *Chapter 7 traditional and alternative health care*, viewed 23 January 2020, <<https://section27.org.za/wp-content/uploads/2010/04/Chapter7.pdf>>
- Heleta, S 2018, 'Decolonizing knowledge in South Africa: Dismantling the "pedagogy of big lies"', *Ufahamu: A Journal of African Studies*, vol. 40, no. 2, pp. 47–65. <https://doi.org/10.5070/F7402040942>
- Iheduru, OC 2004, 'Black economic power and nation-building in post-apartheid South Africa', *Journal of Modern African Studies*, vol. 42, no. 1, pp. 1–30. <https://doi.org/10.1017/S0022278X03004452>

## References

- Incayawar, M, Wintrob, R, Bouchard, L & Bartocci, G 2009, *Psychiatrists and traditional healers: Unwitting partners in global mental health*, John Wiley & Sons, Hoboken.
- International Health Conference, 2002, 'Constitution of the World Health Organization. 1946', *Bulletin of the World Health Organization*, vol. 80, no. 12, pp. 983-984.
- Khoza, VL & Du Toit, HS 2011, 'The Batho Pele principles in the health services', *Professional Nursing Today*, vol. 15, no. 3, pp. 8-11.
- Khoza-Shangase, K 2019, 'Intellectual and emotional toxicity: Where a cure does not appear to be imminent', eds. G Khunou, ED Phaswana, K Khoza-Shangase & H Canham, *Black academic voices: The South African experience*, HSRC, Cape Town, pp. 42-64.
- Khoza-Shangase, K 2021, 'Confronting realities to early hearing detection in South Africa', eds. K Khoza-Shangase & A Kanji, *Early detection and intervention in audiology: An African perspective*, Wits University Press, Johannesburg, pp. 66-88.
- Khoza-Shangase, K & Kanji, A 2021, 'Best practice in South Africa for early hearing detection and intervention', eds. K Khoza-Shangase & A Kanji, *Early detection and intervention in audiology: An African perspective*, Wits University Press, Johannesburg.
- Khoza-Shangase, K & Mophosho, M 2018, 'Language and culture in speech-language and hearing professions in South Africa: The dangers of a single story', *South African Journal of Communication Disorders*, vol. 65, no. 1, a594. <https://doi.org/10.4102/sajcd.v65i1.594>
- Khoza-Shangase, K & Mophosho, M 2021, 'Language and culture in speech-language and hearing professions in South Africa: Reimagining practice', *South African Journal of Communication Disorders*, vol. 68, no. 1, a793. <https://doi.org/10.4102/sajcd.v68i1.793>
- Khunou, G, Canham, H, Khoza-Shangase, K & Phaswana, ED 2019, 'Black in the academy: Reframing knowledge, the knower, and knowing', eds. G Khunou, ED Phaswana, K Khoza-Shangase & H Canham, *Black academic voices: The South African experience*, HSRC, Cape Town, pp. 1-10.
- Kim, JH 2015, *Understanding narrative inquiry: The crafting and analysis of stories as research*, Sage, Newbury Park.
- Kirkland, J 1992, *Herbal and magical medicine: Traditional healing today*, Duke University Press, Durham.
- Kothari, M & Mehta, L 1984, 'White/might has rights: Apartheid and health', *Journal of Postgraduate Medicine*, vol. 30, no. 2, a65. <https://www.jpjgmonline.com/text.asp?1984/30/2/65/5470>
- Lee, MM, Lin, SS, Wrensch, MR, Adler, SR & Eisenberg, D 2000, 'Alternative therapies used by women with breast cancer in four ethnic populations', *Journal of the National Cancer Institute*, vol. 92, no. 1, pp. 42-47. <https://doi.org/10.1093/jnci/92.1.42>
- Leith, JH 2010, *John Calvin's doctrine of the Christian life*, Wipf and Stock Publishers, Eugene.
- Madomombe, I 2006, 'Traditional healers boots primary health care: Reaching patients missed by modern medicine', *Africa Renewal*, viewed 05 January 2018, <<http://www.un.org/africarenewal/magazine/january-2006/traditional-healers-boost-primary-health-care>>
- Makhanya, M 2019, 'University transformation draws attention to what we still need to learn', *Daily Maverick*, viewed 10 February 2020, <<https://www.dailymaverick.co.za/opinionista/2019-02-11-university-transformation-draws-attention-to-what-we-still-need-to-learn/>>
- Maluleke, NP, Khoza-Shangase, K & Kanji, A 2021, 'An integrative review of current practice models and/or process of family-centered early intervention for children who are deaf or hard of hearing', *Family and Community Health*, vol. 44, no. 1, pp. 59-71. <https://doi.org/10.1097/FCH.0000000000000276>
- Maphumulo, WT & Bhengu, BR 2019, 'Challenges of quality improvement in the healthcare of South Africa post-apartheid: A critical review', *Curationis*, vol. 42, no. 1, a1901. <https://doi.org/10.4102/curationis.v42i1.1901>
- Matshipi, MG, Mulaudzi, NO & Mashau, TS 2017, 'Causes of overcrowded classes in rural primary schools', *Journal of Social Sciences*, vol. 51, no. 1-3, pp. 109-114. <https://doi.org/10.1080/09718923.2017.1305568>



