
10 ♦ ONE MEDICINE?

Advocating (Inter)disciplinarity at the Interfaces of Animal Health, Human Health, and the Environment

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Since the mid-2000s, international agencies, veterinary associations, NGOs, and funding bodies have issued calls of increasing frequency and volume advocating greater integration across the domains of human, animal, and environmental health. Citing threats to health from climate change, food insecurity, and emerging infectious diseases, alongside the similarity of disease processes across humans and animals, advocates have lobbied for the broader integration of health research, policy, and clinical practice, using slogans including “One World One Health” (Wildlife Conservation Society 2004), “One Medicine” (Schwabe 1984), and “One World–One Medicine–One Health” (Kahn et al. 2012). In recent years, “One Health” (OH) has been increasingly adopted as a catchall term by actors across a broadening range of scientific, medical, and professional disciplines, particularly veterinary medicine, global health, and infectious diseases. But what does OH actually mean? Where has OH come from, how is it used, who by, in what contexts, and how has it come to prominence in such a short space of time?

Perhaps the most widely used working definition is the one put forward by the One Health Initiative, a U.S.-based advocacy group including veterinarians, physicians, and public and environmental health professionals: “The One Health concept is a worldwide strategy for expanding interdisciplinary collaborations and communications in all aspects of health care for humans, animals and the environment” (Kahn et al. 2012). This definition is strikingly broad, promoting “interdisciplinary collaboration” without specifying who should be collaborating with whom and on what, or indeed how they should actually go about it. This is reflected in varying references to OH as a “concept,” as illustrated earlier, but

also as an “approach,” a “movement,” and even a “paradigm.” In recent years, the language of OH has been adopted by a series of powerful actors in biomedicine and global health, including the U.S. government’s Centers for Disease Control and Prevention (CDC 2013), international organizations including the Food and Agriculture Organization (FAO), World Health Organization (WHO), and World Organization for Animal Health (OIE) (FAO et al. 2008, 2010), and the biomedical research funders Wellcome Trust (2010) and Gates Foundation (2013).

Given the influence of these institutions in shaping health research, policy, and practice globally, it is important to understand why OH has had so much traction with these actors. Perhaps they have been convinced by the arguments—even if the main priority is to improve human health, understanding why and how, for example, infectious diseases move between multiple species can bring obvious benefits. However, arguments about why we should think across humans and animals about health and medicine are far from new, and have been advanced from time to time ever since veterinary medicine emerged as a separate profession during the late eighteenth century (Woods and Bresalier 2014; Bresalier et al. 2015). Animals have regularly played important roles in the history of medicine, as bodies to experiment on, as sources of theoretical insight, and as objects of inquiry in their own right (Hardy 2003; Kirk and Worboys 2011). This raises an obvious question: given that ideas about the convergence of human and animal health have had such a long history, why have they gained significant international and institutional traction only so recently? In other words, the key question is not why OH, but why OH *now*.

This chapter explores the recent emergence of OH as the self-identified, broad-based, interdisciplinary agenda we see today, and traces its origins in the histories of human and animal health, global development, conservation, and infectious diseases. It also investigates OH as an example of the increasing popularity of interdisciplinarity across changing academic, professional, and policy landscapes of the early twenty-first century. What is the relationship between OH and other interdisciplinary agendas such as food security, what can this tell us about how these agendas are built, and why? Itself the outcome of an interdisciplinary collaboration,¹ the research underlying this chapter has adopted a longitudinal, contemporary-historical approach. It has investigated OH as part of ongoing interactions between scientific, professional, and policy spheres, while following the construction and spread of OH ideas and terminology over time and across multiple disciplines. The research has investigated a series of questions following from “why OH now?” What has happened to bring this agenda to the fore in biomedicine and global health, and to be adopted so widely over such a short period of time? Who are the key actors in this process, when did they become involved, and what does OH mean to them? What broader agendas

and disciplinary interests are driving the uptake of OH? What forms of interdisciplinary and cross-disciplinary partnership have been advocated, by which actors, and when?² How have these discourses related to collaborative practice? Following the work of Jacobs and Frickel (2009), is interdisciplinarity in OH “bottom-up” (generated by working researchers) or “top-down” (imposed by institutions)?

While the vast majority of publications discussing OH come from biomedical and health oriented authors, there is a small but rapidly developing social science and humanities literature on the topic. This has taken two main forms: social scientists adopting OH to work collaboratively with natural scientists on human and animal health research (e.g., Wood et al. 2012) and scholarship investigating OH itself. For the purposes of clarity, this chapter refers to OH as an “agenda,” and builds upon the latter body of work which, paradoxically enough, starts with studies of disciplinarity, the problems it can cause, and the reasons why OH actors reach out beyond their own disciplines. Several scholars researching OH have pointed toward mid-2000s crises over threats of a global influenza pandemic as the most immediate driver (Scoones and Forster 2010). What these researchers and OH actors have described as the traditional disciplinary “silos” (tightly contained organizations) responsible for human health, animal health, food, and environment proved to be a major barrier to effectively managing diseases that moved freely across these domains (Jerolmack 2013). The intensity of concerns over pandemic risks drove a well-funded international response to these disease threats, which in turn drove greater cooperation across the silos of OH. During this process the international agencies FAO, WHO, and OIE adopted OH to signal their cooperative intent. Several studies have explored the breadth and conceptual flexibility of OH, as demonstrated earlier. While some have identified this flexibility as a key weakness, diffusing the idea beyond any useful meaning and acting as a barrier to further action (Lee and Brumme 2012), others have argued that this breadth enables OH to act as an “umbrella” under which OH actors can articulate a range of “slightly different visions” while working together (Leboeuf 2011, 64–66).

Developing this theme, Chien (2013, 223) concluded that the “productive vagueness” of OH enabled FAO, WHO, and OIE to move from mutually exclusive understandings of avian influenza toward a collective reframing that enhanced their interests, while minimizing interagency tensions. Chien drew upon Star and Griesemer’s (1989) classic study of “boundary objects” in scientific collaboration: concepts concrete enough to articulate common ideas across several “social worlds” (groups of people working toward a shared goal), yet flexible enough to be reinterpreted to fit the particular needs of each of these groups.³ Chien argued that OH acts as a boundary object for actors pushed into working together across the siloed social worlds of international health.

However, as Star (2010) later discussed, boundary objects are not simply words with multiple meanings: they must be understood as the product of ongoing processes of social negotiation, and tend to operate at the scale of organizations, rather than in the details of interpersonal relationships or larger social structures.

By focusing on the international health organizations, Chien's analysis ably demonstrates how OH functions as a boundary object at a very specific "scope and scale" (Star 2010, 612–613). However, by doing so, it cannot engage with how OH has been mobilized beyond this particular context, nor its relationship with scientific and medical practice more generally. Boundary objects function not only as collaborative tools, but also as markers of political negotiations between social worlds, especially in the case of academic disciplines. By using boundary objects strategically, individual and institutional actors can claim legitimacy, gain allies, and bring about changes in working practices (Löwy 1992). In her studies of the adoption and spread of molecular biology into cancer research during the 1980s, sociologist Joan Fujimura (1992, 1996, 1998) argued that the use of boundary objects is one of several techniques employed by scientists when working across social worlds: another is the standardization of theories and of experimental techniques. Fujimura analyzed the growth of molecular biology, observing how the research agenda was initially constructed, then scientific allies were successfully enrolled via boundary objects and standardization. She characterizes this overall process as the "scientific bandwagon," which involves two key stages: initially progressing slowly as key actors develop and advance their ideas while negotiating meanings and alliances, then speeding up and expanding to run under its own momentum once it has gathered sufficient recognition, support, and resources.

