# Considerations for an ethic of One Health

Towards a socially responsible zoonotic disease control

Joost van Herten

**Propositions**

1. A holistic interpretation of the One Health concept will ultimately promote human health more than the current anthropocentric conception.
   *(this thesis)*

2. Zoonotic disease control measures that are harmful for animals or ecosystems can only be ethically justified if underlying drivers of these diseases are addressed as well.
   *(this thesis)*

3. The political decree to transfer the decision-making power in zoonotic disease control to the ministry of Health is a potential risk for animal health and -welfare.

4. Vaccines to stop a pandemic are a global public good and must be excluded from intellectual property protection.

5. The regulation of the veterinary profession in The Netherlands is insufficiently coherent and hence not adequate to secure the quality of veterinary practice.

6. The blame culture in politics prevents democratic institutions to learn from their mistakes.

Propositions belonging to the thesis entitled

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## *Towards a socially responsible zoonotic disease control*

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# Preface

**From disease X to patient zero**

Until recently, 'disease X' was predominately known as a theoretic example of a zoonotic disease that could potentially cause the next pandemic. Zoonotic diseases are defined as diseases or infections that are naturally transmissible from vertebrate animals to humans (World Health Organization 2020). The involved pathogen is mostly a bacterium, a virus or some kind of parasite. Zoonotic diseases can spread to humans via direct contact with animals, but also through food, water or the environment. Normally, the World Health Organization (WHO) uses the description 'disease X' to close their list of most virulent infectious diseases that circulate the globe (World Health Organization 2018). According to the WHO, diseases on this list should have priority in research and development activities. They are considered extremely dangerous for human health and often lack treatment or a vaccine. In this respect, 'disease X' represents the awareness that a serious international epidemic could be caused by a zoonotic pathogen currently unknown to cause human disease.

In 2019 this 'disease X' turned out to be a corona virus, labelled corona virus disease 2019 or COVID-19. It was not any of the known viruses on the WHO-list, like the Marburg virus, Ebola or Rift Valley fever. No, it was a new type of coronavirus called SARS-CoV2, that was identified as the source of a cluster of cases of 'viral pneumonia' in Wuhan, a city in the People's Republic of China. The first human patient starting an epidemic is usually indicated as 'patient zero'. To date, the exact origin and location of the first animal-human transmission is not univocally identified (World Health Organization 2021). Patient zero is still unknown. However, there are strong indications the virus originated in horse shoe bats (Boni 2020). Transmission to humans could have taken place directly or indirectly, with the help of an intermediate host like a pangolin (Burki 2020). Both bats and pangolins are traded on so-called 'wet markets', places where fresh meat, fish and other perishable food is sold. It is therefore assumed that 'patient zero' was perhaps infected on such a wet market in Wuhan. For a corona virus, like SARS-CoV2 it might be a small step from 'disease X' to 'patient zero'. The implications for mankind were immense.

It may seem that COVID-19 has taken the world by surprise. But scientists have warned us for years that the number of infectious disease outbreaks had increased significantly over time (Jones et al. 2008). Since the start of the new millennium the world is confronted with outbreaks of SARS (2002), H1N1 influenza (2009), MERS (2012), Ebola (2014) and Zika (2015). All of these diseases are zoonotic by origin. In 2019, scientists predicted that it was highly likely that future SARS- or MERS-like coronavirus outbreaks would originate from bats. Moreover, they argued that there was an increased probability that this would occur in China (Fan et al. 2019). Until COVID-19, however, the consequences of these disease outbreaks were mostly suffered locally or regionally, providing the rest of the world the opportunity to more or less watch and wait, till it passed by. And even while COVID-19 was causing serious problems in China since the end of 2019, it took the Western world until the spring of 2020 before authorities fully realized the impact of the COVID-19 pandemic.

Despite the warnings of scientists, many people underestimated the effect of globalisation and the concurrent worldwide traffic of humans, animals and food or products of animal origin on the spread of zoonotic diseases like COVID-19.

