Culling and the Common Good: Re-evaluating Harms and Benefits under the One Health Paradigm

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One Health (OH) is a novel paradigm that recognizes that human and non-human animal health is interlinked through our shared environment. Increasingly prominent in public health responses to zoonoses, OH differs from traditional approaches to animal-borne infectious risks, because it also aims to promote the health of animals and ecological systems. Despite the widespread adoption of OH, culling remains a key component of institutional responses to the risks of zoonoses. Using the threats posed by highly pathogenic avian influenza viruses to human and animal health, economic activity and food security as a case exemplar, we explore whether culling and other standard control measures for animal-borne infectious disease might be justified as part of OH approaches. Our central premise is that OH requires us to reformulate 'health' as universal good that is best shared across species boundaries such that human health and well-being are contingent upon identifying and meeting the relevant sets of human and non-human interests and shared dependencies. Our purpose is to further nascent discussions about the ethical dimensions of OH and begin to describe the principles around which a public health agenda that truly seeks to co-promote human and non-human health could potentially begin to be implemented.

Introduction

Non-human animals are the source of 70% of emerging infectious threats to human health (Jones *et al.*, 2008), and more than half of all established human pathogens (Woolhouse and Gowtage-Sequeria, 2005). The globalization of trade and travel means we are all in some way at risk from the health and socio-economic impacts of animal-borne infections (Kareesh *et al.*, 2012). The risks and impacts of zoonotic and endemic diseases are not limited to low-income settings, and yet, these risks are socially, economically and geographically patterned. Consequently the threats posed by animal-borne infectious risks are now shaping national and global

biosecurity and public health agendas (Davies, 2008). A One Health (OH) approach is increasingly seen as an effective way to manage these risks (CDC, 2010). OH refers to interdependence of human, animal and environmental health. It is ecological in orientation, with an emphasis on understanding and regulating the environmental context of disease emergence and expression (Kakkar and Abbas, 2011). As the term implies, OH rests on the assumption that the cross-sectorial integration of expertise, research methodologies and public health infrastructure is necessary to improve capacity for disease-risk prediction and effective intervention (Zinsstag *et al.*, 2012). A OH approach not only necessitates, but mandates, inter-disciplinary collaboration

across human, animal and environmental health sectors (Degeling *et al.*, 2015). Although principally associated with emerging infectious disease (EID) prevention and control, OH approaches are also relevant to endemic and zoonotic animal diseases, food safety and health promotion (Grace and Jones, 2011; Marabelli, 2003; Rock and Degeling, 2016).

Traditional measures to control animal-borne infectious diseases include restrictions on movements of people and potentially infected animals; strategies to limit interactions between humans, domestic animals and potentially infected wildlife; and the vaccination or treatment of any or all three of these populations. At times of heightened infectious risk, livestock and wildlife are often culled as a means of restricting their movements and limiting their interactions with other animals and humans. Indeed, culling—or ‘stamping out’—remains the major strategy used to control emergent disease events in animal populations (Johansen and Penrith, 2008). The aim of culling is to eradicate a host species, to prevent the pathogen entering and contaminating new individuals and populations. It is commonly believed that culling eliminates or reduces the size of reservoir populations, either halting or decreasing the frequency of pathogen transmission to new hosts. However, evidence as to the epidemiological efficacy and cost-effectiveness of culling as a sustainable solution to many zoonotic and epizootic risks remains inconclusive (Lederman, 2016), and both expert communities and the broader public have legitimate conservation and animal-welfare concerns. Consequently, objections to culling rest on whether the killing of animals is necessary when alternative approaches to infectious disease control could be employed.

Influential proponents state that OH approaches are ‘grounded on the concept that preventing and controlling EIDs is an international public good’ (Nuttall *et al.*, 2014: 662). Public goods may be broadly construed as the shared benefits and background conditions of a human community that enable a flourishing life. In political philosophy, and, consequently, public health policy, public goods are understood to be the strict preserve of human interests and human benefits (Coggon, 2012; Rushton, 2009). In its broadest and most inclusive explication, however, OH aims to attain optimal health for humans, non-human animals and their shared environments. Because human, animal and ecological health are explicitly linked, OH approaches could potentially justify privileging non-human interests with the presumptive aim of promoting mutual benefits to both humans and non-human animals (Capps and Lederman, 2014; Rock and Degeling, 2015). Yet, much

of the current scientific discourse and practice that describes itself as OH specifically focuses on pathogen evolution and host–pathogen relationships. While developing a detailed understanding of how hosts and pathogens change and interact is important, the ecological dimension implicit within a OH approach might require us to acknowledge that infectious pathogens are key constituents of the ecological systems in which humans and animals live together. If so, we need to learn to work *with*, rather than *against*, complex microbial environments (Hinchliffe, 2015).