- Maylam, P 2017, *South Africa's racial past: The history and historiography of racism, segregation, and apartheid*, Routledge, New York.
- Mayosi, BM & Benatar, SR 2014, 'Health and health care in South Africa – 20 years after Mandela', *New England Journal of Medicine*, vol. 371, no. 14, pp. 1344–1353. <https://doi.org/10.1056/NEJMSr1405012>
- McLeroy, KR, Bibeau, D, Steckler, A & Glanz, K 1988, 'An ecological perspective on health promotion programs', *Health Education Quarterly*, vol. 15, no. 4, pp. 351–377. <https://doi.org/10.1177/109019818801500401>
- Miller, LJ 2012, *The Oxford handbook of psychology and spirituality*, Oxford University Press, Oxford.
- Moola, N & Pillay, D 2016, 'Hakeems and their role within the community in relation to speech pathology and audiology', unpublished undergraduate study, University of the Witwatersrand, Johannesburg.
- Moola, N & Pillay, D 2020, 'Traditional and alternative healthcare practices within rehabilitation professions in South Africa', unpublished postgraduate study, University of the Witwatersrand.
- Moonsamy, S, Mupawose, A, Seedat, J, Mophosho, M & Pillay, D 2017, 'Speech-language pathology and audiology in South Africa: Reflections on transformation in professional training and practice since the end of apartheid', *Perspectives of the ASHA Special Interest Groups*, vol. 2, no. 17, pp. 30–41. <https://doi.org/10.1044/persp2.SIG17.30>
- Moosa, E 2000, 'Tensions in legal and religious values in the 1996 South African constitution', ed. M Mamdani, *Beyond rights talk and culture talk: Comparative essays on the politics of rights and culture*, David Philip Publishers, Cape Town, pp. 121–135.
- Moses, AD 2011, 'Official apologies, reconciliation, and settler colonialism: Australian indigenous alterity and political agency', *Citizenship Studies*, vol. 15, no. 2, pp. 145–159. <https://doi.org/10.1080/13621025.2011.549698>
- Mothibe, ME & Sibanda, M 2019, 'African traditional medicine: South African perspective', ed. C Mordeniz, *Traditional and complementary medicine*, IntechOpen, London, pp. 1–27.
- Nemutandani, SM, Hendricks, SJ & Mulaudzi, MF 2016, 'Perceptions and experiences of allopathic health practitioners on collaboration with traditional health practitioners in post-apartheid South Africa', *African Journal of Primary Health Care & Family Medicine*, vol. 8, no. 2, a1007. <https://doi.org/10.4102/phcfm.v8i2.1007>
- Nzimakwe, TI & Mpehle, Z 2012, 'Key factors in the successful implementation of Batho Pele principles', *Journal of Public Administration*, vol. 47, no. si-1, pp. 279–290. <https://hdl.handle.net/10520/EJC121941>
- O'Connor, BB 2010, *Healing traditions*, University of Pennsylvania Press, Philadelphia.
- Oleribe, OO, Momoh, J, Uzochukwu, BS, Mbofana, F, Adebisi, A, Barbera, T, Williams, R & Taylor-Robinson SD 2019, 'Identifying key challenges facing healthcare systems in Africa and potential solutions', *International Journal of General Medicine*, vol. 2019, no. 12, a395. <https://doi.org/10.2147/IJGM.S223882>
- Otieno, B & Ochieng, A 2018, 'Green economy in the wastewater treatment sector: Jobs, awareness, barriers, and opportunities in selected local governments in South Africa', *Journal of Energy in Southern Africa*, vol. 29, no. 1, pp. 50–58. <https://doi.org/10.17159/2413-3051/2018/v29i1a3379>
- Oyebode, O, Kandala, NB, Chilton, PJ & Lilford, RJ 2016, 'Use of traditional medicine in middle-income countries: A WHO-SAGE study', *Health Policy and Planning*, vol. 31, no. 8, pp. 984–991. <https://doi.org/10.1093/heapol/czw022>
- Peltzer, K & Khoza, L B 2002, 'Attitudes and knowledge of nurse practitioners towards traditional healing, faith healing and complementary medicine in the Northern Province of South Africa', *Curationis*, vol. 25, no. 2, pp. 30–40. <https://doi.org/10.4102/curationis.v25i2.749>
- Perroux, F 2017, 'The pole of development's new place in a general theory of economic activity', eds. B Higgins & DJ Savoie, *Regional economic development*, Routledge, New York, pp. 48–76.