One of the reasons for this is perhaps human hubris. Since the invention of antibiotics and vaccines, it appeared that most infectious diseases were no longer a threat to public health. After the Second World War the United Nations founded their World Health Organization and many successes in the combat against infectious diseases followed. Their campaigns against diseases like tuberculosis and malaria reduced the worldwide number of deaths dramatically. Moreover, in 1979 smallpox was the first infectious disease that was eradicated with a vaccination program. This caused many scientists, governments and health authorities to believe that infectious diseases, like zoonoses, were largely under control. As we know now, this belief was false.

CHAPTER 1

# General Introduction

If COVID-19 has taught us one thing, it is that zoonotic diseases are one of the great challenges to global public health. That is why governments and health authorities strive to prevent and manage these infectious diseases, which are transmitted from animals to humans, and their public health, social and economic impacts. Some important zoonotic diseases such Q-fever, brucellosis, zoonotic influenza or multiresistant bacteria can originate in livestock. Protection against these diseases then also affects food production. Societal debates about these issues often focus on the easily polarised conflict between safeguarding public health versus serving the interests of agriculture and livestock farming. Although this conflict cannot be ignored, such a conceptualization obscures other dimensions of zoonotic disease control. Other values and actors are at stake as well. Think of values such as animal welfare and integrity, sustainability, biodiversity or other environmental values and actors such as consumers, food producers, and NGO's. Moreover, a highly polarized debate may create obstacles to finding policies that are reasonable and fair to all stakeholders.

At present, the One Health approach is believed to be the worldwide standard to combat zoonotic diseases (OIE 2021). This strategy aims to expand interdisciplinary collaboration and communication in all aspects of health care for people, animals and the environment (Zinsstag et al. 2012). However, it is not self-evident that the common interpretation of the One Health concept is also in the interest of animals or the environment (Verweij and Bovenkerk 2016). During the Q-fever outbreak that struck the Netherlands from 2007-2012 the Dutch government decided to cull 50.000 pregnant goats to stop the disease, that until then infected 4000 people and caused the death of 95 persons. It was suggested that economic interests, privacy issues and scientific uncertainty prevented a quick and effective response to control the disease (Van Dijk et al. 2010). Furthermore, to combat antimicrobial resistance the Dutch government launched strict policies to reduce the use of antibiotics in animal husbandry by 70%. Veterinarians as well as farmers addressed the risk that these policies could seriously compromise animal welfare. On this issue the Dutch Council on Animal Affairs stated: "the wish to achieve major reduction in antibiotic use in animal husbandry should never lead to the attitude that higher disease incidence and mortality are acceptable"(Council on Animal Affairs 2016a).

The Q-fever outbreak in the Netherlands revealed that zoonotic disease control can lead to ethical questions. Not only because conflicts of interest can arise between human centered values like public health and economy. When the One Health concept is at the basis of zoonotic disease control, the question arises whether animal and environmental interests are as important. If we understand One Health as a call to promote the health of humans as well as the health of animals and the environment, many current practices of zoonotic disease control are morally problematic. Within a holistic One Health approach it is difficult to accept policies, that lead to culling of healthy animals, for economic reasons. The same goes for long term confinement of free range poultry, whose housing systems are often not suitable for this purpose, in order to prevent avian influenza outbreaks. In general, high density of livestock within close distance to populated areas imposes a risk for zoonotic disease transmission and other human health risks, such as fine particle emissions (National Institute for Public Health and the Environment 2017). Besides the risks to human health, due to ammonia emission and manure deposition animal husbandry

can have a negative effect on ecosystems too. Again, from a One Health perspective this sparks discussions about the role of intensive animal husbandry as a driver of zoonotic diseases. How do we articulate and weigh such competing values and interests? These ethical questions are the start of this thesis, which aims to develop an ethic of One Health in the context of zoonotic disease control.

In combating zoonotic diseases to prevent possible harm to public health, policymakers are confronted with scientific uncertainties and often invoke the precautionary principle to justify (sometimes drastic) disease control measures. The precautionary principle is a strategy to manage risks in situations where there is scientific uncertainty about possible danger or damage to human health and the environment. An appeal to the precautionary principle however, does not automatically entail that all precautionary actions are morally justified. In bioethics it is argued that there are certain constrains like consistency, avoiding counter productivity and proportionality (Kramer, Zaaijer, and Verweij 2017). In this thesis I will analyse the use of the precautionary principle in zoonotic disease control and formulate recommendations for its application.