In this article we critically review the ethical justifications for culling animals as a measure to control and prevent infectious disease of economic or public health concern. Using the threats posed by highly pathogenic avian influenza (HPAI) viruses as a case study, we explore whether and how culling and other current control measures might be justified as part of OH approaches to the risk of animal-borne infectious disease. Our central premise is that to be effective and ethical, OH approaches might require us to reformulate ‘health’ as a common or universal good that is necessarily shared across species boundaries. Our purpose is to further nascent discussions about the ethical dimensions of OH and to explore the implications arising from OH for public health ethics.

Killing in the Name of . . .

Policy responses to infectious diseases in animals appear to find their ethical justification in a version of John Stuart Mill’s ‘harm principle’, wherein its application usually excludes the interests of non-human animals (Meijboom *et al.*, 2009). In its broadest formulation, the harm principle holds that the only legitimate basis for interfering with an individual’s liberties and choices is to prevent non-consensual harm to others. Under this principle, harms are understood to be actions that are injurious or that set back important interests of rights-holders. Accordingly, animals that carry an infectious risk are subject to interventions to minimize and prevent harm to humans.

The simplicity of this idea is, however, deceiving. In the first instance, any judgment about harm requires a normative evaluation. Therefore a decision must first be made as to the types and magnitudes of harm that are relevant (Verweij, 2011). For example, is the presence of a mild disease in production animals that poses minimal risk to human interests sufficient to trigger depopulation measures? Secondly, because harms are seen to be the consequences of actions or omissions,

determinations on the presence of harm require a comparison between two or more alternate states. Therefore, all the relevant potential harms and benefits caused by each of the possible responses available must be weighed against each other, which, in the case of an animal-borne infectious diseases, have been mainly focused on economic evaluations and the protection of the public.

Importantly, not all set-backs are harms, and in most legal jurisdictions, rights-holders are exclusively natural people or legal entities. Domestic animals are typically property, under law, which means their owners have a greater moral claim for determining their value and the right to make most of the decisions about how they will be used. Animal welfare legislation provides some protection to animals in many jurisdictions, but their slaughter is not considered to cause them harm as long as it is conducted humanely. Conversely, the mandatory killing or culling of animals is understood to cause harms to the important interest of their owners—by restricting their choices as to how their property is used and how the benefits of ownership are realized. This is why public health-mandated culling programmes often involve some measure of compensation for the legal owners of animals. The culling of animals is intended to protect a public ‘good’, such that the health and economic well-being of the human community is prioritized over the unique interests of individuals (Dawson, 2011). While liberal approaches such as those promulgated around the harm principle are often held up as being individualistic in opposition to more communitarian ideals (Jennings, 2007), the idea of community is still central to how the harm principle is operationalized in public health. Being part of the community that benefits from a public good relies upon the active maintenance of systems, institutions and environments that sustainably maintain and promote benefits for all people. Establishing and maintaining the good for the benefit of a community becomes more important when populations are conjoined or contiguous within a shared system—such that health is shared communally (Coggon, 2012).

What is the Good of OH?