## References

- Pillay, D & Moonsamy, S 2018, 'A pilot study: Considering spirituality in an inclusive model of practice in clinical audiology', *South African Journal of Communication Disorders*, vol. 65, no. 1, a552. <https://doi.org/10.4102/sajcd.v65i1.552>
- Pillay, D & Serooe, T 2019, 'Shifting and transforming the practice of audiology: The inclusion of traditional healing', *South African Journal of Communication Disorders*, vol. 66, no. 1, a635. <https://doi.org/10.4102/sajcd.v66i1.635>
- Pillay, M & Ramkissoon, I 2020, 'Civic responsibility and global health care: Audiology service learning in Africa', *Perspectives of the ASHA Special Interest Groups*, vol. 5, no. 4, pp. 1075–1084. [https://doi.org/10.1044/2020\\_PERSP-19-00161](https://doi.org/10.1044/2020_PERSP-19-00161)
- Pillay, M, Tiwari, R, Kathard, H & Chikte, U 2020, 'Sustainable workforce: South African audiologists and speech therapists', *Human Resources for Health*, vol. 18, no. 1, pp. 1–13. <https://doi.org/10.1186/s12960-020-00488-6>
- Pourbohloul, B & Kieny, MP 2011, 'Complex systems analysis: Towards holistic approaches to health systems planning and policy', *Bulletin of the World Health Organization*, vol. 89, no. 4, a242. <https://doi.org/10.2471/BLT.11.087544>
- Price, M 1986, 'Health care as an instrument of apartheid policy in South Africa', *Health Policy and Planning*, vol. 1, no. 2, pp. 158–170. <https://doi.org/10.1093/heapol/1.2.158>
- Puchalski, CM 2001, 'The role of spirituality in health care', *Proceedings Baylor University Medical Center*, vol. 14, no. 4, pp. 352–357. <https://doi.org/10.1080/08998280.2001.11927788>
- Ratele, K 2009, 'Apartheid, anti-apartheid and post-apartheid sexualities', eds. M Steyn & M Van Zyl, *The prize and the price: Shaping sexualities in South Africa*, HSRC, Cape Town, pp. 290–306.
- Reagan, T 2001, 'The promotion of linguistic diversity in multilingual settings: Policy and reality in post-apartheid South Africa', *Language Problems and Language Planning*, vol. 25, no. 1, pp. 51–72. <https://doi.org/10.1075/lplp.25.1.04rea>
- Ruiters, M 2009, 'Collaboration, assimilation and contestation: Emerging constructions of coloured identity in post-apartheid South Africa', ed. A Mohamed, *Burdened by race: Coloured identities in Southern Africa*, UCT Press, Cape Town, pp. 104–133.
- Segal, EA, Gerdes, EK & Seiner, S 2010, *An introduction to the profession of social work: Becoming a change agent*, Cengage Learning, Boston.
- Sisk, T 2017, *Democratization in South Africa: The elusive social contract*, Princeton University Press, Princeton.
- Smith, AB 1990, 'On becoming herders: Khoikhoi and San ethnicity in Southern Africa', *African Studies*, vol. 49, no. 2, pp. 51–73. <https://doi.org/10.1080/00020189008707727>
- Susta, D, Browne, S, Coppo, A, Minozzi, S & Bellisario, C 2019, *Healthy lifestyle empowerment: A manual for healthcare professionals*, viewed 18 October 2020, <<http://doras.dcu.ie/22682/1/M9%20Manual%20Healthy%20Lifestyle%20Empowerment.pdf>>
- Toon, P 2011, *The emergence of hyper-Calvinism in English nonconformity 1689–1765*, Wipf and Stock Publishers, Eugene.
- Tshehla, B 2015, 'Traditional health practitioners and the authority to issue medical certificates', *South African Medical Journal*, vol. 105, no. 4, pp. 279–280. <https://doi.org/10.7196/SAMJ.9217>
- Tugendhaft, A 2010, 'Medical pluralism and HIV/AIDS in South Africa: What are the barriers to collaboration between traditional healers and medical doctors?', Doctoral dissertation, University of the Witwatersrand.
- UNAIDS 2006, *Country progress report*, viewed 18 October 2020, <<http://www.unaids.org/en/regionscountries/countries/southafrica/>>
- Van Wyk, JH 2016, 'Should we blame Calvinism for the development of apartheid in South Africa? A perspective from the Reformed Churches in South Africa: A case study', *In die Skriflig/In Luce Verbi*, vol. 50, no. 1, a2155. <https://doi.org/10.4102/ids.v50i1.2155>

