

Forum

Where to Now for One Health and Ecohealth?

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INTRODUCTION

Whilst subdivided and with complex interactive origins, two broad groups, One Health and Ecohealth, currently characterise global efforts to tackle the health of people, animals and our environment. One Health and Ecohealth have much in common conceptually in the issues they address (although they differ in their emphasis) and institutionally in their emphasis on interdisciplinary collaboration, but both suffer from limited resources and support. We explore the possibilities for further convergence or unity.

EVOLUTION OF ECOHEALTH

Ecohealth seeks to understand how social, economic and ecological factors and their interactions affect ecosystem ‘health’—the condition and sustainability of ecosystems (natural or man-made, e.g. agroecosystems, urban ecosystems) (Costanza et al. 1998a, b)—including the ability to provide ecosystem services, and the impact of this on human health. Ecohealth is anthropocentric, but has an

emphasis on optimising ecosystem health to benefit human health. It is traditionally applied in a development context: socioeconomic development activities give rise to social factors (e.g. poverty reduction) which improve health but also ecological factors (e.g. natural resource depletion) which threaten health. These factors are exacerbated by social inequity factors (Charron 2012b). Ecosystem approaches use an action-research framework informed by six principles: systems thinking, transdisciplinarity (incorporating nonacademic knowledge of communities and decision makers), multi-stakeholder participation, sustainability, social and gender equity and knowledge-to-action (Charron 2012b).

Ecological approaches to public health, represented mainly by the field of environmental health, seek to understand and mitigate physical and social environmental factors affecting health. The effect of the environment on health has long been recognised: in the 18th century, Vicq d’Azyr linked climate and geographical circumstances to epidemics (Bresalier et al. 2015). However, the germ theory of disease brought about the era of infectious epidemiology (Susser and Susser 1996a), with its reductionist focus on the specific pathogens causing disease diverting attention away from environmental determinants (Bresalier et al. 2015). In the twentieth century, infectious epidemiology gave way to chronic disease epidemiology, which highlighted behavioural risk factors for disease (Pearce 1996; Susser and Susser 1996a). The ecological approach to

public health was revived in the 1970s due to increasing appreciation of social environmental factors, e.g. poverty, poor education, unequal power resulting in health inequality (Dakubo 2010). The Lalonde report laid the foundations for the revival: it set out biological, physical and social environments, behavioural and healthcare as the four fundamental determinants of health (Lalonde 1974), and the 1986 Ottawa Charter for Health Promotion advocated health promotion using an ecological approach (WHO 1986). More recently, the field of eco-epidemiology has emerged (Susser and Susser 1996b), which focusses on the interactions between physical and social environmental factors. Emerging in the late nineteenth century, the field of ecology studies the interactions of populations, communities, and biotic and abiotic components of the ecosystem (Odum 1971). The ecology-and-health approach can address more complex problems than the traditional environmental health approach, specifically interactions between health determinants and indirect effects on health. This was furthered by the emergence of human ecology (Parkes et al. 2003).

The ecosystem health concept originated in environmental management, addressing the need to balance socioeconomic development with ecosystem sustainability (Great Lakes Research Advisory Board 1978). The Brundtland report defined sustainable development (Brundtland 1987) and Agenda 21 of the 1992 Earth Summit in Rio de Janeiro addressed its importance for human health (UNCED 1992).

The ecosystem approach to human health arose from the union of ecological approaches to public health and ecosystem health from environmental management (Forget and Lebel 2001). In recent years, the Canadian International Development Research Centre (IDRC) has been the leading advocate. In 1996, it introduced the Ecohealth research programme. The first International Ecohealth Forum was held in Montreal in 2003, and in 2004, the IDRC founded the Ecohealth journal, merging previous journals *Ecosystem Health and Global Change* and *Human Health*. The IDRC established the International Association for Ecology and Health (IAEH) in 2006, to organise the Ecohealth movement globally and curate the journal (Charron 2012a). Other important international initiatives include the International Panel on Climate Change which addressed the health risks of climate change and the Millennium Ecosystem Assessment which identified the links between ecosystem services and human health (Parkes 2011; Charron 2012b).

EVOLUTION OF ONE HEALTH

One Health seeks to understand how interactions between humans, animals and environmental factors affect human and animal health, and in return, the impact of health on environmental factors. One Health interventions strive to optimise human and animal health (placing equal importance on the two) and environmental factors, but does not emphasise improving ecosystem health. One Health can be defined as the “added value in terms of health of humans, animals, financial savings or environmental services achievable by the cooperation of human and veterinary medicine when compared to the two medicines working separately” (Zinsstag et al. 2015, p. 18). It uses strategies including integrated surveillance and prevention, e.g. human and animal vaccination (Atlas 2013).