Arguments based on the public good are both prospective and instructive (Dawson, 2011). They concern the kinds of communities we want to live in; the shared interests and values important to maintaining these collectives; and, thereby, a framework through which we should seek to achieve specific types of community (understood as ways of living our lives together), and

distribute any costs and benefits. Traditional justifications for culling animals rest on balancing the interests of rights holders (i.e., animal owners in cases of culling) and those of the broader community (i.e., those humans who benefit from the public good). OH approaches—putatively predicated on maintaining and sharing health across species boundaries—invite a reconsideration of who or what should be included as subjects of a shared or common good such that it is framed around a broader set of contributors and beneficiaries. In other words, the OH approach requires us to understand health as a good we share with other species. Moving the core concerns of public health beyond consideration of only the needs and interests of human communities to include our shared dependencies and interests with animal populations and ecosystems would go some way towards incorporating OH objectives into standard public health approaches. Capps and Lederman argue that a simple way to augment such a step would be to re-conceptualize OH as being founded on a ‘universal’, rather than a public, good. They describe universal goods as:

the kinds of goods that reach beyond the needs of human communities; they describe benefits as inclusive across species, ecosystems, the environment and future generations . . . Universal goods differ from public goods in that they consider non-human animals and the environment as the recipients, as well as human beings. (Capps and Lederman, 2014: 3)

The net effect of conceptualizing health as a ‘universal good’ would be to re-articulate human health priorities with long-term issues in ecological health and environmental sustainability. Thus any OH approach would run counter to narrow liberalism in which ethical considerations are limited to negotiating conflicts between rights-holders, competing human interests and the maintenance of public goods.

Conceptualizing health as a universal good has the potential to promote radical reform. Because the health of humans, animals and ecosystems is inextricably linked, OH approaches might entail the construction and consideration of a non-human account of interests when policies are drafted and executed. While such a move could potentially drive us into endless cycles of utilitarian calculus and moral debates as to the respective value of different types of subjectivity, in its very foundations OH explicitly invites interdisciplinary and pluralistic approaches. Drawing on casuistry, the ethical dimensions of OH can be grounded in empirical cases where the focus is on the nature of the

dependency, and the distribution of harms and benefits across and between human and non-human populations (Light and McKenna, 2004; Rock and Degeling, 2015). Rather than the harm principle, judgments about the appropriateness of different responses to heightened infectious risk can be based on the consequences of individual actions for the good of the collective—assessed through their impacts on human and non-human health, biodiversity and ecosystem resilience. From this more modest position of accepting that human and non-human interests are both central to the maintenance of a universal good, and of relevance to effective infectious disease control, some key principles to guide OH interventions can be put forward without becoming embroiled in broader debates about the moral importance of animal life and the ethics of animal use. Below we illustrate some of the tensions that emerge from founding OH around a public good in relation to culling and other measures to control HPAI. We begin to explore what framing approaches to animal-borne infectious diseases around a universal good might imply for the governance and management of infectious risk.

Playing Chicken—Putting Culling in Context

There are now more than 7 billion people in the world—three times as many as 1950. Meanwhile, global poultry production has increased by a factor of 10, such that hundreds of millions of chickens are slaughtered for food each year (FAO, 2015). Increases in productivity have been achieved by an expansion of the scale of production and intensification on a per unit basis—both in stocking density and through the selection for desired genetic traits. At the same time, the vast majority of the world's rural poor keep poultry and depend on these animals to supplement their diets and to sustain their livelihoods (Oparinde and Birol, 2008). Villages in developing countries most often keep their poultry collectively as flocks of up to 100 free-range birds with minimal costs and without any measures for biosecurity. However, poultry production in developing countries in Asia is growing rapidly, and consequently becoming more diverse. Large industrial-style production units now sit alongside small backyard holdings—often in peri-urban areas (Thornton, 2010). The shift to intensive poultry production occurred earlier in Europe and North America—where demand and the industry have stabilized in the last few decades.