Another issue I will explore in this thesis is the fact that the rise of certain zoonotic diseases and corresponding control measures are the result of our own (morally problematic) way of living. The growth of the human population and the massive impact of easy mobility, food production and consumption on our natural environment and climate are creating an immense pressure on the viability of (eco)systems in which human and non-human life can flourish. Emerging infectious diseases, natural species that go extinct, climate change, soil degradation and antimicrobial resistance are only some of the most visible effects of these processes (Verweij and Bovenkerk 2016). This raises the question to what extent it is justifiable to take zoonotic disease control measures which seriously affect the health of animals and the environment, to resolve negative consequences of human actions.

From the ideal perspective of animal and environmental ethics, to combat zoonotic diseases would imply a drastic global restriction of animal husbandry and consumption of animal protein. However, in the near future this scenario is not very likely. It seems that what ethical theories demand from us in these situations is sometimes too far removed from everyday reality and therefore often ineffective. An objective of this research is to look for possibilities to overcome the risk of ineffectiveness of ideal ethical theories in our non-ideal world when addressing moral dilemmas in zoonotic disease control.

In summary, the purpose of my research is to examine and elaborate the moral dilemmas of a One Health approach in zoonotic disease control. My main objectives are: 1) to clarify the ethical assumptions of a One Health approach in zoonotic disease control, 2) to explore how these can be coherently understood and justified and 3) to indicate what this implies for policymaking. This research contributes to the development of an ethic of One Health and is related to the interdisciplinary Wageningen UR strategic research theme 'Global One Health'.

## 1.1 The idea of One Health

The emergence of several serious zoonotic disease outbreaks at the beginning of this millennium, fueled a renewed interest in the relation between human health, the health of animals and our environment. The awareness that human health is inextricably connected with the health of animals and ecosystems, led to the understanding that interdisciplinary cooperation is indispensable to combat (re)emerging zoonotic diseases. In 2004 the Wildlife Conservation Society (WCS) organized a conference to address the emergence of new infectious diseases in relation to wildlife and ecology. To establish a more holistic approach in preventing these diseases, at the end of this meeting the WCS introduced 12 recommendations under the term 'One World-One Health' (Wildlife Conservation Society 2004). A few years later the American Veterinary Medical Association defined the term 'One Health' as: "the integrative effort of multiple disciplines working locally, nationally, and globally to attain optimal health for people, animals, and the environment" (American Veterinary Medical Association 2008). This was the start of a broad range of initiatives in science and policymaking, covering the implications of One Health for health issues at the human-animal-environment interface. Since 2004, the number of scientific publications under the heading of One Health shows a steep rise (Cassidy 2016). At first, this scientific attention was mainly reflected within veterinary science but gradually in medical, ecological and social sciences, researchers embraced the concept too. On an institutional level the WHO, the Food and Agricultural Organization of the United Nations (FAO) and the World Organization for Animal Health (OIE -Office International des Epizooties), joined in a tripartite declaration to improve international collaboration and coordination of global activities to address health risks at the human-animal-ecosystem interface (WHO, OIE, and FAO 2010). Nowadays, while the COVID-19 pandemic plagues the world, One Health has reached the level of common understanding and has become a logical paradigm for contemporary health policies.

However, the basic idea behind the concept of One Health is of course not new. The interdependence between humans and animals together with respect for land and water, which are the foundation of One Health, are an intrinsic part of the culture and spiritual beliefs of many ancient civilisations (Evans and Leighton 2014). At least since Neolithic times, when humans started to domesticate animals for food and other purposes, zoonotic pathogens jump the species border and cause diseases. Ancient physicians, like Hippocrates (460 BCE–367 BCE), already recognized the importance of a clean environment to the benefit of public health. Later in history, the German physician and pathologist Rudolf Virchow (1821–1902) famously stated that: "between animal and human medicines there are no dividing lines – nor should there be. The object is different but the experience obtained constitutes the basis of all medicine" (Natterson-Horowitz and Bowers 2012). Virchow as well as Osler (1849–1919) can be identified as founding fathers of what is called 'comparative medicine'. The recognition that many diseases in humans and animals have a comparable pathogenesis has led to improvement of diagnostics and treatment methods in both ways. Besides zoonotic disease control, 'comparative medicine' is one of the fields where human and veterinary medicine have proven to be mutually reinforcing. Building on these views, James Steele (1913-2013) and Calvin Schwabe (1927–2006) further promoted veterinary public health and emphasized the importance of veterinary