This chapter builds upon Fujimura's notion of the scientific bandwagon in order to understand the recent and rapid rise of the OH agenda. While OH fits well with Fujimura's description in many respects, there are some key differences, particularly around the foregrounding of interdisciplinarity, the applied nature of the agenda, and the prominence of institutional actors alongside scientific practitioners. I argue that OH shares these features with several adjacent agendas that it mutually enrolls, including food security and translational medicine, and that these may all be examples of a new style of agenda building across twenty-first-century science, medicine, and policy: the "interdisciplinary bandwagon."

METHODS

In order to understand OH more broadly, particularly as an explicitly interdisciplinary agenda, this chapter follows OH via the usage of specific terms, in much the same way that other scholars have "followed" technologies, organisms, or

diseases (e.g., Goedeke and Rikoon 2008; Scheffler 2014). As demonstrated in Ariane Dröscher's (2012) study of the usage of "stem cell" in twentieth-century biology, following terminology can be an effective approach to tracing the spread of ideas and agendas: not only is it indicative of key issues of concern, but it can also tell us about the strategic agendas, origins, and broader meanings bound up with those issues. In the increasingly interconnected domains of science/medicine/policy/industry in the early twenty-first century, the creation and adoption of such "buzzwords" has become increasingly ubiquitous (Bensaude Vincent 2014). Therefore following the terminology of OH can be particularly productive, given that defining the meaning and origins of OH appears to be a key concern among its own advocates. This chapter draws upon search results from the citation database Web of Science, initially for the phrase "One Health," then for a series of associated terms: "one medicine," "one world," AND "health," "comparative medicine," and "veterinary public health." The results were cleaned to remove irrelevant references (e.g., the phrase "one health authority") and multiple hits from conference proceedings, leaving only journal articles discussing OH. These were analyzed using bibliometrics to chart changes in usage levels over time and across fields. Alongside these indicators, the articles were also analyzed qualitatively to identify key actors, fields, terminology, and variations in the scope, aims, and meanings of OH. The qualitative analysis also drew upon the results of Google searching for these phrases, revealing the online presence of OH and the existence of a policy-oriented "gray literature." Several OH workshops and conferences were attended and a series of exploratory interviews with OH actors was conducted, providing background information. This enabled the development of OH to be located within a broader and longer historical context than the immediate post-2000 visibility of the term itself.

Having already introduced OH, this chapter will now outline the meanings, histories, and disciplinary origins of several terms that actors have used alongside or instead of OH to describe their aims and activities, illustrating the varying ideas that sit together under the OH umbrella. Once these have been explored, the chapter will move on to discuss the bibliometric analysis of OH terminology in journal articles, showing when and how these ideas have come together. Finally the implications of these findings for our understanding of the OH agenda and of interdisciplinary agenda building more generally will be discussed.

VETERINARY MEDICINE AND "ONE MEDICINE"

As veterinary medicine emerged from human medicine in Europe during the late 1700s, doctors continued to work with animal patients until well into the nineteenth century. As such, veterinarians often sought to defend and distinguish

their profession from its bigger and more powerful neighbor, as well as from other professions involved in the care of animals (Woods and Matthews 2010). However, vets and doctors continued to work together under the right circumstances, and the insights from such collaborations, alongside the financial and status benefits, particularly for veterinarians, provided powerful incentives to do so. Over the past two hundred years, there have been a series of veterinary agendas concerned with bringing animal and human health closer together (Bresalier et al. 2015). Comparative medicine involved the study of disease by comparing cases across a wide range of species, sometimes including humans, and was advocated and adopted by veterinary and zoological researchers from the late nineteenth century, gaining considerable traction from the 1920s onward. By the middle of the century, comparative medicine was highly influential, guiding public health research programs at the WHO for example. Comparative medicine then gradually lost prominence through the 1970s, and the term was adopted by researchers developing laboratory animal models for human clinical medical research, moving to a more anthropocentric mode of comparison (Michell 2000). Unlike comparative medicine, veterinary public health (VPH) has had a more applied orientation, involving itself with policy, regulatory structures, and public health, concerning itself with “community efforts influencing and influenced by the veterinary medical arts and sciences applied to the prevention of diseases, protection of life and promotion of the well-being and efficiency of man” (WHO and FAO 1951, 3). VPH has particularly concerned itself with controlling disease in domestic animals in order to prevent transmission to humans via food, and maintaining animal health in order to boost food production. Like comparative medicine, VPH originated in the nineteenth century but became much more prominent from the mid-twentieth century onward, also becoming institutionalized at the WHO at this time, but instead continuing as an active approach into the present day.

“One Medicine” is often regarded as the most direct precursor to OH: the term is now generally used to refer to the alliance or cooperation of veterinary and human medical research and clinical practice, including mutual exchanges in developing new procedures, equipment, and drugs (e.g., Cardiff et al. 2008; Kaplan et al. 2009). Veterinary epidemiologist Calvin Schwabe is often credited by today’s OH advocates as the originator of the term “one medicine” in his 1984 textbook *Veterinary Medicine and Human Health* (Kaplan and Scott 2011; Schwabe 1984). This seven-hundred-page volume provided a fully articulated vision for reforming veterinary research, education, and practice, using “One Medicine” (OM) as the core organizing principle. However, searching citation databases for the term reveals that OM had been in use several decades prior to Schwabe’s book, particularly by a series of authors linked with the University of Pennsylvania (e.g., Allam 1966; Cass 1973; Schmidt 1962). During the fifties

and sixties, medical and veterinary faculty at Penn collaborated closely and were involved in comparative medicine and VPH: today the veterinary school is a key advocate for OH (Hendricks et al. 2009). Unlike many of the terms under discussion here, OM was never defined in these texts: instead it tended to be used in a self-evident way that implied that readers were already familiar with the term. This continued in Schwabe (1984), where OM was used in section and chapter headings: however it was not defined and first appeared in the body text as part of a historical summary. This suggests that OM was never formally “coined,” but may instead have arisen more organically in mid-twentieth-century thinking about animal and human health. Following Schwabe’s book (which was not highly cited until recently), OM reemerged in the early 2000s, in further discussions of comparative medicine and VPH and in pieces bringing them into alignment (e.g., Schwabe 2004). Later in the decade, key veterinary and medical associations in North America agreed on and published a series of statements and organizations promoting “One Medicine, One Health” (Kahn et al. 2008; King and One Health Initiative Task Force 2008). These events—and the ideas behind them—were extensively discussed in veterinary journals such as the *Journal of the American Veterinary Medical Association*, the U.K.-based *Veterinary Record*, and *Veterinaria Italiana*, which published an open-access special issue devoted to the topic.

“ONE WORLD” AND ITS RELATIONSHIP WITH HEALTH

The idea and term “One World” (OW) was developed by political philosophers during the Second World War, and became prominent during its aftermath, when the idea that national interests should be overcome in order to deal with international problems became highly compelling. While initially OW was articulated in the context of international relations and the formation of the UN, the idea was also instrumental in the formation of the international health agencies WHO and FAO (Brockington 1958; Staples 2011). The term OW was used by biologist Julian Huxley in his early leadership of UNESCO, and mobilized by actors in international health during postwar debates about population control and food supply (Bashford 2014; Sluga 2010). However, following this early period the term was rarely used in health contexts until it resurfaced during the 1990s, in health policy responses to the HIV/AIDS epidemic, as well as academic discussions of “emerging infectious diseases,” and the transition from “international” to “global” health (Anderson 2004; King 2004).