- Vearey, J 2014, 'Healthy migration: A public health and development imperative for South (ern) Africa', *South African Medical Journal*, vol. 104, no. 10, pp. 663–664. <https://doi.org/10.7196/SAMJ.8569>
- Veeresham, C 2012, 'Natural products derived from plants as a source of drugs', *Journal of Advanced Pharmaceutical Technology & Research*, vol. 3, no. 4, pp. 200–201. <https://doi.org/10.4103/2231-4040.104709>
- Von Holdt, K & Murphy, M 2007, 'Public hospitals in South Africa: Stressed institutions, disempowered management', eds. S Buhlungu, J Daniel, R Southall & J Lutchman, *State of the nation: South Africa 2007*, HSRC Press, Cape Town, pp. 312–341.
- Wendt, WE 1976, "'Art mobilier" from the Apollo 11 cave, South West Africa: Africa's oldest dated works of art', *The South African Archaeological Bulletin*, vol. 31, no. 121/122, pp. 5–11. <https://doi.org/10.2307/3888265>
- Wilson, IB & Cleary, PD 1995, 'Linking clinical variables with health-related quality of life', *Journal of the American Medical Association*, vol. 273, no. 1, pp. 59–65.
- Woods, D 2000, *Rainbow nation revisited: South Africa's decade of democracy*, Andre Deutsch, London.
- World Health Organization (WHO) 2003, *World health report: Shaping the future*, viewed 18 October 2020, <<http://apps.who.int/iris/bitstream/handle/10665/42789/9241562439.pdf;jsessionid=C53310FDFBE208DE5B19CB4F812E3D07?sequence=1>>
- World Health Organization (WHO) 2007, *Promoting the role of traditional medicine in health systems*, viewed 18 October 2020, <<https://apps.who.int/iris/handle/10665/95467>>
- World Health Organization (WHO) 2012, *Traditional and complementary medicine policy*, viewed 18 October 2020, <<http://apps.who.int/medicinedocs/documents/s19582en/s19582en.pdf>>
- World Health Organization (WHO) 2018, *Country cooperation strategy at a glance*, viewed 18 October 2020, <[https://apps.who.int/iris/bitstream/handle/10665/136874/ccsbrief\\_zaf\\_en.pdf;jsessionid=E4076B95B82E47064DB7DB3E8F795799?sequence=1](https://apps.who.int/iris/bitstream/handle/10665/136874/ccsbrief_zaf_en.pdf;jsessionid=E4076B95B82E47064DB7DB3E8F795799?sequence=1)>
- Yuan, H, Ma, Q, Ye, L & Piao, G 2016, 'The traditional medicine and modern medicine from natural products', *Molecules*, vol. 21, no. 5, a559. <https://doi.org/10.3390/molecules21050559>
- Zhang, Q, Sharan, A, Espinosa, SA, Gallego-Perez, D & Weeks, J 2019, 'The path toward integration of traditional and complementary medicine into health systems globally: The World Health Organization report on the implementation of the 2014–2023 strategy', *The Journal of Alternative and Complementary Medicine*, vol. 25, no. 9, pp. 869–871. <https://doi.org/10.1089/acm.2019.29077.jjw>
- Zihindula, G, John, RA, Gumede, DM, Gavin, MR & De Wet, N 2019, 'A review on the contributions of NGOs in addressing the shortage of healthcare professionals in rural South Africa', *Cogent Social Sciences*, vol. 5, no. 1, a1674100. <https://doi.org/10.1080/23311886.2019.1674100>
- Zihindula, G, MacGregor, RG & Ross, AJ 2018, 'A rural scholarship model addressing the shortage of healthcare workers in rural areas', *South African Health Review*, vol. 2018, no. 1, pp. 51–57.
- Zuberi, T, Sibanda, A & Udjo, EO 2016, *The demography of South Africa*, Routledge, New York.