medicine in relation to food safety and the quality of environmental conditions. Schwabe coined the term 'One Medicine' stating that: "the practice of veterinary medicine was directly related to man's well-being in a number of ways" (Schwabe 1964). Steel was inter alia responsible for the founding of the Center for Disease Control and Prevention in the United States in 1917, where he launched mass vaccination campaigns and prevention programs for zoonotic diseases like rabies and bovine brucellosis. Since the beginning of the 21th century it is broadly recognized that ecological processes and environmental factors are key determinants of human and animal health (Evans and Leighton 2014). This implies that besides human and veterinary medicine, collaboration with other disciplines, like ecology, is essential to pursue the goal of One Health, which is to promote the health of humans, animals and the environment.

Although the most prominent aspect of One Health is perhaps zoonotic disease control, the concept is currently applied in a much broader sense. For instance, the shared combat against antimicrobial resistance is also seen as a One Health effort. Since the use of antimicrobials naturally stimulates the emergence of resistant bacterial strains, there is a risk of transmission of these resistant bacteria or their resistance genes, from animals to humans. In this and many other contexts, One Health bears the risk of becoming an anthropocentric concept in which human health is central and animals and the environment are considered as risk factors. Meijboom and Nieuwland (2017) have pointed out that this is too narrow a conception of One Health.

Besides the possible negative impact of animals on human health by transmitting zoonotic diseases or antimicrobial resistance, there are also positive effects that can be attributed to human-animal interactions. Examples of this are animal assisted interventions, such as guide dogs, or the positive effect that companion animals can have on the physical and mental health of their owners[1]. The latter was, for instance, apparent during the lockdown phase of the COVID-19 pandemic (Ratschen et al. 2020). In this respect, it needs to be said that in general the effects of these practices on animal health or -welfare receive much less attention. The same applies to comparative medicine and animal testing, where laboratory animals are predominantly used to benefit human health. On the other hand, the core principles of the One Health concept can stimulate ethical debate on creating mutual benefits and the search for alternative practices that could accommodate human- as well as animal- and environmental health.

## 1.2 The practice of zoonotic disease control

As said, the call for One Health thinking is most prominent in zoonotic disease control. Zoonotic diseases occur in livestock, horses, companion animals and wildlife. In the case of livestock, zoonotic pathogens can be transferred through direct contact but more often by consumption of contaminated products like milk, eggs or meat. Examples of these alimentary or foodborne zoonoses are salmonellosis and listeriosis, both caused by

1 In animal ethics it is nowadays more accepted to speak of animal caretakers than of animal owners. However, because in veterinary medicine and in law and policy the use of the term animal owners is still broadly used, I choose to use the latter term in the rest of this thesis.

bacteria, and commonly referred to as food poisoning. Besides that, we also distinguish non-alimentary zoonoses. These diseases have a different route of infection and often spread through aerogenic transmission. Examples in this category are Q-fever, psittacosis (Parrot fever) and COVID-19. Depending on the nature of the pathogen, animals that transmit these zoonotic diseases to humans show few or many clinical symptoms. Sometimes animals are only carriers of such diseases and do not suffer any illness themselves.

Because of the risk for human health, zoonotic diseases are often notifiable. This implies that animal owners, veterinarians and laboratories have a legal obligation to report any clinical signs or a confirmed diagnosis to the responsible authorities. In many cases, zoonotic diseases must be combated according to official regulations. The status of zoonotic diseases and the subsequent mandatory disease control measures are dependent on several factors. These include inter alia: the speed of disease spread, the difficulty of disease control and the impact on public health and economy. Zoonotic disease control is often regulated in international regulations, issued by the European Union or the OIE. When a notifiable zoonotic disease is reported and confirmed in animals, a competent authority, like the Ministry of Agriculture, Nature and Food Safety, will issue the disease control measures as prescribed. In the Netherlands, the Dutch Food Safety Authority is subsequently responsible for the implementation of these disease control measures.