During the 2000s these debates continued and gained an additional focus with a new series of rapidly changing viral disease threats. In 2004, following the SARS outbreak and as the H₅N₁ strain of avian influenza was spreading and causing widespread concern, a series of meetings themed on “One World, One

Health” (OWOH) were organized, held initially in New York but subsequently at international locations such as China and Brazil. These meetings were organized by the U.S.-based NGO the Wildlife Conservation Society and sponsored by the Rockefeller Foundation.⁴ They were specifically focused on how to manage these infections, which travel freely across countries as well as between humans, domestic animals, and wildlife, causing problems for human health, animal health, and conservation agendas. Participants included the FAO and WHO, U.S. governmental bodies including the CDC, research scientists, and a range of other conservation, disease ecology, agricultural, and public health actors (Wildlife Conservation Society 2004). Over the following years these and other international health organizations started building closer working relationships, and when the H₅N₁ strain of avian influenza emerged, this process accelerated, driven by the international response to the outbreak. In 2008, international agencies including FAO, WHO, OIE, and the World Bank adopted OWOH as the organizing framework for a statement of cooperative intent, fostered by this international response (FAO et al. 2008). Since then OWOH has generally been used to highlight the interconnected nature of infectious disease, as microorganisms pass between animals and humans via the wider environment. Advocates of OWOH argue that these diseases can therefore be tackled only by research and policy that encompass these domains and take a global perspective (Vallet 2009). While concerns about viral pandemics appear to have provided the primary driver for the appearance of OWOH, advocates also point to a series of disease events over the past three decades that have highlighted the animal origins of much infectious disease. These included the HIV/AIDS epidemic, the BSE/CJD crisis in the United Kingdom, the discovery of new hemorrhagic fevers and resurgence of others, and the reemergence of older disease problems such as malaria and TB.

TRANSITIONING TO “ONE” HEALTH

By the mid-2000s, both OM and OWOH were in use across research and policy in human and animal health, but as we have seen their meanings (and the actors using them) were somewhat different. While OM addressed only veterinary and human medicine, its scope included all forms of illness and clinical practice, including chronic disease and the treatment of injuries. Conversely OWOH involved a wider range of disciplines, including biological and environmental sciences, but was specifically concerned with infectious disease. The parallel statements in 2008, from the U.S. veterinary/medical associations and from the international agencies, mark a key turning point. While the statements did not cross-refer, actors involved in both agendas advocated a move to a single banner (Zinsstag et al. 2005), and by 2010 the international health agencies (FAO et al.

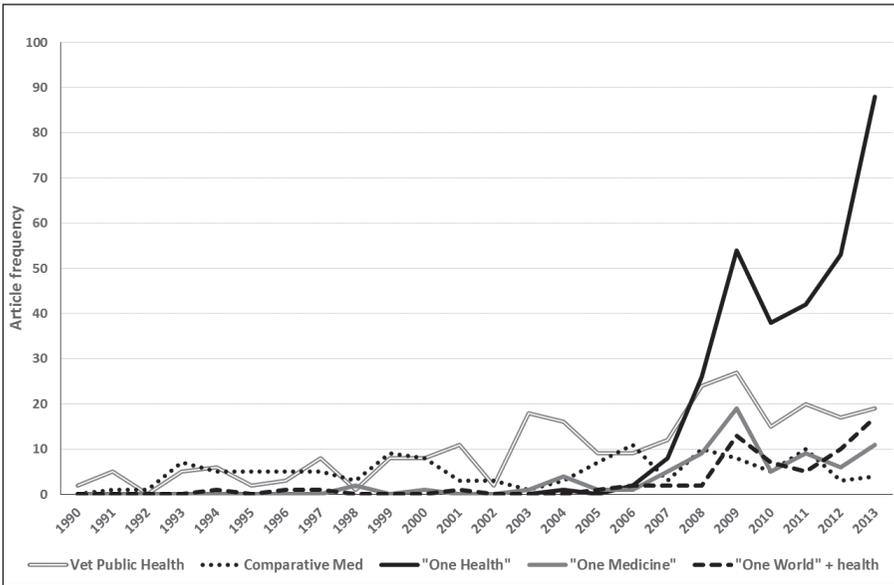


FIGURE 10.1. Frequency of journal articles using “One Health” and related search terms. SOURCE: Web of Science.

2010) had adopted OH. Figure 10.1 reflects this transition in the usage of OH and related terms in academic journal publications from 1990 until the end of 2013.

It is clear that authors were starting to use OH as a standalone term from 2008, and following the FAO/WHO/OIE joint statement in 2010, OH overtook its predecessors and became adopted much more widely. Data for 2014 suggest an acceleration of this trend, with citations using the term OH nearly doubling to 173 per year, although usage of OM and OWOH persists at much lower levels.

So what happened to initiate this change and the more widespread uptake of OH? Adopting OH as a single term had advantages for both OM and OWOH advocates: it was less cumbersome, significantly broadened the scope of their shared agenda, and decentered disciplines. The idea of “health” reaches far beyond infectious disease or clinical research and encompasses a much broader range of issues, practices, and policies than “medicine” can. Many advocates have embraced the flexibility of this expanded version of OH, adopting the “umbrella” metaphor as a way of articulating the inclusive nature of the agenda (One Health Sweden 2014). This shift was also driven by more pragmatic concerns: in 2008 the Wildlife Conservation Society registered the OWOH slogan as a trademark with the U.S. Patent Office, preventing its usage by other organizations. Since 2010, a biennial international conference series and journal have been founded and activities have been sponsored by research funding bodies, philanthropic foundations, and pharmaceutical companies. Moving out from

its origins in the United States and Switzerland, OH meetings and associations have become increasingly international, appearing across Europe (e.g., Netherlands, Sweden), Southeast Asia (e.g., South Korea, Malaysia), Australia, and Africa (e.g., Ethiopia, Uganda). The ideas and terminology of OH have increasingly been used to facilitate interdepartmental cooperation in policy making and government (CDC 2013; Department of Health 2013; Leung et al. 2012). In the United Kingdom at least, several universities have merged their veterinary, medical, and biological sciences schools, referencing OH as part of the reason for these moves and launching new training programs (Royal College of Veterinary Surgeons [RCVS] 2014; University of Surrey 2012).

Qualitative examination of research articles, online material, and policy reports mobilizing OH can offer further insights into the recent expansion of the agenda, how this flexibility lends itself to multiple interests, contexts, and agendas, and how different visions of interdisciplinarity are built into these texts. In biomedical, clinical, and pharmaceutical contexts, OH tends to retain the OM model of collaboration or partnership between veterinary and human medicine. A good example of this can be seen in a recent statement from the U.K. Biotechnology and Biological Sciences Research Council (BBSRC)—a government funding body: “BBSRC will also support . . . the opportunities arising from taking a ‘One Health’ approach, in partnership with the MRC, to the support of multidisciplinary studies that underpin improvements in both human and animal health” (BBSRC 2014). While BBSRC’s central concern is with the biological sciences, the MRC concerns itself with funding and supporting medical research in the United Kingdom. OH is therefore once again being used to signal the cooperative intentions of these two organizations.

Similar articulations of OH as facilitating partnerships can also be seen in commercial biomedicine, where animal health is seen as an increasingly profitable area aiding the “translation” of knowledge across the domains of pharmaceutical, agricultural, and clinical practice and research (Twine 2013). OH advocates cite “translational medicine” as an area where their approach can be of use, facilitating the movement of research insights and technical innovations between animal and human health (Immuno Valley 2014). This move develops the long-standing role that veterinarians have played in twentieth-century biomedical research in maintaining the health of laboratory animals, previously described as “comparative medicine” or “laboratory animal science” (Kirk 2010). Large-scale translational research programs such as the International Knock-out Mouse Project have greatly increased the numbers of animals required, and intensified demand for scientifically trained veterinarians (Davies 2012; Hendricks et al. 2009). In turn, this has reignited long-standing debates about the balance between research and clinical practice in veterinary education (Schwabe 1984) and stimulated new training programs (Gibbs 2014). In these contexts,

OH is invoked as a potential solution to a complex set of problems cutting across several disciplinary domains. However, just as with the earlier ideas of OM, this version of OH generally involves collaboration between well-established disciplinary specialists, and would probably be described by scholars of interdisciplinarity as cross- or multidisciplinary activity (Barry and Born 2013).

