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The challenges of implementing an integrated One Health surveillance system in Australia

I. Johnson | **A. Hansen** | **P. Bi**

School of Public Health, The University of Adelaide, Adelaide, SA, Australia

Correspondence
Peng Bi and Alana Hansen, School of Public Health, The University of Adelaide, Adelaide, SA, Australia.
Emails: peng.bi@adelaide.edu.au and alana.hansen@adelaide.edu.au

Summary

As 75 per cent of emerging infectious diseases are of animal origin, a One Health approach that integrates the health of humans, animals and the environment could provide an earlier opportunity for zoonotic disease detection and prevention. In Australia, human, animal and ecological health are managed by separate sectors with limited communication. This study aims to explore how professionals in these fields perceive a One Health approach to zoonotic disease surveillance, aiming to identify the challenges to the implementation of an integrated system in Australia. Using a qualitative research method, ten semistructured interviews were conducted with academic experts to gain insight into the possibility of developing an integrated surveillance system in Australia. A thematic analysis of the data was undertaken. Findings showed the absence of a clear definition and subsequent vision for the future of One Health act as a barrier to interdisciplinary collaboration, and that siloed approaches by different sectors restrict the ability for professionals to work collaboratively across disciplines. An understanding of disease transmission was considered by participants to be a necessary requirement for a successful One Health approach. Finally, participants considered political will an essential requirement for the integration of surveillance systems. This study demonstrates that for a One Health approach to be implemented in an Australian setting, those working in the fields of human, animal and ecological health must agree on several aspects. The establishment of a formal governance body with representatives from each sector could assist in overcoming long-standing barriers of privacy and distrust. Further, developing interdisciplinary training in One Health concepts for medical, environmental and veterinary students may encourage cross-disciplinary collaboration. Finally, demonstrating to policymakers the economic benefit of improved and timely detection of zoonoses may help in facilitating a structured One Health approach to disease surveillance in Australia.

KEYWORDS

infectious disease, One Health, public health, surveillance, zoonoses

1 | INTRODUCTION

One Health, the concept of structured collaboration and coordination between human, animal and ecohealth systems, has, in recent years, become an emerging focus amongst public health, veterinary and ecological sectors (Hinchliffe, 2015). The concept of One Health seeks to transition from traditional management of individual sectors towards an interdisciplinary approach that addresses zoonotic diseases at the human-animal-environmental interface (Burke et al., 2012; Conrad, Meek, & Dumit, 2013). With 75% of all emerging

infectious diseases (EIDs) being traced to animal origin, there are compelling grounds to recognize zoonoses as a central factor in the battle against EIDs (Jeggo & Mackenzie, 2014; Osburn, Scott, & Gibbs, 2009; Taylor, Latham, & Woolhouse, 2001).

There are many emerging and re-emerging zoonotic infectious diseases threatening human health, including West Nile virus disease, human infection with avian influenza (H5N1, H7N9 and H1N1), salmonellosis, Middle East Respiratory Syndrome coronavirus, Hendra virus infection, Severe Acute Respiratory Syndrome (SARS), Ebola virus disease, and most recently, Zika virus disease, all of which have caused significant public health challenges and economic burdens (Osburn et al., 2009; Stark & Morgan, 2015). The World Health Organization (WHO) estimates that infectious diseases, the majority of which are zoonotic, account for 43% of the overall global burden of disease (World Health Organization, 2016).

The last two decades have seen a shift in our understanding of how wildlife reservoirs act as pathogenic hosts, significantly influencing human health (Mackenzie, Jeggo, Daszak, & Richt, 2013; Palmer, 2013). Ecosystem health, concerning the health of ecosystems and the environment, has been influenced by population growth, globalization, urbanization and economic development, with changes to these intricate systems resulting in increased numbers of vectors, including mosquitoes, carrying zoonotic diseases (Osburn et al., 2009; Stark & Morgan, 2015). Additionally, climate change is considered to increase the incidence of vector-borne diseases, including dengue fever, Japanese encephalitis and Ross River virus disease (Bambrick, Woodruff, & Hanigan, 2009; Whelan et al., 2003).