The emergence of H5N1 HPAI strains from Asian poultry flocks in 1997 indicates that gains in productivity from intensification have an external cost—beyond animal welfare concerns and the associated costs of heritable diseases. Between 2003 and 2013 there were 630 confirmed human cases of H5N1 HPAI resulting in 375 deaths. HPAI has attracted global media and public attention because of fear the virus may mutate into a strain capable of human-to-human transmission. Human infections with HPAI are closely linked with outbreaks in domestic poultry. The ecosystems created by large-scale poultry production are providing ideal conditions for rapid evolution and replication of low pathogenic avian influenza (LPAI) into more virulent strains of virus (Lebarbenchon *et al.*, 2010). LPAI viruses are endemic in wild waterfowl where they tend to cause mild respiratory symptoms (Peiris and Yen, 2014). In contrast, HPAI infections cause acute respiratory disease as well as broader systemic effects in susceptible animals—poultry, people and other mammals (Lebarbenchon *et al.*, 2010). Adapted to non-aquatic environments, HPAI rarely causes disease in wild bird populations because previous LPAI infection affords some protection against more virulent strains. HPAI has spread around the world through poultry production and trade systems that have failed to establish or maintain adequate levels of biosecurity. The virus has been able to circulate between wild and domestic poultry, and establish itself in new locations and settings through movements of equipment, people and produce (Karesh *et al.*, 2012). Models of HPAI population dynamics in poultry industries suggest that the persistence of the virus in domestic poultry flocks is a function of farm size, and that current production systems are increasingly configured in ways that can sustain the pathogen indefinitely (Hosseini *et al.*, 2013). Notably, proposed solutions to the persistence of HPAI in poultry production systems—such as increasing flock size in larger more biosecure installations—are primarily focused on enhancing outbreak detection and improving the time and amount of control within which infection containment and farm disinfection measures can be implemented.

Control strategies for HPAI have relied on four basic components: (i) education of those involved in poultry production, (ii) maintaining biosecurity through hygiene and disinfection along the food chain, (iii) rapid diagnostics and continual surveillance of domestic and wild poultry populations and (iv) the elimination of infected poultry through culling or 'depopulation'. Note that the first three measures are primarily

preventive, the fourth is reactive—infected or at-risk birds are culled in response to an outbreak.

Vaccines developed from LPAI strains were first introduced in 1995 as further preventive measures. Yet, even as vaccination against influenza is a mainstay of human health protection, for public health reasons it is not typically used for primary prevention in poultry. Vaccinated birds can still be infected, provide a host for virus mixing and genetic mutation, shed the virus and spread the infection to other susceptible hosts—avian, porcine or human. Mass poultry vaccination can lead to problems identifying birds that carry the virus but do not have disease, making it difficult to control the spread of the virus to other host, including people. Finally, there are technical barriers to poultry vaccine effectiveness. Because we now live in a globalized world, new influenza viruses can spread across populations and continents in ways that outpace current vaccine-making technologies (Peiris and Yen, 2014). Consequently, control programmes against HPAI have focused on eradicating the virus from poultry populations through culling.

In responding to HPAI, considerably less emphasis has been placed on evaluating the effectiveness of culling, including their impacts on industry and community (Oparinde and Birol, 2008). Killing chickens to curb influenza outbreaks has significant costs. Fifteen years after its emergence, the direct economic costs of the ongoing H5N1 HPAI outbreak—including destroying more than 250 million birds—were estimated by the World Bank (2010) at more than US\$10 billion. Moreover, the economic burden of animal-borne diseases disproportionately affects developing nations. In Vietnam alone, almost 40 million birds were culled in 2004 in an unsuccessful attempt to ‘stamp out’ H5N1 HPAI. Although many birds were owned by large commercial operations, villagers, ‘backyard’ farmers and small holders were also affected. Already struggling to maintain a livelihood through subsistence farming, the levels of support offered were insufficient to compensate for the loss of prime assets and an essential source of food security, resulting in farmer non-compliance (Alders *et al.*, 2014). As well as being dependent on the acceptability of compensations offered to producers, the effectiveness of the mass culling programmes relies upon robust and reliable disease reporting, tracing and surveillance systems—which are typically beyond the scope of developing nations (Sims, 2013). Consequently, vaccination has sometimes been added to responses to HPAI outbreaks because poultry depopulation has failed to eradicate the disease, or the need to maintain rural livelihoods and food security were a pressing concern (Swayne, 2012). Since 2004 China,

Vietnam and Indonesia have attempted to control HPAI by vaccinating all domestic flocks—with immediate positive impacts but limited long-term success. Outbreaks of HPAI still occur sporadically in many countries in South East Asia because the virus remains endemic to some poultry production systems, and continues to jump into and circulate within wild waterfowl populations.