Other U.K. funders such as the Wellcome Trust use OH primarily in connection with infectious diseases, continuing the OWOH idea that disease transmission between humans and animals can be better understood via an interdisciplinary approach (Wellcome Trust 2010). In a similar fashion to the mutual invocation of OH and translational medicine, in global health contexts agendas such as “health security” and “biosecurity” appear alongside OH around topics such as antimicrobial resistance (Department of Health 2013), influenza (Dwyer and Kirkland 2011), and Ebola (Gebreyes et al. 2014). Another key example of this can be seen in the case of “food security”—the need to maintain an adequate food supply for human populations worldwide (FAO 1996). A long-standing advocate of OH, the UN FAO describes OH as a “unifying force to safeguard human and animal health” (FAO 2011, 2). Just as with OH and translational medicine, this mutual deployment continues older collaborative connections: advocates of VPH played key roles in mid-twentieth-century WHO and FAO programs to alleviate world hunger (Bresalier et al. 2015). Beyond the FAO, many other actors in food security do not mention OH: however OH advocates often cite food security as another example of a complex, interdisciplinary, global problem that their agenda can help to address (King and One Health Initiative Task Force 2008). In a recent call for research proposals on tropical and infectious diseases, the global health funder Gates Foundation outlined their vision for OH: “If the artificial barrier that separates the fields of human and animal health could be broken down, many opportunities would emerge across the discovery-development-delivery spectrum for knowledge and practices in one field to accelerate progress in the other” (Gates Foundation 2013). Such a radical vision of the sciences sees disciplinary identification largely as a barrier to progressing knowledge of health and disease, and continues the OWOH tradition of bringing together a broad range of disciplines beyond veterinary and human medicine. This could be more properly described as interdisciplinarity: indeed some OH advocates argue that they are moving beyond this to a “transdisciplinary” model, also involving participatory research with local communities (Zinsstag et al. 2012).

DISCIPLINES AND INTERDISCIPLINARITY IN OH

While the uptake by institutions across human health, animal health, and the environment has been clear, which journals have been publishing OH articles?

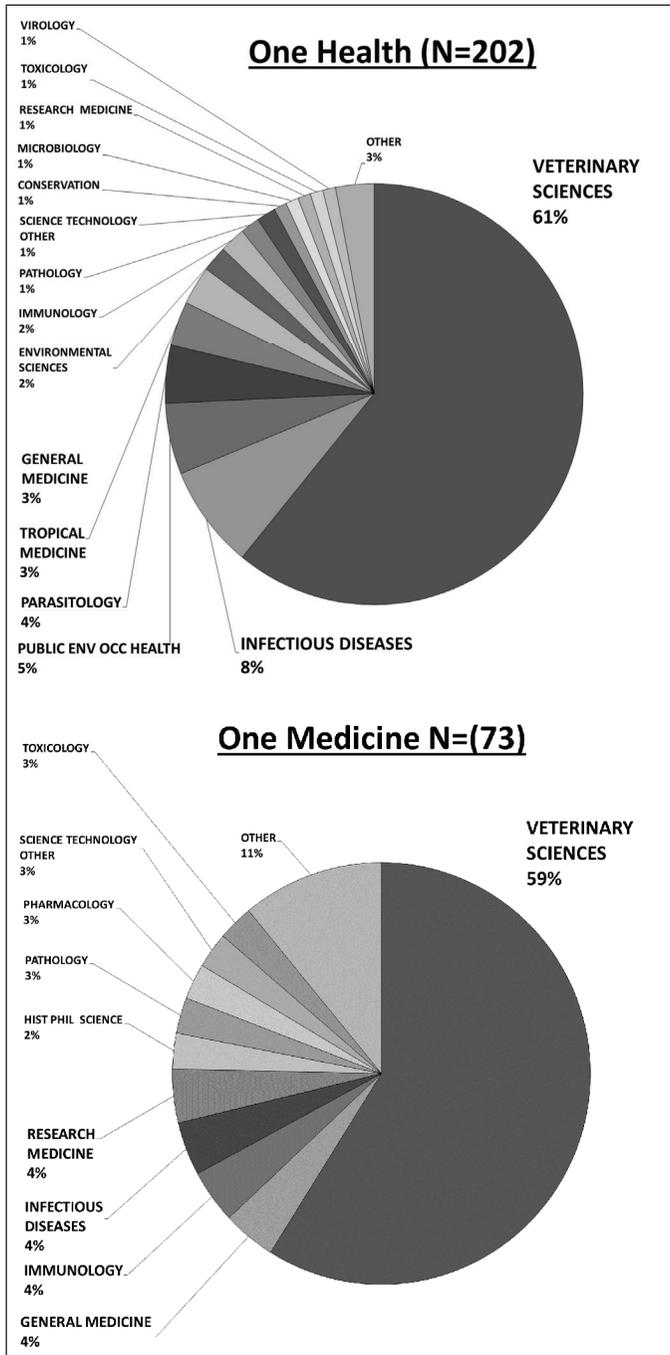
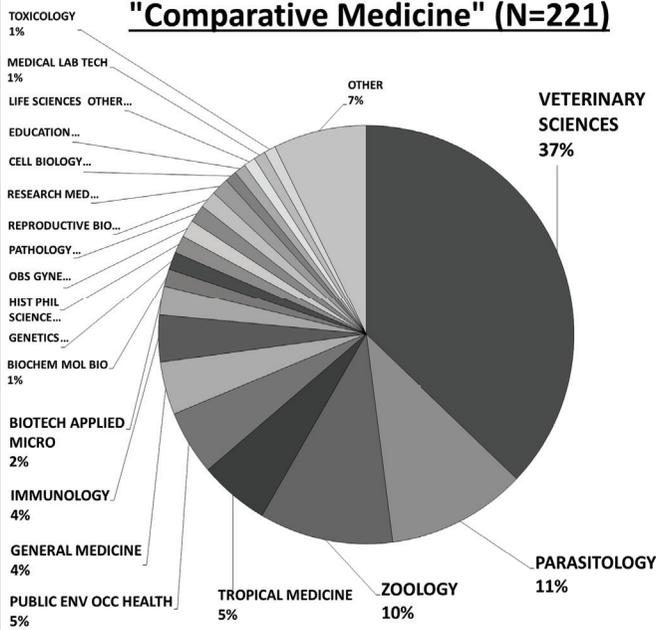
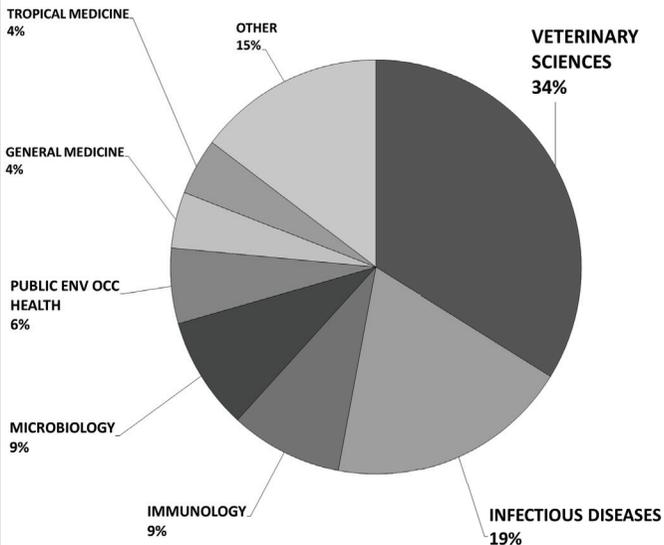


FIGURE 10.2. Disciplinary distributions of One Health–related search terms, 1970–2012.
 SOURCE: Web of Science.