However, it has been in recent years that the One Health concept has gained momentum, with the SARS outbreak acting as an important catalyst (Mackenzie, McKinnon, & Jeggo, 2014). Thus, international efforts have been made to strengthen the integrated surveillance of emerging infectious diseases (Jeggo & Mackenzie, 2014). In 2011, the First International One Health Congress was hosted in Melbourne, Australia, where One Health concepts and principles were developed (Jeggo & Mackenzie, 2014). Also in Australia, the New South Wales health service has achieved enhanced infection control, as well as improved biosecurity procedures, through the implementation of a single reporting system (Adamson, Marich, & Roth, 2011; Uchtmann, Herrmann, Hahn, & Beasley, 2015). While positive steps in achieving integrated One Health surveillance have been undertaken at both national and global levels, it has been suggested that focusing on the challenges to the implementation of One Health in individual countries, with consideration of their cultural and societal elements, could help enable effective national strategies, and therefore, a strengthened international approach to zoonotic disease control (Mackenzie et al., 2014).

In Australia, the government spends around two billion dollars annually managing zoonotic diseases (Australian Institute of Health and Welfare, 2014). From both economic and population health perspectives, it is imperative to understand zoonotic epidemiology to focus on the surveillance of zoonoses with an integrated approach (Hinchliffe, 2015; Taylor et al., 2001; Wendt, Kreienbrock, & Campe, 2015). Health surveillance in Australia operates at both state and national levels and is the ongoing systematic collection and interpretation of health-related data (Australian Government Department of Health, 2016b).

Impacts

- Qualitative, national Australian study outlining the benefits and challenges of implementing an integrated "One Health" zoonotic disease surveillance system in Australia.
- Findings reflect the perceptions of academic experts in human, animal and ecological health.
- Provides recommendations for overcoming the (perceived) challenges of implementing integrated surveillance in Australia including a One Health approach to the understanding of zoonoses, political will and governance issues.

Currently in Australia, human diseases, animal infections and matters relating to the environment are monitored and managed by separate sectors with limited information and data sharing, and as such, effective and timely communication between these departments can be inherently compromised (Armstrong, Gillespie, Leeder, Rubin, & Russell, 2007; Australian Institute of Health and Welfare, 2016). Under the Australian National Notifiable Disease Surveillance System (NNDSS), doctors and laboratories are required by law to report certain communicable diseases in humans; however, notifiable diseases differ amongst various jurisdictions (Australian Government Department of Health, 2015; Miller, Roche, Spencer, & Deeble, 2004). Additionally, notifications of animal diseases are collected by a separate government sector and are primarily for the purposes of minimizing adverse impacts on trade (Australian Government Department of Health, 2015). Disease notifications, therefore, vary significantly between human and animal health sectors, and a One Health approach could strengthen intersectoral communication and collaboration (Adamson et al., 2011; Australian Government Department of Health, 2016a). This study aims to explore professionals' perceptions on the challenges of implementing an integrated national One Health surveillance system in Australia.

2 | METHODS

This study adopted a qualitative approach, employing semistructured interviews to gather data. Purposeful sampling identified academic experts around Australia who have prior experience and active involvement in the One Health dialogue. Their areas of expertise ranged from public health, medicine, disease surveillance, tropical infectious diseases, veterinary sciences and microbiology, zoology, ecology and medical entomology. All participants were contacted by email or telephone and provided with an outline of the study in the form of a participant information sheet. Written and signed informed

consent was required from participants before the interview began. Participant anonymity was assured. A total of thirteen people were invited to participate in the research, ten of whom agreed based on availability.

Interviews took place in August and September 2016. A total of three interviews were conducted face-to-face in Adelaide, South Australia, Australia, and seven were conducted over the telephone. The mean duration of interviews was 25 min. A review of the literature identified a gap in the understanding of the barriers and enablers to the implementation of a One Health surveillance system in Australia. The aims and objectives of this study were developed accordingly. Based on the findings of this literature review the interview topic guide was open-ended, giving participants freedom to elaborate on areas of interest. Transcription of audio recordings took place shortly after each interview, and participants were offered a copy of their interview transcript.