# Index

## A

access to health care, 50, 59, 64–66, 72, 165, 173, 183–184

African context, 1–4, 6, 8–10, 12–21, 24, 26–27, 31–32, 36–43, 48–51, 53, 57–59, 61–69, 71–72, 80–81, 84–88, 91, 96–102, 104–106, 112, 115, 118, 121–122, 125, 131–132, 137–140, 143, 145, 156–161, 163, 166–169, 171–172, 174, 178–179, 184, 188, 190–191, 194–195

African mines, 110, 120–121, 125–126, 128, 130–132, 134, 136, 138, 140, 143–149, 151

African mining context, 126, 139–140

African mining industry, 113, 115, 126, 129, 133–134, 139, 142

artificial intelligence (AI), 81–83, 144, 148

assessment and management, 20, 71–72, 74, 76, 78, 80–82, 84, 86, 88, 91–106, 123, 178, 180

audiologists, 1, 6, 8–9, 15–16, 19–21, 28, 31–32, 34–35, 39, 41–42, 46, 48–49, 51–53, 62–66, 77, 79–80, 82, 85, 87–89, 92–93, 95–97, 99, 102, 104–106, 116, 118–123, 134–135, 138–140, 156–160, 164, 172–173, 178, 180, 188, 193–196

audiology service delivery, 19, 157, 166

audiology, 1–2, 4–6, 8–10, 12, 14–16, 18–20, 23–25, 35, 37, 40–42, 49, 52–53, 55, 68, 71–73, 77–78, 85, 87–88, 91, 93–95, 98, 100, 102, 105–107, 121, 125, 141, 152, 154–175, 177–181, 184, 188, 191–192, 194–196

audiometry, 79–80, 83, 94, 121, 142–145, 147, 149–154

auditory verbal therapy, 44

## B

best practice, 38–39, 54, 58, 60, 111, 121, 126, 143, 151

building blocks, 10–11, 14–15, 19, 24, 53, 92, 106, 161, 174

burden of disease, 2, 14, 17–18, 51, 53, 56, 66, 73–75, 85, 109, 129, 136, 160, 163, 168, 184