The One Health idea has been revisited many times. Integrated human and animal medicine was the norm in the 19th century. Louis Pasteur’s development of vaccines and Robert Koch’s studies on anthrax and TB, developing the germ theory of disease, highlighted the common causes of diseases in different species (Atlas 2013). Rudolph Virchow and William Osler championed comparative medicine (Saunders 2000). Virchow founded the field of cellular pathology, whilst Osler played a key role in both medical and veterinary education (Kahn et al. 2007). The first veterinary school was established in 1761 in Lyon but physicians continued to study animal health in collaboration with veterinarians (Bresalier et al. 2015). However, increasing academic specialisation and divergence in governance led to isolated professional silos (Zinsstag et al. 2012).

In the twentieth century, veterinarians revived the One Health movement. Calvin Schwabe, the pioneer of veterinary epidemiology, coined the term ‘One Medicine’ to assert that the paradigms of human and animal medicine are no different (Schwabe 1984), and advocated integrated disease surveillance (Atlas 2013). The field of veterinary public health, in which James Steele was a leading figure (Zinsstag et al. 2015), uses veterinary medicine to tackle disease threats from animals to humans (WHO/FAO 1951).

The increasing emergence of zoonotic infectious diseases, notably HIV/AIDS, BSE and SARS renewed the interest in One Health (Zinsstag et al. 2012). In September 2004, the Wildlife Conservation Society held a ‘One World One Health’ symposium. Here, the Manhattan Principles were devised with 12 recommendations for a holistic

approach to preventing disease. These identified the importance of ecosystem health and biodiversity for human and animal health (Cook et al. 2004), representing a broadening of One Health. Since then, One Medicine and One World have come together under the single One Health movement (Bresalier et al. 2015).

The One Health Commission was formed in 2009 in the USA with the aim of building interdisciplinary collaborations and educational opportunities to improve human, animal and plant health and environmental resilience (One Health Commission 2015). The One Health Foundation was established in 2010 in Zurich to more specifically focus on improving human health and livestock productivity through addressing issues including zoonotic diseases, food safety and pollution (One Health Foundation 2015). In 2010, major international players held a conference at Stone Mountain, Atlanta, USA, calling for cultural change towards One Health, more evidence for its added value and funding for interdisciplinary programmes (Atlas 2013). The World Health Organisation (WHO), Food and Agriculture Organisation (FAO) and World Organisation for Animal Health (OIE) signed a tripartite agreement to cooperate and lead global efforts in One Health (WHO 2010) and the World Bank reported an analysis of One Health economics (World Bank 2010). The first International One Health Congress was held in Melbourne in 2011, and included food safety and security (Atlas 2013); the Ecohealth journal hosted the abstracts of this conference. A recently established One Health Platform seeks to further co-ordinate global One Health activities (One Health Platform 2015). There is strong commitment to One Health on a national level, with many countries, developed (e.g. the USA, Canada and the UK) and developing (e.g. Mongolia, Laos, India, and Tanzania), creating their own One Health agendas.

COMBINING ONE HEALTH AND ECOHEALTH CONCEPTUALLY

Ecohealth is a broader concept than One Health (Zinsstag et al. 2015). Although One Health currently does not emphasise ecosystem health, it is increasingly considering environmental factors determining health, and these are inevitably related to ecosystem condition and sustainability so that, in time, One Health will likely evolve into Ecohealth, with combination or closer cooperation possible on a conceptual level. However, this appears to be held back by conceptually narrow practitioners, funding and training.

Combination or closer cooperation can have significant value. Ecohealth approaches can contribute to One Health. A good example is the evolution of our understanding of Nipah. This disease emerged in Malaysia and was first realised to affect pigs and humans through the work of medical and veterinary virologists. Fruit bats were then identified as a major wildlife reservoir of Nipah virus. Pig farming in fruit tree plantations where bats used to forage led to pigs consuming fruit contaminated by bat saliva containing the virus, developing respiratory symptoms and subsequently transmitting the virus to farmers. This led to control strategies based around keeping pigs away from plantations. However, ecosystem studies were required to reveal the ecological drivers of plantation colonisation by fruit bats, such as the potential association of bat movements with deforestation, and highlight the broader issue of ecosystem management (Daszak et al. 2001; Field et al. 2001; Chua et al. 2002; Pulliam et al. 2012).

A converse example, where One Health approaches contribute to Ecohealth, is that of echinococcosis in Nepal (Joshi et al. 2012). An urban ecosystem programme led by researchers from the National Zoonoses and Food Hygiene Research Centre of Nepal and University of Guelph, Canada was initiated in 1997 to tackle this in Kathmandu. In the years before 1997, it was found that butchers slaughtered water buffalo, infected with echinococcosis tapeworm cysts, in open sites along the Bishnumati River. Offal was consumed by dogs, the cysts they contained developed into mature tapeworms, and tapeworm eggs were shed in dog faeces. Humans were exposed to tapeworm eggs from dogs straying into houses and use of contaminated river water, with serious illness resulting from cyst formation in organs. The programme introduced significant changes including improved slaughtering practice hygiene by community engagement of butchers, indoor slaughterhouses, regulated slaughter waste disposal, opportunities to sell slaughter waste, improved housing in contaminated areas and conversion of riverbanks into community gardens.