For this study, we sought to understand how particular system structures and powers challenge the implementation of an integrated One Health surveillance in Australia. Thus, this research was conducted within a critical realist paradigm, an epistemology which allows for an understanding of reality based on influencing causal mechanisms (McEvoy & Richards, 2003; Willig, 2016). Informed by Braun and Clarke's guide to thematic analysis (Braun & Clarke, 2006), transcripts were read thoroughly multiple times ensuring familiarization and immersion in the data (Green et al., 2007). Initial handwritten notes were made, before electronic coding using NVivo software (QSR International, Doncaster, Victoria, Australia) was undertaken. Codes were then reviewed and comparable codes were grouped into specific codes and general concepts, before relevant themes were identified.

Ethical approval in the low-risk category was granted from the University of Adelaide Human Research Ethics Committee.

3 | RESULTS

Of the ten academics who participated in the study, five were from the state of South Australia, two from Western Australia, and there was one participant each from New South Wales, Queensland and the Australian Capital Territory. The sample consisted of four veterinarians, four public health practitioners, an entomologist and an ecologist, all with expertise in infectious disease control and prevention. Three participants were qualified medical practitioners.

The thematic analysis resulted in a number of important themes and subthemes. It was mentioned recurrently that One Health would be a beneficial approach to surveillance; however, a clearer, consolidated vision of the way forward is needed. The challenges of, and the requirements for, the introduction of a One Health system were also main themes identified. Finally, all participants provided perceived "requirements" for the establishment of a One Health surveillance strategy in Australia which included: understanding disease transmission, political will (for the surveillance approach) and formal governance.

3.1 | A beneficial approach to surveillance

All study participants spoke highly of the One Health paradigm and were emphatic in their discussion of the value of such a system being implemented in Australia. The "integration" of surveillance was a term used commonly, in describing the concept of bringing together disease surveillance of humans, animals and the environment, to form a synchronized system, providing a more comprehensive view of the animal disease–human disease interface, and therefore a more complete understanding. One participant likened One Health to an "intelligence system," while others considered it "vital" in being able to achieve sensitive and timely surveillance across the borders of interspecies health.

> *…by taking a One Health approach we gain greater understanding of disease systems, and obtain more data by which we can act.*
>
> *– P2 (Expert in infectious diseases)*

3.2 | Defining one health

Participants were asked to explain their understanding of One Health. All participants discussed One Health in terms of both human and animal health, with only some encompassing a broader ecological aspect in their definition. For the latter, the lack of environmental consideration was emphasized as a shortcoming and those from the public health and medical sectors saw this a barrier to a shared understanding in the One Health discourse. One participant (a public health practitioner) encapsulated this, stating: "we need to work a bit harder on defining what One Health actually is."

3.3 | Challenges

Participants identified obstacles they perceive to be challenges to implementing an integrated One Health approach, with a main theme of "silos" emerging as the most significant.

3.3.1 | Silos

It was evident in the participant narratives that a perceived "silo effect" and "silo mentality" exist between professional sectors, with an "exclusive," mentality that can inhibit cross-sectoral communication and collaboration. Five key subthemes were identified: commercial interest, lack of inter-sectoral communication, lack of inter-sectoral trust, silos in education and siloed funding.

Commercial interest

"Commercial interest" was stated by participants to be a barrier to cross-disciplinary data sharing, and therefore surveillance. With Australia's agricultural industry a major contributor to the national GDP, the importance of animal surveillance to the commercial sector was noted. However, as the protection of human health is not the main priority of veterinarians, it was considered

necessary to find a way of "sharing" data, while remaining "sensitive and mindful" to the needs of other industries. Participants differed in their standpoints on this concept, based somewhat on their relevant fields, with participants from the animal sector speaking about the need for surveillance to ensure livestock offered for trade are free of disease, while those interested in public health and medicine were clear that animal surveillance should consider risks of transmission of zoonotic diseases to humans.