buying quiet, 164

## C

capacity versus demand, 13, 19, 31, 38, 49, 53, 56, 65–66, 81, 83, 85, 97, 104, 157, 184

challenges to implementation, 92, 140

challenges, 1–2, 4, 6, 8–20, 23–25, 27–33, 35–44, 46, 48–50, 52–57, 59, 61, 64–65, 67–69, 71–72, 74, 76–78, 80–89, 91–92, 94–108, 120, 122, 125–127, 129, 131, 136–141, 145, 149, 153–164, 166, 168–175, 177, 184

communication therapeutic approaches, 41–44, 46–50, 52, 54

compensation, 109, 117, 120, 131, 136

complex interventions, 3, 121, 125–128, 131–138

complexities, 1–2, 4, 6, 8, 10, 12, 14, 16, 18–20, 23–25, 27, 30, 37, 40–44, 46, 48–50, 52–60, 62–64, 66, 68, 71–74, 76, 78, 80, 82, 84, 86, 88–89, 91–92, 94, 96, 98, 100, 102, 104–108, 110, 112–114, 116, 118–120, 122–128, 130–132, 134, 136, 138, 140–141, 145, 155–156, 158–162, 164, 166, 168, 170, 172–174, 177–182, 184–186, 188–192, 194, 196

complexity, 3, 5, 8–10, 24, 59, 63, 65–66, 85, 87, 121, 126–127, 129, 174, 187

contextual realities, 2, 26, 43, 84, 162

contextualisation, 131

cost-effectiveness, 51

cultural and linguistic diversity, 9, 155–156, 158, 160, 162, 164, 166, 168, 170, 172, 174

cultural diversity, 20, 34, 43, 48–49, 52–53, 56, 61, 67–68, 72, 88

## D

data management, 28, 35–36, 38, 98, 121

diagnostic audiometry, 151

disease prevention, 163

## E

early detection and intervention, 44, 72, 84

early hearing detection and intervention (EHDI), 8, 10, 20, 23–46, 48–66, 68–69, 165

early intervention in audiology, 41

economic evaluation, 52

engineering controls, 116, 130, 142–143

evidence-based complex interventions, 128

excessive noise exposure, 109, 129, 142, 144, 146

**F**

- Family-centred early hearing detection and intervention (FC-EHDI), 20, 56–57, 59–61, 63–66, 68
- Family-centred practice, 45
- Fourth Industrial Revolution, 39

**H**

- health and safety, 100, 111–115, 129–130, 134, 142, 144, 150, 153
- health care delivery, 4, 8, 14, 19–20, 64, 147, 158, 161
- health care in South Africa, 13, 19, 181, 183
- health care provision, 6, 76, 126, 156, 188
- health care system, 1–4, 6, 8, 11–21, 36, 42, 63, 68, 72, 80, 86–87, 96, 98–99, 102, 165, 169, 173, 175, 182, 184–189, 191, 194
- health care systems, 5, 9–12, 14–15, 19, 49, 51, 56, 75, 88, 106, 144, 174
- health care, 1–21, 24–26, 28, 31–32, 35–40, 42, 47–53, 56, 59–69, 72–77, 79–82, 84–89, 92–99, 102–104, 106, 120, 126–128, 144–145, 147–150, 153–154, 156–163, 165, 168–175, 177–196
- health promotion, 95, 163, 165, 168, 172
- hearing conservation programme (HCP), 3, 20, 78, 108, 111, 116, 119–124, 125–127, 128–140, 142–150, 152–154, 165, 167
- hearing impairment, 2, 4–5, 20, 24–27, 29–30, 32–35, 39–53, 55–66, 68–69, 72, 74, 80, 88, 92–93, 97, 102–103, 106–107, 110, 160, 163, 166, 168, 178–180, 188, 195
- hearing loss, 2–3, 20–21, 26, 28, 30–31, 33, 39, 51, 56, 60, 71–74, 76–77, 79–80, 82, 84, 92, 96, 99–100, 104–105, 107–111, 115, 118–119, 121, 123, 130, 133, 136, 141–152, 154, 160, 162–168
- hearing protection devices, 110
- hierarchy of control, 130–131, 140
- hierarchy of noise control, 143
- HIV, AIDS and TB, 116–117