Disease control policies are often described in national roadmaps based on national and international regulations. The arsenal of disease control measures is comprehensive and consists of various interventions, like:

- Declaration of a (national, regional or local) stand still period, when it is prohibited to transport animals or animal products;
- Designation of locations where the disease is present and placement of warning signs;
- Isolation and confinement infected or suspected animals;
- Strengthening biosecurity levels on animal locations;
- Testing of suspected animals;
- Culling of infected animals and/or preventive culling of animals suspected of an infection;
- Defusing the culled animals, products of animal origin or other objects;
- Decontamination of animal enclosures;
- Vaccination of (healthy) animals;
- Banning of animal breeding (for example in the case of Q-fever).

Since the start of the COVID-19 pandemic, we have seen that some of these measures are also applied to control infections between humans. However, there are important differences as well. Obviously, measures like (preventive) culling or breeding restrictions are excluded from public health policies. But there are more variations, that are perhaps not so apparent. For instance, in the case of vaccine use. Although vaccination is allowed as a disease control measure for certain animal diseases, in many cases the use is limited because of the economic consequences. Despite of EU arrangements, member states and third countries are inclined to refuse products of vaccinated animals because they

are afraid to import the disease. Even though with modern vaccines it is possible to differentiate between vaccinated and infected animals, the use of vaccination to control an outbreak of a notifiable animal diseases is limited. Currently, in many cases culling strategies are still seen as a more effective and faster method to regain an OIE disease-free status.

Another difference between veterinary and human infectious disease control is that the political mandate is assigned to different ministries. Where in case of animal disease the Dutch ministry of Agriculture, Nature and Food safety is normally in charge, human infectious diseases are controlled by the ministry of Health. The implementation of the actual disease control is also separate. The Food Safety Authority is responsible for the control of animal diseases. In case of an outbreak of a human infection disease, the (regional) Public Health Service is the designated authority. In the Netherlands, this dual system led to public and political debate during the Q-fever outbreak between 2007-2012 because it hampered decision making and implementation of necessary measures. At the basis of this problem was a conflict of interest between public health and agricultural economics (Haalboom 2017).

## 1.3 One Health and moral status

In thinking about the moral dilemmas that originate from a One Health approach in zoonotic disease control, several ethical approaches converge. An important premise for such ethical reflection is that animals and ecosystems have a certain moral status. Without attributing these entities moral status there would be no conflict of interests and the central value would always be human health. In a completely anthropocentric account of One Health, animal and environmental health would merely be instrumental. The substantiation of a holistic account of the One Health concept, in which animals and ecosystems have an intrinsic value apart from the instrumental value to humans, requires the involvement of different disciplines in bioethics (Verweij and Bovenkerk 2016). Combining public health ethics, animal ethics and environmental ethics can be fruitful and challenging at the same time. Traditionally, animal ethics is more focused on the individual animal, whereas public health ethics is more concerned with the collective aspect of health and environmental ethics revolves around the integrity of populations and ecosystems. By integrating these different ethical approaches and their key concepts, I will try to underpin an ethic of One Health.

In this respect, the first question that needs to be answered is: what gives animals moral status? Why do we have to take their interests into account? And what does this imply for our moral duties toward them? These important questions are all addressed in animal ethics. In this field, three main approaches can be distinguished: a utilitarian, a deontological and a relational theory. The concept of moral status is the starting point of all these theories. Warren defined moral status as follows: "to have moral status is to be an entity towards which moral agents have, or can have, moral obligations. If an entity has moral status, then we may not treat it just in any way we please; we are morally obliged to give weight in our deliberations to its needs, interests or wellbeing. Furthermore, we

are obliged to do this not merely because protecting it may benefit ourselves or other persons, but because its needs have moral importance in their own right" (Warren 2000).

Animal ethical theories often start off with a justification of the moral status of animals. They do so by pointing out that there are no relevant moral differences between humans and animals, which could justify the exclusion of animals from our moral deliberation. Animal ethicists often refer to animal ethology and biology, which have taught us that with regard to specific characteristics, such as rationality, self-awareness, language and emotions, differences between animals and humans are merely gradual. The utilitarian perspective in animal ethics emerged from the philosophy of Jeremy Bentham (1748-1832), who stated that regarding our moral obligations towards animals: " The question is not "Can they reason?" nor, "Can they talk?" but rather, "Can they suffer?".