Both One Health and Ecohealth are evolving towards the concept of ‘health in socio-ecological systems’ (HSES). Interactions within social-ecological systems (SES) generate social and ecological determinants of human, animal and plant health (Zinsstag et al. 2011). Interventions based on these determinants can then seek to maximise health outcomes and SES condition. An additional approach is resilience management (enhancing SES resilience) (Walker et al. 2002; Allen et al. 2011). However, it is difficult to see

how the banners of 'One Health' and 'Ecohealth', which have long heritages and widespread recognition, could be abandoned for HSES.

Ecosystem approaches to health have robust principles and frameworks underpinning their application which may be applicable to One Health. One framework is an adaptive methodology for ecosystem sustainability and health (AMESH) (Waltner-Toews 2004). This starts with a presenting (possibly community-raised) issue, followed by identifying stakeholders, an ecosystem description, identifying socially, economically and ecologically desirable states for stakeholders, designing interventions, and ongoing governance, monitoring and management. Conversely, economic analyses used to justify One Health approaches can be applied to Ecohealth approaches (Zinsstag 2012), which suffer from a lack of economic evidence (Charron 2012c).

COMBINING ONE HEALTH AND ECOHEALTH INSTITUTIONALLY

Interdisciplinary methods of working (e.g. agreeing on objectives, roles, responsibility and leadership, communication, information sharing, data collation and analysis), multidisciplinary organisational structures and appropriate attitudes towards other disciplines, already exist in One Health and Ecohealth groups, so combination or closer cooperation is easily possible on an institutional level. One Health and Ecohealth are coming together: the 4th International One Health Congress is being held in conjunction with the 6th Biennial meeting of the IAEH in Melbourne this year (One Health Ecohealth 2016, 2015).

However, different cultures exist between those in government and health professionals working in One Health (who tend to be more conformist) and academics specialising in Ecohealth. Within One Health, there is good uptake by veterinarians but poor engagement of the medical profession. A key reason for this lies in the differences in status, income and political influence between physicians and veterinarians, such that physicians are wary of associating with One Health which is largely composed of veterinarians, and have little interest in its advocacy of the commonality of human and veterinary medicine (Atlas 2013). Moreover, there remains an overwhelming lack of knowledge of One Health among medical practitioners. Introducing a stronger ecologist and environmentalist fraternity may alienate the medical profession even further.

ECONOMIC BENEFITS OF COMBINING ONE HEALTH AND ECOHEALTH

Given the cost, time and expertise needed if One Health and Ecohealth were to combine, there ought to be economic imperative, particularly as One Health and Ecohealth groups each have limited resources.

Closer cooperation between One Health and Ecohealth programmes would enable the two to use shared infrastructure, e.g. storage, transport, equipment and personnel. This would lead to greater economies of scale (as more activities are delivered with one infrastructure), reducing the cost per intervention. An example is joint human and livestock vaccination for mobile pastoralist communities in Chad from 2000 to 2005 (Schelling et al. 2007). Women and children were vaccinated according to the National Expanded Program on Immunization (including against diphtheria, pertussis, DPT/tetanus and polio) by public health professionals, and livestock were vaccinated against anthrax, pasteurellosis, blackleg and contagious bovine pleuropneumonia by veterinarians in the same visit, resulting in savings of 15% compared to delivering human and veterinary services separately.

Combining One Health and Ecohealth programmes should provide a more comprehensive understanding of social, economic and ecological determinants and their impacts on human and animal health (joint burden of disease) and ecosystem health. Based on this understanding, health interventions can be extended to produce more benefits (e.g. improvement of ecosystem services), and interventions targeting more 'upstream' determinants can be chosen (e.g. prevention rather than surveillance) to produce larger benefits (Zinsstag et al. 2015b). Increasing the benefits from an intervention increases its cost-effectiveness.

ADVOCACY BY COMBINING ONE HEALTH AND ECOHEALTH

Combining One Health and Ecohealth groups would bring together the supporters of each. Given that One Health and Ecohealth groups each have limited support, this could be a significant step towards greater advocacy power, attracting more followers, funding and policy influence. The upcoming joint One Health Ecohealth Congress, which will facilitate dialogue between the advocates of each group, is an ideal opportunity for this. Combining them may also be

valuable in managing competition and rivalry between the two groups.

CONCLUSION

In conclusion, further convergence of One Health and Ecohealth should bring a number of advantages: improved understanding and management of health issues, reciprocal adoption of good practices, economic gains and greater advocacy power. However, we recognise that union is unlikely at the moment due to conceptually narrow practices, reluctance to abandon the banners of 'One Health' and 'Ecohealth', cultural differences between the groups and difficulty in engaging the medical profession. The continued separation of One Health and Ecohealth but with closer cooperation and joint processes where there would be advantages is a preferable and realistic direction for the foreseeable future, but we believe that unity will eventually be the best path forward for both groups.

COMPLIANCE WITH ETHICAL STANDARDS

CONFLICT OF INTEREST The authors declare that they have no conflict of interest.

ETHICAL APPROVAL This article does not contain any studies with human participants or animals performed by any of the authors.

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