"Comparative Medicine" (N=221)



"One World" + Health (N=68)



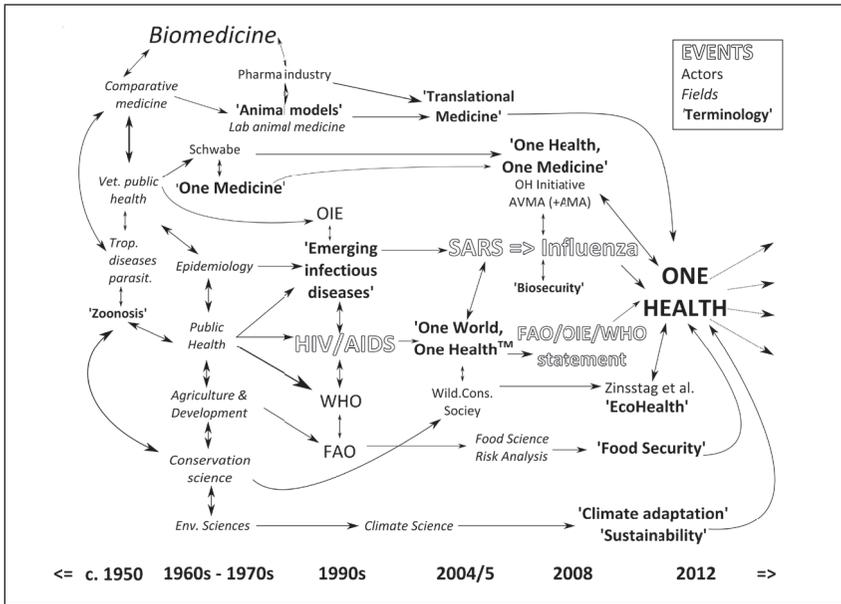


FIGURE 10.3. Scientific fields, actors, events, and terminologies in the recent history of One Health.

Web of Science provides a classification of the journals covered by the database, enabling the results of keyword searches to be broken down by research field. Figure 10.2 illustrates the distribution of journal articles published using OH and associated terms. This figure immediately demonstrates that even though OH aims to bring together human and animal health, these terms are most widely used by authors publishing in animal health (veterinary sciences). These differing distributions reflect the histories traced earlier: for example, comparative medicine was widely used in veterinary journals, but also across a range of biological (parasitology, zoology) and medical (infectious diseases, public health) research fields. Similarly OWOH has been visible in veterinary science but also in fields concerned with infectious disease such as immunology and microbiology. Reflecting its history as a veterinary-led agenda, nearly 60 percent of the usage of OM has been in veterinary journals, with some mentions in medical research fields. What is most striking here is the distribution for OH itself, given that the majority of these articles were published since the consolidation of the agenda from 2008. An even higher proportion of the usage of OH has been in veterinary science journals, with some visibility in infectious disease and public health journals.

There are several key inferences to be drawn from this data. First, while OH has been adopted by key policy and research institutions across multiple

disciplines, its uptake by researchers beyond the veterinary sciences has been relatively limited. Second, the nonveterinary fields where it has been taken up are those with direct interests in key OH topics, particularly those related to infectious diseases. Finally, the differing fields allied to OM and OWOH reflect their orientations toward clinical medicine and global health/infectious diseases.

Figure 10.3 provides a diagrammatic representation of the complex of alliances that have come together to form OH: something like an actor-network diagram, but with an added dimension of change over time. It depicts relations between the key actors, scientific fields, and terminology involved in OH, the impact of disease events, and how these relations have changed over time, drawing upon the bibliometric data and historical analysis presented earlier. The upper part of the diagram shows the trajectory of OM: its roots in comparative medicine and VPH, its development by Schwabe, and the parallel growth of animal models for human biomedical research. It then shows how these came together with the additional driver of translational research into twenty-first-century OM, which then merged into OH. The central area shows the trajectory of OWOH, with its origins in comparative medicine, tropical diseases, and the mid-twentieth-century concept of zoonosis. WHO/FAO collaborations around animal health and food supply from the 1950s onward provided a second point of interaction. HIV/AIDS created a central point of interaction between international health/development, infectious disease, and conservation actors during the 1990s. SARS and pandemic influenza concerns then played a similar role during the 2000s, leading to the emergence of OWOH, and the eventual merger into OH. Finally, the bottom of the diagram illustrates the relationship between OH and the environmental sciences. These have largely been separate, barring the interventions of the Wildlife Conservation Society, primarily concerned with the transmission of infections to and from endangered wildlife. The transition to OH has led to a much greater rhetorical emphasis on the environment, as it provides the obvious connection between humans and animals (although the data in Figure 10.2 suggest that the connection has been more rhetorical than substantive). Advocates of “EcoHealth” now position it as a successor to OH by foregrounding the importance of issues such as climate change and sustainability for health, reaching out to the environmental and social sciences (Zinsstag et al. 2012).

DISCUSSION

This chapter has so far explored the emergence of OH and situated it within a history of advocacy for the convergence of human and animal health. It has followed the appearance and usage of the term and its recent and rapid uptake by powerful actors in global health and biomedicine, alongside the key actors,

events, disciplines, and fields involved. OH has come about through the merger of two overlapping yet distinct ideas about human and animal health: OM and OWOH. OM has its origins in twentieth-century traditions of veterinary advocacy for closer collaboration and partnership with human medicine, including comparative medicine and VPH. In its contemporary form OM is particularly associated with clinical research, veterinarians working with laboratory animals, and translational research. OWOH originated in mid-twentieth-century internationalism and the founding of international health agencies such as the WHO. Twenty-first-century OWOH advocates have included these agencies, conservation actors, and researchers working with zoonotic disease: it is particularly associated with issues such as emerging infectious diseases and food security. OH has come about through the convergence of these interests toward the end of the 2000s, driven in particular by international responses to pandemic disease risks. Following this consolidation, OH has been adopted by a series of powerful institutional actors in global health, research funding, and policy, and the rate at which the term is used in academic journals has rapidly increased. As Leboeuf (2011) and Chien (2013) have argued, the flexibility of OH has meant the term acts as a boundary object, enabling actors across multiple social worlds (including academic disciplines) to reinterpret the agenda to suit their own interests, driving this convergence.

This pattern—of slow emergence, intense negotiation including the use of boundary objects, and consolidation, followed by widespread adoption—fits well with Fujimura's (1992, 1996, 1998) concept of the "scientific bandwagon," originally applied to molecular biology. The increasing adoption of OH by institutional actors across human health, animal health, and environmental issues also suggests that it has been a highly successful bandwagon, achieving its aim of facilitating interdisciplinarity across these domains. However, the data on usage of OH terminology in academic journals indicate that discussions of OH have mostly been published in veterinary journals, appearing only in nonveterinary fields with adjacent interests (e.g., infectious diseases, public health). As we have seen, the OH agenda has its roots in long-standing traditions of advocacy not only for veterinary-medical partnership, but also for boosting the status and defending the boundaries of the veterinary profession, which remains small, sparsely funded, and under-regulated in comparison to human medicine (Hobson-West and Timmons 2015). Given this historical background of rivalry and status anxiety, combined with success in attracting the support of institutional actors including research funders, it is perhaps unsurprising that OH has faced criticism from (human) medical actors seeing it as a veterinary "land-grab" (Institute on Science for Global Policy 2012). This lack of movement into research practice is reflected in the current literature on OH, which tells a tale of

anxiety and argument about how the agenda can move from “rhetoric” to “reality” (Okello et al. 2011; Gibbs 2014).