Difficulties managing the ongoing H5N1 HPAI crisis have propelled OH approaches onto the global health agenda (Chien, 2013; Nuttall *et al.*, 2014). Under the legal umbrella provided by the International Health Regulations (WHO, 2005), the World Bank and key United Nations agencies have endorsed a ‘one World, one Health’ approach to guide their collaborative efforts to control HPAI on both local and global scales (FAO-OIE-WHO, 2010; World Bank, 2010). To reduce threats posed by HPAI strains, government agencies and industry are increasing surveillance and creating evermore biosecure production systems that remove points of contact between poultry flocks, wild birds and potential human vectors (Hinchliffe and Lavau, 2013). HPAI influenza almost always arises from LPAI subtypes H5 and H7. Thus, the emergence of LPAI viruses of these two subtypes in poultry has now become the trigger for aggressive pre-emptive culling. Yet, the threats posed by HPAI outbreaks to human and animal health remain high.

HPAI and the Public Good

Ethical reasoning can establish principles that bound what sorts of practices are acceptable or unacceptable in specific situations. A deeper engagement with ethics might not only have a profound impact on how animal disease control is executed but also how it is perceived. In as much as the normative dimensions of OH can be framed around the promotion of common or universal goods, moving beyond the preserve of human interests requires us to share the risks, burdens and goods of infectious disease control (Rock and Degeling, 2015). Interventions that seek to deliberately exclude humans from burdens or explicitly withhold benefit from non-human others, thereby, become ethically problematic. Because they are currently construed and implemented towards protecting a public good, measures for animal infectious disease control are strictly oriented around avoiding harms to humans and maximizing human benefit. Of the measures currently available to address HPAI, only poultry vaccination and the enhancement of biosecurity across global poultry industries could

conceivably confer benefit on non-humans. But for overriding prudential and economic reasons, within the current mixture of production structures neither of these measures is likely to produce the intended outcomes of offering effective control of infectious risk for all over the longer-term.

Enhanced biosecurity systems, properly maintained, could prevent the entry and circulation of influenza viruses in poultry production and thereby provide a shared benefit to human and non-human alike. Similarly, vaccinating poultry against avian influenza could potentially provide these animals with some protection, while also safeguarding the economic interests and livelihoods of their owners. However, no security system is perfect—and even if we developed a highly effective vaccine against a broad range of avian influenza viruses and could reliably inoculate wild bird populations, it is likely the costs of establishing and then maintaining herd immunity year after year would be prohibitive to maintaining a commercially sustainable poultry industry—and likely continue to leave small-holders and their communities exposed to higher levels of economic and zoonotic risk. Consequently, unless producers and the society that pays for their products remain committed to bearing the costs, the level of investment required to establish and maintain a influenza-free space for all types of poultry production would mean that any breaches to biosecurity or breakdowns in herd immunity would inevitably leave us in the same situation as our current circumstance—where aggressive and preemptive culling is, economically if not ethically, the only available infection-control strategy.

As the case of HPAI illustrates, there are clear practical and political hurdles to simply transitioning OH discourse and practice from public to universal goods. The broader the groups of entities whose interests are included as subjects of the good, the more complex and contentious calculations about interests, burdens and benefits become. In their current formulation as an approach to maintaining a public good (human health), OH approaches to HPAI still struggle to ensure the needs of small-holder farmers in developing nations are given the same priority as the public health needs of Western populations (Coker *et al.*, 2011; Liverani *et al.*, 2013).

Harms, Competing Interests and More-than-Human Communities

One of the key premises of OH is the co-dependency of human, animal and environmental health, thus requiring

collective actions to attain shared goals. The case to articulate OH around sustaining a ‘universal’ good is strong because it asserts that attention to multi-species communities and our common dependencies can promote the sorts of conditions that provide for good lives. One way we could begin to establish which shared dependencies are relevant to OH, and which harms to non-human interests conflict with the promotion of a universal good, is to distinguish between congruent, convergent and common interests. According to Angus Dawson (2011: 16), common interests are those that ‘we necessarily and irreducibly share as a group or community’. So, for example, human and non-humans both have a common interest in services (civic or ecological) that help to maintain an environment capable of providing safe and sustainable sources of food and water. If supported by some form of collective action, common interests can instantiate common goods. From this perspective, common goods are emergent properties of how the community is organized. Drawing on the work of Geoffrey Rose (1992), Dawson asserts that perturbations in how common interests are expressed—through social attitudes, food production systems or environmental protections—can have substantial population level effects. This is why the protection of common goods is often sufficient justification for mandating collective actions.