Lack of inter-sectoral communication

Participants discussed and focussed on the lack of communication currently occurring between sectors, and the difficulty this causes to any form of integrated system. This lack of communication was considered by all participants to be counterproductive. However, it was acknowledged that all sectors have differing objectives and requirements, and thus increased collaboration will be a challenging task. Furthermore, with a One Health approach requiring cross-sectoral communication, there could be issues that must be managed sensitively, for example the leadership or "priority" of one sector over others. However, despite the challenges, participants all agreed that cross-sectoral collaboration is essential for the implementation of an integrated surveillance system that would address zoonotic diseases in a holistic manner, encompassing all relevant sectors. One example referred to a recent Q fever outbreak in the Netherlands.

> *…the veterinary community knew there was an issue with abortions and Q fever outbreaks on goat farms, but they hadn't thought to consider that was a human health risk.*
>
> *– P5 (Veterinarian)*

Lack of inter-sectoral trust

Trust was often mentioned and explained in the context of siloed systems. Participants identified occasions where blame has led to distrust and professional tensions existing between sectors, further reinforcing the lack of cross-sectoral communication and collaboration. For example, veterinary participants felt their sector has been blamed for the issue of antimicrobial resistance, which has caused tensions with the medical sector. Antibiotics have been used as growth promoters in intensive livestock production, as well as over-prescribed clinically, with extensive over-use in both sectors resulting in bacteria becoming resistant to treatment (Jeggo & Mackenzie, 2014; Nathan & Cars, 2014).

> *…antimicrobial resistance…there was a lot of blame going on about who caused the problem… the animal side has been blamed.*
>
> *– P3 (Veterinarian)*

Silos in education

The siloed education of young practitioners was a recurrent theme. Participants regularly stated that a lack of tertiary education about One Health leads to professionals thinking in a siloed way within their respective fields. It was considered, predominantly by those in the veterinarian field, that once people have been in the workforce for a number of years it is less likely they will think in a collaborative way outside of their specific scope of interest and therefore integrate their thoughts into an interdisciplinary approach in a professional setting. This discussion trended towards a concern that this lack of cross-disciplinary training can underpin cross-sectoral communication issues.

> *…we're still trained either as vets or doctors or environmental scientists…so we have a very siloed view of the world.*
>
> *– P3 (Veterinarian)*

Siloed funding

Funding was discussed often as a challenge to the establishment of a One Health approach. Participants considered that with limited funding available, particularly in environmental and agricultural fields, it is challenging to encourage collaboration between sectors where a financial cost is involved, and this presents as a barrier. Participants believed funding could become a sensitive issue, as financial investment would need to be justified and benefit the sector to which it was allocated.

> *…when money comes down it ends up allocated, for example, to human health, so it's very hard for a department of health to justify spending their health dollars on an animal issue.*
>
> *– P8 (Veterinarian)*

3.4 | Requirements for successful One Health surveillance

While identifying areas that hinder or challenge One Health implementation, participants offered suggestions to the integral requirements for successful One Health surveillance in Australia. Three main themes were discovered: understanding disease transmission, formal governance and political will.

3.4.1 | Understanding disease transmission

Participants often specified the importance of understanding diseases in the context of the epidemiological triad—the causative relationship between an agent, host and environment. Participants believed that without a "big picture" understanding of the origin of zoonoses and how transmission occurs, it is impossible to offer early interventions and reduce the incidence of zoonotic diseases, and without this understanding the health of professionals and the public can be at risk.

> *…we've had several cases of emerging infectious diseases such as Hendra virus, that have been incredibly significant and have caused deaths…maybe a little bit more One*

Health focus…might have saved the lives of some of our veterinarians.

– P8 (Veterinarian)

And so you can't come up with human interventions without knowledge of what's happening in the animals.

– P4 (Expert in disease surveillance)

3.4.2 | Formal governance

Participants made clear that a One Health approach requires a formal governance body, however perceptions of who should run this governance varied. Some believed if One Health seeks to benefit public health, it demands responsibility from the public health or medical sector. Others, particularly veterinarians, consider the responsibility lies with a formal, yet impartial agency, sitting between sectors. While these variations in perception act as a challenge unto themselves, all participants agreed that without an overarching governance body the organization, momentum and implementation of such a system are almost impossible. Further, participants identified this as a first step, as without formal governance, little, besides continued dialogue, will be achieved.