The positioning of OH alongside a range of contemporary—and usually more prominent—agendas across science, medicine, and policy can offer further clues about OH, interdisciplinarity, and bandwagons. As we have seen, the OH literature often references terms including “food security,” “health security” “emerging infectious diseases,” and “translational medicine,” arguing that OH can provide solutions for problems in these areas. Like OH, these terms refer to new scientific and policy agendas, arguing for applied research about the world’s highly complex “wicked problems” that cut across traditional disciplinary domains (Brown et al. 2010). Like OH, these agendas provide twenty-first-century articulations of long-standing twentieth-century concerns (e.g., “world hunger” becomes “food security”), and interdisciplinarity is seen as a key solution. Each of these addresses a set of concerns that overlap with OH, but oriented toward a different cluster of disciplines—although OH is unique in bridging the biomedical and environmental/agricultural sciences. Rather than competing, these agendas appear to be mutually reinforcing, so arguments for OH draw upon arguments for food security or translational medicine and (at least some of the time) vice versa. The secondary literature on these agendas offers further intriguing parallels with OH: for example analyses of the discourse around food security describe it as a “master frame” (Mooney and Hunt 2009) that is deliberately broad and flexible, enabling framings and reframings by multiple actors, leading to an ultimate, if fractured, consensus (Maye and Kirwan 2013). This and similar work on global health (King 2004; Scoones and Forster 2010), translational medicine (Yaqub and Nightingale 2012), biosecurity (Dobson et al. 2013), and OH itself (Craddock and Hinchliffe 2015) argues that the dominant framings of these agendas are strategic and political, working in favor of industry and large institutional actors, often at the expense of local communities and nonprofit solutions.

To return to the question of bandwagons, I argue that while OH shares many features of Fujimura’s “scientific bandwagon,” there are some key differences. In particular, OH is overtly interdisciplinary in its ambitions, extends beyond science into the policy sphere, and appears to have been constructed, aimed at, and taken up by large institutional as well as individual scientific actors. The bibliometric data suggest that the relationship between OH and scientific or clinical practice appears to be rather distanced, particularly beyond veterinary science. To put it into the terms posed by Jacobs and Frickel, OH started as a “bottom-up” movement, but as such has largely been (and remains) a deeply disciplinary concern, working to increase the status and resources of veterinarians. OH then became interdisciplinary via powerful institutional actors in biomedicine, transforming into a “top-down” agenda, to the point that some veterinarians

now express concerns that they will merge back into the biomedical sciences, overtaking their own interests (RCVS 2014, 10). The parallels between OH and adjacent agendas such as global health, food security, and translational medicine suggest that all of these may be examples of a new style of agenda building: the “interdisciplinary bandwagon.” Unlike the molecular biology bandwagon, which appealed to scientists in multiple disciplines by providing new techniques and ideas useful in day-to-day research practice, interdisciplinary bandwagons operate by providing mechanisms to facilitate institutional cooperation, gathering funding and visibility along the way (Caulfield and Condit 2012)

This may explain why the language of interdisciplinarity across contemporary academia and policy tends to be so uniform and unreflective (Barry and Born 2013; Jacobs and Frickel 2009), particularly in institutional contexts: it serves to “iron out the mess of actually working together” (Donaldson et al. 2010, 1525), enabling the bandwagon building process. If this is so, then interdisciplinary bandwagons may even be an impediment to fostering practical engagement across specialisms and, as we have seen with OH, carry with them strong disciplinary interests, potentially creating resistance and resentment elsewhere. As we have seen in chapter 2 by Downey and colleagues, even the meaning of “interdisciplinarity” itself is open to multiple, sometimes conflicting interpretations that vary according to context and research field. While the impulse to elide these differences is understandable, it may contribute to misunderstandings and tensions between collaborators when they start working together on a day-to-day basis. Histories of interdisciplinary collaboration suggest that successful work in this mode has been driven by practical concerns such as shared research questions, exchanges of materials and methods, sociable working relationships, and supportive institutional settings (Aicardi 2014; Schlich et al. 2009), albeit still with a partial understanding of what works, when, and why. While OH discussions of the need to move “from rhetoric to reality” (Okello et al. 2011) suggest some awareness of these tensions, OH actors have rarely discussed practical steps that could be taken to facilitate collaborative research or clinical practice in particular situations.

In order to move their agendas forward, advocates of OH and other interdisciplinary bandwagons would benefit by learning from how scientists have successfully managed to work together across disciplines in the past. This includes the institutional, material, political, linguistic, and financial factors contributing to an “epistemic culture” of collaboration (Smith-Doerr et al. this volume). In other words, paying close attention to the particularly social nature of science may help to support the success of such endeavors long after the interdisciplinary bandwagon has rolled on.

NOTES

- 1 “One Medicine? Investigating Human and Animal Disease c. 1850–2015” is a five-year collaborative project funded by Wellcome Trust (Principal Investigator Abigail Woods, grant 092719), involving a science and technology studies scholar working with historians of veterinary medicine, human medicine, and biology. I would like to thank my colleagues on the project for their support and invaluable contributions to the development of this analysis.
- 2 Following, e.g., Barry and Born (2013), I take “interdisciplinary” to indicate approaches that combine perspectives from multiple fields, while “cross-disciplinary” indicates approaches where multiple fields collaborate but retain their distinct identities. It is worth noting that many scientific and policy actors, including those involved in OH, have a tendency to use terms such as inter/cross/multi/transdisciplinary almost interchangeably.
- 3 Adele Clarke (1991, 131) defines social worlds as “groups with shared commitments to certain activities, sharing resources of many kinds to achieve their goals, and building shared ideologies about how to go about their business.”
- 4 WCS, originally the New York Zoological Society, was founded in 1895, runs several wildlife parks and zoos in the United States, and undertakes international conservation research, campaigning, and activism.

REFERENCES

- Aicardi, Christine. 2014. “Of the Helmholtz Club, South-Californian Seedbed for Visual and Cognitive Neuroscience, and Its Patron Francis Crick.” *Studies in History and Philosophy of Biological and Biomedical Sciences* 45 (March): 1–11.
- Allam, Mark W. 1966. “The M.D. and the V.M.D.” *Pennsylvania Medicine* 69 (8): 57–60.
- Anderson, Warwick. 2004. “Natural Histories of Infectious Disease: Ecological Vision in Twentieth-Century Biomedical Science.” *Osiris* 19: 39–61.
- Barry, Andrew, and Georgina Born. 2013. *Interdisciplinarity: Reconfigurations of the Social and Natural Sciences*. London: Routledge.
- Bashford, Alison. 2014. *Global Population: History, Geopolitics, and Life on Earth*. New York: Columbia University Press.
- Bensaude Vincent, Bernadette. 2014. “The Politics of Buzzwords at the Interface of Technoscience, Market and Society: The Case of ‘Public Engagement in Science.’” *Public Understanding of Science* 23 (3): 238–253.
- Biotechnology and Biological Sciences Research Council. 2014. “Strategic Plan: 2010–2015.” Swindon: Biotechnology and Biological Sciences Research Council. <http://www.bbsrc.ac.uk/news/planning/strategy/>. Accessed December 15, 2015.
- Bresalier, Michael, Angela Cassidy, and Abigail Woods. 2015. “One Health in History.” In “*One Health*”: *The Theory and Practice of Integrated Health Approaches*, edited by J. Zinsstag, E. Schelling, M. Whittaker, M. Tanner, and D. Waltner-Toews, 1–15. Wallingford: CABI.
- Brockington, Colin Fraser. 1958. *World Health*. London: Penguin.
- Brown, Valerie A., J. A. Harris, and J. Y. Russell. 2010. *Tackling Wicked Problems: Through the Transdisciplinary Imagination*. London: Earthscan.
- Cardiff, Robert D., J. W. Ward, and S. W. Barthold. 2008. “‘One Medicine–One Pathology’: Are Veterinary and Human Pathology Prepared?” *Laboratory Investigation* 88 (1): 18–26.
- Cass, J. 1973. “One Medicine—Human and Veterinary.” *Perspectives in Biology and Medicine* 16 (3): 418–426.