**I**

- Industrial Revolution, 39
- intervention methods, 84
- invitational theory, 172–174

**L**

- lack of knowledge, 34, 56–57, 59–60, 68, 187
- language and culture, 34, 49, 52, 67–68, 88, 97, 120, 157–163, 165–167, 169–170, 175
- levels of prevention, 89, 93, 106, 167, 173–174
- low- and middle-income countries (LMICs), 2, 30–32, 40, 59, 142

**M**

- machine learning systems, 20, 141–142, 144–146, 148–150, 152, 154
- machine learning, 20, 81–82, 141–142, 144–146, 148–150, 152, 154
- middle ear pathologies, 3, 20, 71–89
- milestones, 26, 46, 61, 130–131, 133–135, 139–140
- mineworkers, 109, 111, 113–120, 122, 130, 137, 141–146, 148–154
- mining industry, 110, 113–118, 123–124, 126, 129–130, 132–134, 139, 141–142, 146, 153–154
- mining sector, 107–109, 111–118, 120, 123, 129–130, 132–133, 135–136, 147
- models of service delivery, 62

**N**

- Noise-induced hearing loss, 3, 107–108, 110, 115, 118–119, 133, 142, 147, 149, 151

**O**

- occupational health and safety (OHS), 100, 107, 111–116, 118, 120, 123, 130–131, 133, 136–139, 144
- occupational hearing loss (OHL), 100–101, 141–142, 144–146, 148, 150, 152–154
- occupational noise exposure, 107, 142, 147, 152
- occupational noise-induced hearing loss (ONIHL), 3, 20, 82, 100, 107–116, 118–123, 126, 129–138, 142–149, 151–154, 166
- opportunities, 1, 4, 6, 8, 12, 27, 33, 37–39, 43, 45, 60, 67, 77, 109, 196
- oral-aural approach, 44
- ototoxicity monitoring and management, 6, 96
- ototoxicity monitoring programmes, 92, 94–95, 98–101, 105
- ototoxicity, 2–3, 6, 20, 91–106, 159, 166–167

**P**

- percentage loss of hearing, 131, 151
- pharmacovigilance, 91–92, 101, 164
- pillars, 122, 127, 129–131, 136–138, 140, 143
- prevention, 2, 8–9, 18, 30, 39, 71–72, 75, 82, 87–89, 93–97, 101, 106, 135, 143, 146–150, 153–154, 156, 162–169, 171–174, 178–180, 182, 185, 188–189, 193–195
- preventive audiology, 1–2, 4–6, 8–10, 12, 14–16, 18–20, 23–25, 41, 52–53, 55, 68, 71, 85, 88, 91, 93–94, 106–107, 121, 125, 141, 152, 154–156, 158–175, 177–179, 181, 184, 188, 191, 194–196
- preventive health care, 1–2, 4, 9, 19, 39, 74–76, 79, 86–89, 93–94, 99, 104, 106, 161–162, 165, 170–171

preventive methods, 77, 119, 194  
 preventive strategies, 88, 93  
 proactive data management, 121  
 programmatic approach, 15, 72, 87

**Q**

quadruple burden of disease, 17–18, 51, 66, 85, 184

**R**

realist reviews, 122, 128–129, 140  
 recent advances, 5  
 religion, 178–179, 181, 184, 188  
 resource constraints, 31, 43, 56, 63, 66, 68, 169, 173  
 risk factors, 26, 30, 32, 42, 50–51, 59–62, 68, 71, 74–77, 85, 93, 95, 105, 108, 110, 129, 138, 144–146, 151–152, 163–165, 167–168  
 rural communities, 19, 169