I think the only way to progress One Health surveillance is to have a group or agency responsible…that sits between animal health and human health and also environmental health…that's seen as independent, and nonpartisan.

– P3 (Veterinarian)

3.4.3 | Political will

Political will—the necessity for political involvement in canvassing and implementing a One Health approach—was discussed frequently. It was considered that without political will the operational issues that exist will not be overcome, and thus involving the relevant ministers and policymakers in the One Health discussion is essential, providing the best opportunity for implementation. To achieve this, participants believed politicians need to be convinced of the economic benefit of a One Health approach. This theme presented as necessary to establish in the early planning stages, only second to formal governance.

…if health economists can demonstrate the monetary value of what we're doing, then the political impetus would follow quite rapidly.

– P1 (Ecologist)

4 | DISCUSSION

Australia's focus on biosecurity, in part due to its geographical isolation, has prevented many diseases from entering the country to date, although there remains an increasing threat due to globalization and increasing international travel (Australian Government Department of Agriculture and Water Resources 2016; Mwangi, de Figueiredo, & Criscitiello, 2016). Additionally, Australia does not have an integrated human-animal disease surveillance aiding in early recognition of diseases (Australian Government Department of Health, 2015, 2016a). With infectious diseases regularly crossing the boundaries of human, animal and ecological health, an interdisciplinary approach to zoonotic disease surveillance could be valuable (Fauci, Touchette, & Folkers, 2005; Narrod, Zinsstag, & Tiongco, 2012; Stark et al., 2015).

The issue of alternate definitions for One Health existing amongst professionals recurs both in the wider literature and in this study. While for the most part One Health is recognized to reflect a particular focus on diseases that affect humans, domestic animals, wildlife and ecosystems (Jeggo & Mackenzie, 2014), different definitions (i.e. with or without the inclusion of the environmental aspect) can create ambiguity (Lee and Brumme, 2013). Participants of this study indicate that these differences in definition and perception of meaning likely contribute to a lack of consensus on the scope of the One Health paradigm, which compromises the planning and implementation of any such strategy, preventing collaboration and harmonization. A holistic view of disease epidemiology would dictate that One Health is broader than just zoonotic diseases affecting human and animal health combined, yet the environmental aspect which incorporates potential pathogens in soil, air and water, and diseases that can affect biodiversity, is often overlooked (Casas & Maloy, 2014; Jeggo & Mackenzie, 2014).

The concept of silos existing in the world of public health, and health more broadly, has been addressed in the wider literature (Allen-Scott, Buntain, Hatfield, Meisser, & Thomas, 2015; Garcia & Gostin, 2012; Halliday et al., 2012; Manlove et al., 2016; Zinsstag et al., 2012). As described by Yang (2011, p. 5), "As emerging diseases and health priorities evolve into global and multi-sectoral issues, public health professionals – from interventionists to advocates to researchers – must step outside of their silos." Participants identified that restructuring traditional siloed education into a multidisciplinary educational approach is important in training professionals, in order to encourage and support cross-disciplinary collaboration and communication. This concept resonates with the wider literature and is acknowledged in several studies, (Allen-Scott et al., 2015; Mackenzie et al., 2014; Mwangi et al., 2016; Stark et al., 2015) with Lee and Brumme (2013) advocating for an increased focus on "interdisciplinary One Health degree programs" to integrate knowledge across the three sectors. Participants expressed the necessity for interdisciplinary education to be instituted in the early stages of tertiary training in the areas of medicine, public health, veterinary science and environmental health. Jeggo and Mackenzie (2014) reinforce this and argue that education facilitates generational changes to thinking, which is likely to increase and improve the willingness of inter-sectoral cooperation over time.