- Caulfield, Tim, and Celeste Condit. 2012. "Science and the Sources of Hype." *Public Health Genomics* 15: 209–217.
- Centers for Disease Control and Prevention. 2013. "One Health." Last modified October 18, 2013. <http://www.cdc.gov/ONEHEALTH/>.
- Chien, Yu-Ju. 2013. "How Did International Agencies Perceive the Avian Influenza Problem? The Adoption and Manufacture of the 'One World, One Health' Framework." *Sociology of Health & Illness* 35 (2): 213–226.
- Clarke, Adele. 1991. "Social Worlds/Arenas Theory as Organizational Theory." In *Social Organization and Social Process: Essays in Honour of Anselm Strauss*, edited by David Maines, 119–158. Hawthorne, NY: Aldine de Gruyter.
- Craddock, Susan, and Steve Hinchliffe. 2015. "One World, One Health? Social Science Engagements with the One Health Agenda." *Social Science & Medicine* 129: 1–4.
- Davies, Gail. 2012. "What Is a Humanized Mouse? Remaking the Species and Spaces of Translational Medicine." *Body & Society* 18 (3–4): 126–155.
- Department of Health. 2013. "UK Five Year Antimicrobial Resistance Strategy 2013 to 2018." London: U.K. Department of Health. <https://www.gov.uk/government/publications/uk-5-year-antimicrobial-resistance-strategy-2013-to-2018>.
- Dobson, Andrew, Kezia Barker, and Sarah L. Taylor, eds. 2013. *Biosecurity: The Socio-Politics of Invasive Species and Infectious Diseases*. London: Routledge.
- Donaldson, Andrew, Neil Ward, and Sue Bradley. 2010. "Mess among Disciplines: Interdisciplinarity in Environmental Research." *Environment and Planning A* 42 (7): 1521–1536.
- Dröschner, Ariane. 2012. "Where Does Stem Cell Research Stem From? A Terminological Analysis of the First Ninety Years." In *Differing Routes to Stem Cell Research: Germany and Italy*, edited by R. G. Mazzolini and H. G. Rheinberger, 19–54. Berlin: Duncker & Humblot.
- Dwyer, Dominic E., and Peter D. Kirkland. 2011. "Influenza: One Health in Action." *New South Wales Public Health Bulletin* 22 (5–6): 123–126.
- Food and Agriculture Organization (FAO). 1996. "Rome Declaration on Food Security." Rome: Food and Agriculture Organization. <http://www.fao.org/docrep/003/w3613e/w3613e00.htm>.
- . 2011. "One Health: Food and Agriculture of the United Nations Strategic Action Plan." Rome: Food and Agriculture Organization. <http://www.fao.org/docrep/014/a1868e/a1868e00.pdf>.
- Food and Agriculture Organization, World Organization for Animal Health, and World Health Organization (FAO, OIE, and WHO). 2010. "The FAO-OIE-WHO Collaboration. Sharing Responsibilities and Coordinating Global Activities to Address Health Risks at the Animal-Human-Ecosystems Interfaces. A Tripartite Concept Note." Geneva: World Health Organization. http://www.who.int/influenza/resources/documents/tripartite_concept_note_hanoi/en/.
- Food and Agriculture Organization, World Organization for Animal Health, World Health Organization, UN System Influenza Coordination, World Bank, and UNICEF. 2008. "Contributing to One World, One Health: A Strategic Framework for Reducing Risks of Infectious Diseases at the Animal-Human-Ecosystems Interface." Rome: Food and Agriculture Organization. <http://www.fao.org/docrep/011/aj137e/aj137e00.htm>.
- Fujimura, Joan. 1992. "Crafting Science: Standardized Packages, Boundary Objects, and 'Translation.'" In *Science as Practice and Culture*, edited by A. Pickering, 168–211. Chicago: University of Chicago Press.

- . 1996. *Crafting Science: A Sociohistory of the Quest for the Genetics of Cancer*. Cambridge, MA: Harvard University Press.
- . 1998. "The Molecular Biological Bandwagon in Cancer Research: Where Social Worlds Meet." *Social Problems* 35 (3): 261–283.
- Gates Foundation. 2013. "The 'One Health' Concept: Bringing Together Human and Animal Health for New Solutions: Grand Challenges Explorations 11." <http://www.grandchallenges.org/Explorations/Topics/Pages/OneHealthRound11.aspx>. Accessed September 27, 2013.
- Gebreyes, W. A., J. Dupouy-Camet, M. J. Newport, C. J. B. Oliveira, L. S. Schlesinger, Y. M. Saif, et al. 2014. "The Global One Health Paradigm: Challenges and Opportunities for Tackling Infectious Diseases at the Human, Animal, and Environment Interface in Low-Resource Settings." *PLOS Neglected Tropical Diseases* 8 (11): e3257.
- Gibbs, E. Paul J. 2014. "The Evolution of One Health: A Decade of Progress and Challenges for the Future." *Veterinary Record* 174 (4): 85–91.
- Goedeke, Theresa L., and S. Rikoon. 2008. "Otters as Actors: Scientific Controversy, Dynamism of Networks, and the Implications of Power in Ecological Restoration." *Social Studies of Science* 38 (1): 111–132.
- Hardy, Anne. 2003. "Animals, Disease, and Man: Making Connections." *Perspectives in Biology and Medicine* 46 (2): 200–215.
- Hendricks, Joan, Charles D. Newton, and Arthur Rubenstein. 2009. "'One Medicine–One Health' at the School of Veterinary Medicine of the University of Pennsylvania—The First 125 Years." *Veterinaria Italiana* 45 (1): 183–194.
- Hobson-West, Pru, and Stephen Timmons. 2015. "Animals and Anomalies: An Analysis of the UK Veterinary Profession and the Relative Lack of State Reform." *Sociological Review* 64: 47–63.
- Immuno Valley. 2014. "About Immuno Valley." <http://www.immunovalley.nl/about-immunovalley/>. Accessed May 15, 2014.
- Institute on Science for Global Policy. 2012. "Emerging and Persistent Infectious Diseases (EPID): Focus on the Societal and Economic Context." <http://scienceforglobalpolicy.org/conference/epid-societal-and-economic-context/>. Accessed December 15, 2012.
- Jacobs, Jerry A., and Scott Frickel. 2009. "Interdisciplinarity: A Critical Assessment." *Annual Review of Sociology* 35 (1): 43–65.
- Jerolmack, Colin. 2013. "Who's Worried about Turkeys? How 'Organisational Silos' Impede Zoonotic Disease Surveillance." *Sociology of Health & Illness* 35 (2): 200–212.
- Kahn, Laura H., and Ronald M. Davis. 2009. "'One Medicine–One Health': Interview with Ronald M. Davis, MD, President of the American Medical Association, 14 May 2008." *Veterinaria Italiana* 45 (1): 19–21.
- Kahn, Laura H., Bruce Kaplan, and Thomas P. Monath. 2012. "One Health Initiative—One World One Medicine One Health: About the One Health Initiative." <http://www.onehealthinitiative.com/about.php>. Accessed May 11, 2015.
- Kahn, Laura H., Bruce Kaplan, Thomas P. Monath, and James H. Steele. 2008. "Teaching 'One Medicine, One Health.'" *American Journal of Medicine* 121 (3): 169–170.
- Kaplan, Bruce, Laura H. Kahn, and Thomas P. Monath, eds. 2009. "'One Health–One Medicine': Linking Human, Animal and Environmental Health." *Veterinaria Italiana* 45 (1). http://www.izs.it/vet_italiana/2009/45_1/45_1.htm.
- Kaplan, Bruce, and C. Scott. 2011. "One Health History Question: Who Coined the Term 'One Medicine'?" One Health Initiative. <http://www.onehealthinitiative.com/publications/>