**S**

South Africa, 1–2, 9–10, 13–19, 23–24, 26–28, 30–32, 34–36, 38–42, 47–48, 50–53, 55–56, 60–68, 71, 73, 75, 77, 79–81, 83–88, 91–92, 94, 96, 98, 100, 102–104, 106–107, 109, 111, 113–115, 117–118, 125, 129–130, 136, 141–144, 146, 148–150, 152–158, 160–162, 164–165, 169–172, 175, 177–189, 191, 193–194, 196  
 South African context, 6, 10, 13–15, 17, 19–20, 24, 26–27, 31–32, 36–40, 42–43, 48, 51, 57–59, 61–69, 71–72, 80–81, 84–88, 91,

96–102, 104–106, 112, 115, 121, 131–132, 137–140, 145, 156–161, 163, 166–169, 171–172, 174, 178–179, 184, 188, 190–191, 194–195

South African mines, 120–121, 125–126, 128, 130–132, 134, 136, 138, 140, 143–149, 151  
 South African mining industry, 113, 115, 126, 129, 133–134, 139, 142  
 standard threshold shift (STS), 131, 134–135, 140, 143, 145, 151  
 Sub-Saharan Africa, 50–51, 56, 77, 107–111, 118–119, 123–124, 129, 132, 136–137  
 systems theory approach, 9, 21, 24

**T**

task-shifting, 6, 19, 32, 38–39, 76, 78, 80, 86–87, 106  
 tele-audiology, 19, 37  
 telehealth, 38, 86  
 telepractice, 13, 37–38, 76, 83, 86  
 traditional healers, 185–189, 192–196  
 traditional healing and alternative health care, 177–178, 180–182, 184–186, 188–192, 194, 196

**U**

universal newborn hearing screening (UNHS), 25–26, 30–32, 37, 40, 50, 55–57, 60–64, 66, 68–69, 103

**V**

vestibulotoxicity, 3, 20, 93, 105





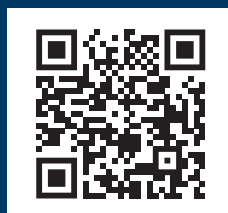
This book timely and concisely captures a snapshot of current insights and practices within the audiology domain, not only in South Africa, but globally. Careful consideration is given to framing every topic of discussion within the global, regional and local contexts. No efforts have been spared in highlighting the policies (such as position statements from the Health Professions Council of South Africa) which guide service provision and how lack of political will has perpetuated inequities in an already fragmented society. The first chapter sets the scene by making a strong case for the need to rethink preventative audiological care through applying a systems-thinking approach, which ensures a thorough consideration of all the elements involved in the implementation of complex health interventions. Drawing from frameworks of the World Health Organization, the authors accurately capture the major challenges and inhibitory factors that hinder successful service provision. Factors such as lack of legislative support, a fragmented multidisciplinary system of health workers, human resource deficits and slow adoption of information and communication technologies have been hot topics within the audiology community for a while, and ones that need urgent amelioration if progress and – ultimately – alignment with the sustainable development goals are to ever be realised. Complex concepts such as systems-thinking and complex interventions are presented in an easy-to-read style, rendering it palatable for a diverse audience.

**Dr Zenzo Chakara, Department of Health and Rehabilitation Sciences,  
Faculty of Health Sciences, University of Cape Town,  
Cape Town, South Africa**

---

This book is a well-written piece. The theme presented is necessary, especially in a context with competing health needs and barriers to some services. There are many valid challenges presented, and all have a detrimental effect on health systems and service delivery. I commend the authors for emphasising the role of government within audiology services as they are not prioritised, even though hearing loss in a community has a negative impact on the country's economy. The authors are encouraged to be advocates for hearing loss and to involve higher levels of government in prevention of hearing loss and its adverse effects on quality of life. Our nation has a long way to go, and we need initiatives like this that are supported by evidence.

**Dr Nondumiso A. Gina, Department of Audiology, Faculty of Health  
Sciences, University of KwaZulu-Natal, Durban, South Africa**



Open access at  
[https://doi.org/10.4102/  
aosis.2022.BK311](https://doi.org/10.4102/aosis.2022.BK311)



ISBN: 978-1-77995-212-7