The impact of zoonoses on commercial interests and animal trade was often mentioned by participants and discussed as a barrier to the establishment of a harmonized surveillance system for zoonoses. Participants of this study were, however, sympathetic in their understanding of why this occurs, and the necessity to carefully manage the wider implications on the nation's economy. The disjuncture that

exists between human health and animal trade is particularly relevant in an Australian context. Australia's agriculture sector is a significant contributor to the national economy, estimated to be worth around 40 billion dollars annually, and therefore matters concerning disease surveillance systems may best be managed nationally (Australian Bureau of Statistics, 2016). As described by Zinsstag et al. (2012), and reinforced by the results of this study, successful implementation of One Health systems requires government involvement and political will, as funding must be restructured to support inter-sectoral collaboration, communication and new surveillance.

There have been a number of zoonotic disease outbreaks in Australia and overseas which illustrate the need for an enhanced One Health approach. With improved interdisciplinary surveillance and earlier detection and reporting of disease outbreaks in animals, human infections may have been identified earlier and better managed, preventing localized cases from spreading (Bond et al., 2016; Crawford, Roth, & Grillo, 2012; Gubler et al., 2000; Halliday et al., 2012; Roest et al., 2011; van den Wijngaard et al., 2011). For example, Hendra virus causes a highly infectious disease with a high mortality rate, primarily infecting horses and, occasionally, humans and dogs that have contact with infected horses (Mendez, Buttner, & Speare, 2014). Between 1994 and 2010 Hendra outbreaks (in horses) in Australia saw seven veterinarians becoming infected, four fatally (Mendez et al., 2014). Similarly, in the Netherlands between 2007 and 2009, Q fever in infected goat farms was linked to 3523 cases of human infection, following a time-consuming epidemiological investigation (Roest et al., 2011; van den Wijngaard et al., 2011).

The Australian Prime Minister's Science, Engineering and Innovation Council (PMSEIC) reported in 2009 "it is a matter of when, not if, a lethally catastrophic epidemic will happen" (Prime Minister's Science, 2009). Australia could benefit by adopting an approach to zoonotic disease control that accommodates industry while enhancing zoonotic disease surveillance, managing each issue with consideration of any wider implications. Additionally, looking abroad for examples of successful collaboration may be useful, such as the European Food Safety Authority agency, responsible for animal health and food safety in Europe, who work collaboratively with each sector (Stark et al., 2015). The findings of this study suggest a formal governance body could be established to address emerging infectious diseases and zoonoses in Australia, providing the essential cross-disciplinary communication, information sharing, and bringing together a shared surveillance approach to zoonoses. Based on the participant perspectives of this study, professionals involved in this governance should equally represent human, animal and environmental health, and the policymakers for these areas should be kept informed.

The small sample size of this scoping study is a limitation and highlights the need for further large-scale studies in the area. Additionally, widening the scope of participants to include more stakeholders such as practitioners, policymakers and the representatives from relevant industries would provide a broader depth of understanding and strengthen the validity of the findings. The different interviewing techniques used (a mix of face-to-face and telephone interviews) act as limitations. Further, the study group was homogenous, consisting of academics, and as such the perspectives of participants included in this research are not necessarily representative of those of their peers, practitioners and stakeholders in industry. Despite this, participants branched a wide scope of expertise from varying fields, bringing a multitude of experience to the study.

In conclusion, a formal, integrated One Health surveillance system could provide an effective approach to reducing the prevalence of zoonoses in Australia. While an enhanced understanding of One Health principles has seen public health and animal health authorities, and epidemiologists, work together to address zoonotic disease outbreaks, there remain challenges to the implementation of integrated national surveillance. Broadly, this study illustrates how limited collaboration in tertiary and professional settings results in siloed approaches and mentalities across the sectors and acts as a barrier to the development of an integrated human-animal disease surveillance system. The study findings, in conjunction with relevant literature, suggest for a One Health approach to be successfully implemented in Australia a number of priorities should be addressed. A clear definition and shared vision for the future of One Health should be agreed upon, and cross-disciplinary tertiary training could help broaden knowledge of One Health to young professionals. A formal governance body should be established with the involvement of relevant policymakers. Interdisciplinary communication about zoonoses and the collaboration of relevant sectors are crucial in addressing the prevention of emerging zoonotic diseases in Australia and abroad.

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CONFLICTS OF INTEREST

None.

ORCID

I. Johnson http://orcid.org/0000-0003-2854-7748

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