- Who coined the term? One Medicine by Bob Kaplan and Carol Scott May 19 2011-CS.pdf. Accessed November 7, 2013.
- King, Lonnie, and One Health Initiative Task Force. 2008. "One Health: A New Professional Imperative." American Veterinary Medical Association. https://www.avma.org/KB/Resources/Reports/Documents/onehealth_final.pdf.
- King, Nicholas B. 2004. "The Scale Politics of Emerging Diseases." *Osiris* 19: 62–76.
- Kirk, Robert. 2010. "A Brave New Animal for a Brave New World: The British Laboratory Animals Bureau and the Constitution of International Standards of Laboratory Animal Production and Use, circa 1947–1968." *Isis* 101 (1): 62–94.
- Kirk, Robert, and Michael Worboys. 2011. "Medicine and Species: One Medicine, One History?" In *The Oxford Handbook of the History of Medicine*, edited by M. Jackson, 561–577. Oxford: Oxford University Press.
- Leboeuf, Aline. 2011. "Making Sense of One Health Cooperating at the Human-Animal- Eco-system Health Interface." *IFRI Health and Environment Reports*, 7. <http://www.ifri.org/en/publications/enotes/notes-de-lifri/making-sense-one-health>.
- Lee, Kelly, and Z. L. Brumme. 2012. "Operationalizing the One Health Approach: The Global Governance Challenges." *Health Policy and Planning*, December 7, 1–8.
- Leung, Zee, Dean Middleton, and Karen Morrison. 2012. "One Health and EcoHealth in Ontario: A Qualitative Study Exploring How Holistic and Integrative Approaches Are Shaping Public Health Practice in Ontario." *BMC Public Health* 12 (1): 358.
- Löwy, Illana. 1992. "The Strength of Loose Concepts—Boundary Concepts, Federative Experimental Strategies and Disciplinary Growth—The Case of Immunology." *History of Science* 30 (90): 371–396.
- Maye, Damian, and James Kirwan. 2013. "Food Security: A Fractured Consensus." *Journal of Rural Studies* 39: 1–6.
- Michell, A. R. 2000. "Only One Medicine: The Future of Comparative Medicine and Clinical Research." *Research in Veterinary Science* 69 (2): 101–106.
- Mooney, Patrick H., and Scott A. Hunt. 2009. "Food Security: The Elaboration of Contested Claims to a Consensus Frame." *Rural Sociology* 74 (4): 469–497.
- Okello, Anna L., E.P.J. Gibbs, A. Vandersmissen, and S. C. Welburn. 2011. "One Health and the Neglected Zoonoses: Turning Rhetoric into Reality." *Veterinary Record* 169 (11): 281–285.
- One Health Sweden. 2014. "One Health Sweden Steering Committee Visit to Florida December 2013." <http://www.onehealth.se/ohs/node/176>. Accessed August 15, 2015.
- Royal College of Veterinary Surgeons (RCVS). 2014. "Liverpool Visitation Report 2012." June 6. <http://www.rcvs.org.uk/document-library/liverpool-visitation-report-2012/>.
- Scheffler, Robin Wolfe. 2014. "Following Cancer Viruses through the Laboratory, Clinic, and Society." *Studies in History and Philosophy of Science Part C* 48: 185–188.
- Schlich, Thomas, Eric Mykhalovskiy, and Melanie Rock. 2009. "Animals in Surgery—Surgery in Animals: Nature and Culture in Animal-Human Relations and Modern Surgery." *History and Philosophy of the Life Sciences* 31 (3–4): 321–354.
- Schmidt, Carl F. 1962. "Editorial: One Medicine for More Than One World." *Circulation Research* 11 (6): 901–903.
- Schwabe, Calvin W. 1984 [1964]. *Veterinary Medicine and Human Health*. Baltimore: Williams and Wilkins.
- . 2004. "Keynote Address: The Calculus of Disease—Importance of an Integrating Mindset." *Preventive Veterinary Medicine* 62 (3): 193–205.

- Scoones, Ian, and Paul Forster. 2010. "Unpacking the International Response to Avian Influenza: Actors, Networks and Narratives." In *Avian Influenza: Science, Policy and Politics*, edited by Ian Scoones, 19–64. London: Earthscan.
- Sluga, Glenda. 2010. "UNESCO and the (One) World of Julian Huxley." *Journal of World History* 21 (3): 1–18.
- Staples, Amy L. S. 2011. *The Birth of Development: How the World Bank, Food and Agriculture Organization, and World Health Organization Have Changed the World, 1945–1965*. Kent, OH: Kent State University Press.
- Star, Susan Leigh. 2010. "This Is Not a Boundary Object: Reflections on the Origin of a Concept." *Science, Technology & Human Values* 35 (5): 601–617.
- Star, Susan Leigh, and James Griesemer. 1989. "Institutional Ecology, 'Translations' and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology, 1907–39." *Social Studies of Science* 19 (3): 387–420.
- Twine, Richard. 2013. "Animals on Drugs: Understanding the Role of Pharmaceutical Companies in the Animal-Industrial Complex." *Journal of Bioethical Inquiry* 10 (4): 505–514.
- University of Surrey. 2012. "Press Release: New Veterinary School Plans to Embrace Links between Human and Animal Health." October 25. http://www.surrey.ac.uk/mediacentre/press/2012/92737_new_veterinary_school_plans_to_embrace_links_between_human_and_animal_health.htm.
- Vallet, Bernard. 2009. "Editorial from the Director General: One World, One Health." World Organization for Animal Health. April 20, 2009. <http://www.oie.int/for-the-media/editorials/detail/article/one-world-one-health/>.
- Wellcome Trust. 2010. "Strategic Plan: 2010–2020." London: Wellcome Trust. <http://www.wellcome.ac.uk/About-us/Strategy/>. Accessed September 27, 2013.
- Wildlife Conservation Society. 2004. "About 'One World, One Health.'" New York: Wildlife Conservation Society. <http://www.oneworldonehealth.org>.
- Wood, James L. N., Melissa Leach, Linda Waldman, Hayley MacGregor, Anthony R. Fooks, Kate E. Jones, et al. 2012. "A Framework for the Study of Zoonotic Disease Emergence and Its Drivers: Spillover of Bat Pathogens as a Case Study." *Philosophical Transactions of the Royal Society of London Series B, Biological Sciences* 367 (1604): 2881–2892.
- Woods, Abigail, and Michael Bresalier. 2014. "One Health, Many Histories." *Veterinary Record* 174: 650–654.
- Woods, Abigail, and Stephen Matthews. 2010. "'Little, if at All, Removed from the Illiterate Farrier or Cow-leech': The English Veterinary Surgeon, c. 1860–1885, and the Campaign for Veterinary Reform." *Medical History* 54 (1): 29–54.
- World Health Organization and Food and Agriculture Organization (WHO and FAO). 1951. Joint "WHO/FAO Expert Committee on Zoonoses." WHO Technical Report Series No. 40. Geneva: World Health Organization.
- Yaqub, Ohid, and Paul Nightingale. 2012. "Vaccine Innovation, Translational Research and the Management of Knowledge Accumulation." *Social Science & Medicine* 75 (12): 2143–2150.
- Zinsstag, Jakob, Andrea Meisser, Esther Schelling, and Marcel Tanner. 2011. "From Two Medicines to One Medicine to One Health and Beyond." [http://www.sacids.org/kms/resources/OneHealth_Johannesburg_Zinsstagetal_2011%20\(2\).pdf](http://www.sacids.org/kms/resources/OneHealth_Johannesburg_Zinsstagetal_2011%20(2).pdf).
- Zinsstag, Jakob, Esther Schelling, Kaspar Wyss, and Mahamat Bechir Mahamat. 2005. "Potential of Cooperation between Human and Animal Health to Strengthen Health Systems." *Lancet* 366 (9503): 2142–2145.