Common interests can be contrasted with congruent and convergent interests. Congruent interests are those that we share with other individuals that essentially run parallel with each other and typically require minimal collective action for their provision. They are collections of interests in the same kind of thing possessed by a large number of individuals. Thinking across species boundaries, access to sexual mates for the purposes of reproduction are congruent interests we share with other species. Congruent interests may be important and beneficial to meeting the needs of specific individuals, but are unlikely to be important for OH and the provision of universal goods because they are not based on attaining the exact same goal for the benefit of all (Postema, 1987). Whereas convergent interests are those most members of a community have in the same thing, but attaining them requires public provision. Convergent interests are broadly understood to aggregate to support public goods in that they require widespread social co-operation to create and maintain them. Except for possible examples, such as off-leash dog-walking areas in public parks and the stringent regulation of pet food to ensure it is safe for human consumption, as currently construed, convergent interests almost always aggregate into the provision of public goods in ways that exclude the needs of non-humans such as animals, plants and ecosystems. In contrast,

common goods implicitly already include non-human interests because they transcend simple aggregations and distributions of benefit in that they are indivisible—we already share common goods with non-humans and, by their nature, they are goods which cannot be shared out (Cribb, 2005).

Implicitly at least, a OH approaches require us to understand health as a common good we share with other species. If OH requires us to value and account for non-human interests, then the common goods entailed by promoting flourishing and sustainable multi-species communities and inter-species health protection, could plausibly be described as a universal good. However, articulating OH around meeting common human and non-human interests will still require some of the trade-offs in harms and benefits described previously. Therefore, the degree to which something like preventing outbreaks of HPAI promotes health as a universal good depends on the extent to which the burdens and benefits are shared across species boundaries. Primary vaccination of all poultry could conceivably promote health as a universal good, but humans will have to bear a larger proportion of the burden of the risks to health posed by HPAI outbreaks.

Re-configuring OH to Address Structural Disadvantage

So far we have limited discussion to what OH can achieve within the structure of existing production systems that remain articulated around contaminationist models of infectious disease control. From this it would seem that remaining wedded to the more limited anthropocentric frame of public goods will prescribe policies and practices that are not significantly different from traditional existing public health approaches to animal-borne infectious disease. Conversely, a more inclusive and locally embedded approach to the provision of universal goods might support policies and practices for economically important endemic animal diseases and zoonotic risks that explicitly seek to co-promote human and non-human benefits. These include approaches that seek to address the risks of HPAI further upstream—by seeking to modify more distal rather than proximal causes of disease emergence. OH approaches that are more structurally oriented—and treat infectious disease risk as a problem of configuration rather than contamination—necessarily entail that decisions are not simply justified on the basis of immediate factors that impact on the lives of the animals,

people and communities at risk from HPAI outbreaks, but also the way in which the structures that underpin society determine how people and animals live within economic and ecological systems (Wallace *et al.*, 2015).

According to the FAO (2011), HPAI has become endemic in countries with complex and unmanaged poultry production chains, poor veterinary services and a lack of political will to respond to the threat. Yet, the failure of current measures for controlling HPAI to reliably confer benefit to both humans and non-humans points to deeper structural issues with current poultry production systems. Current approaches to infectious disease control at the human-animal interface are strongly oriented towards addressing contamination—interventions focused on controlling the transfer of pathogens between susceptible hosts (Scoones and Forster, 2008). The central justification for culling domestic poultry with influenza is their potential to amplify and transmit the virus to other parts of the system, and, potentially, promote the risk of it infecting and spreading in human populations. This focus on contamination inevitably detracts from alternative approaches that seek to address the social and material configurations that promote disease emergence and expression. From the configuration perspective, the focus is not on the pathogen, but on the contexts, structures and power relationships that make the disease a social, economic and medical problem (Hinchliffe, 2015). Rather than concentrating on microbial action, configurationist models emphasize how the multiple relationships between humans, animals and their natural and social contexts can either promote or inhibit the pathogenesis of disease (Rosenberg, 1992; Hooker *et al.*, 2016).

In the case of HPAI, management systems focused on preventing microbial contamination create and sustain further conflicts of interest, as increased level of surveillance for new influenza strains in poultry do not provide any net benefit to the poultry industry. Finding evidence of a new infectious threat to humans is almost always followed by major negative social and economic consequences for poultry producers and their communities (Peiris and Yen, 2014). The production system and market that promote disease emergence and expression are structured to offset the burdens onto non-humans and disadvantaged people remains beyond the scope of inquiry (Wallace *et al.*, 2015). Small stakeholders in developing nations are blamed for exacerbating the risk even though it is becoming increasingly clear that traditional village-based modes of poultry production are safer than intensive systems operating with imperfect biosecurity (Alders *et al.*, 2014). Yet, intensive systems that produce the risks of HPAI are treated as a natural state,

and, therefore, beyond the scope of reform. The current configuration that emphasizes controlling LPAI and HPAI contamination in poultry production actually inhibits the development of alternative solutions (Forster, 2014).

A more structurally focused OH approach based on the protection and maintenance of health as a universal good will still entail selectivity. Because instantiations of universal goods in different contexts will be complex and heterogeneous, the first steps towards a set of guiding ethical principles for OH could be to create an ethical preference for interventions that do not withhold but seek to promote non-human benefit. In this context, it is also important to emphasize that consequentialist and liberal approaches such as the harm principle are not the only ethical theories that can be based around a substantive notion of the good (Dawson, 2011). Capability-based and relational approaches—with their commitment to flourishing—also seek to promote conditions for health and a good life and could meaningfully extend to more-than-human concerns (Haraway, 2008; Nussbaum, 2007).

Concluding Remarks

Traditional public health measures for animal-borne diseases such as culling discount the interests of animals. OH could potentially replace standard public health strategies, as it provides evidence-based grounds to extend ethical consideration to public health and economic decision-making processes beyond protecting short-term human interests. There are significant differences between OH policies and practices that remain wedded to only protecting public goods and those that also seek to promote, rather than withhold, benefit for non-humans. To be both ethical and effective, OH approaches might require us to understand health as a universal good that is necessarily shared between species (Capps and Lederman, 2015). Inconsistencies and ambiguities in the values underpinning stated OH objectives and currently accepted infection control practices invite a reconsideration of how we use and interact with other species—and any obligations that should follow from our actions.

In this article we have argued that orienting OH towards sustaining health as a universal good requires us to seek to balance harms and benefits across more-than-human collectives. We acknowledge that some harm to non-humans is unavoidable (as is some harm to humans, such as quarantines and other coercive measures), but these should be attenuated with consideration of our dependency on non-human life by seeking to

meet relevant sets of common human and non-human interests. Under these conditions, infection control measures applied to animals are arguably unethical if they are motivated by short-term, partisan (human) gains rather than being directed towards the long-term overall reduction of harm by configuring food and agricultural practices around multispecies collectives that sustain effective infectious disease management. Further work on the relevance and ethical significance of ‘shared benefit’ approaches (Johnson and Degeling, 2012, Capps and Lederman, 2015) and other putative public health principles and values such as solidarity, reciprocity and transparency to OH is needed (Rock and Degeling, 2015). As the case of HPAI illustrates, applying these principles may require a fundamental reconfiguration of how we understand and approach the promotion of interspecies health.

For OH approaches to live up to the rhetoric of elevating the importance of the health of non-humans and our shared dependency on healthy ecosystems, greater emphasis must be given to configuration perspectives in research, policy and practice. In practical terms, what this means is that OH is likely to require us to work *with*, rather than *against*, complex microbial environments. As Hinchliffe and Ward (2014) point out, this means embracing and adapting to the heterogeneity of sharing our lives with non-human others, and directing them towards a common cause of making life ‘safe’. This is best achieved through promoting local practices and environments in which immunity and community enfold one another to create conditions that allow the attainment of health by most, if not all, of the members of the collective. This new approach departs from reductive causal accounts wherein our connection with other species is seen as a source of threats and from intervention hierarchies that only ask whether the benefits to individuals outweigh the costs. Rather, this emerging approach requires a communitarian moral ecology that prioritizes ways to sustain interspecies communities.

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