Building on these famous words, Peter Singer introduced the concept of sentience which can be defined as the capacity to experience pain and pleasure (Singer 1975). Singer advocated that not rationality or language should be marked as a touchstone for moral status, but sentience. Therefore, all sentient living beings should be part of our moral considerations. In his utilitarian approach, that prescribes actions that maximize wellbeing for all morally relevant beings, Singer promotes that in like cases all sentient beings should be treated alike. If not, this would be a sign of speciesism, which Singer compares to racism or sexism.

A deontological view on the moral status of animals is provided by Tom Regan (1983). Regan argues that all beings that are a "subject-of-a-life" have an inherent value which should be respected. This implies that when living beings have inter alia: beliefs and desires, preferences, a sense of the future, emotions and the ability to initiate action, they are subject-of-a-life. In short, when their lives can be better or worse, then we should attribute these beings moral status. Because this definition would expand the moral domain enormously and could lead to overdemanding moral obligations, Regan proposed to at least include all mammals over a year of age. However, he realized that future scientific evidence on mental capacities of animals could lead to widening te moral circle. The philosophy of Regan is regarded as a rights -based approach in animal ethics. Being a subject-of-a-life with inherent value implies having certain rights, such as a right not to suffer or even a right to live.

According to Clare Palmer, these two ethical approaches lack important and morally relevant aspects like context and relations (Palmer 2010). Palmer acknowledges that sentience is a basic aspect of moral status, but indicates that our relations with animals differ and that these relations determine our moral obligations towards them. For instance, our commitments towards domesticated animals are different from our obligations towards animals in the wild. This is due to the fact that the process of domestication has made them dependent on us. We therefore have positive duties regarding all domesticated animals under our direct care. On the other hand, with regard to wild animals, we rather have a negative duty not to interfere. This distinction is not always a sharp as it seems. Especially, since we have entered the Anthropocene, more and more wild animals have become affected by human action. For instance, in the case of polar bears whose natural

habitat is destroyed by anthropogenic climate change. In this respect, we can also have positive duties to wild animals (Palmer 2010).

A holistic conception of One Health is a call to cooperate to promote the health of humans, animals and the environment. Humans and animals are all part of ecosystems that constitute our living and non-living environment. Of course, environmental health is essential for human and animal health. But should we promote the health of ecosystems just because of their importance for human and animal health? Or does the One Health concept require that we should promote environmental health for its own sake too? Environmental ethics studies these ethical relations between humans and our environment. Philosophers within this discipline examine questions such as what are our moral obligations towards ecosystems and why? Aldo Leopold, for instance, argued that an action is morally right when it tends to preserve the integrity, stability, and beauty of the biotic community (Leopold and Schwartz 1949) . Although Leopold's land ethic stretches our moral obligations beyond human self-interest and even beyond the interests of individual living beings, what exactly construes the intrinsic value of ecosystems remains under debate. Many people intuitively appreciate and recognize the value of nature as a whole. In some world views, ancient cultures and religions, plants, trees or forests are considered sacred and hence must be respected. However, it is difficult to imagine how this leads to direct moral obligations that transcend interests of living beings. The philosophical debate about the moral status of ecosystems or even non-living entities like mountains or rivers is ongoing. Some scholars advocate moral status for nature or ecosystems (Rolston 1988, Johnson 1992) others oppose such a view (Regan 1983, Nolt 2006).

To date there is no knock-down argument that justifies our direct moral obligations towards ecosystems[2]. I hold that humans as well as sentient animals have moral standing. Whether the environment has some kind of intrinsic value and for this reason should be included in our moral community, might be an issue that cannot be decided. Opposite views on this matter are often founded on different world views. Therefore, a fundamental philosophical debate on this topic aiming at a univocal answer, will probably not solve this issue. Moreover, attributing ecosystems a separate moral status will not make ethical decision making in zoonotic disease control easier. Nevertheless, healthy ecosystems are a necessary precondition for all life on earth and if we consider their moral value primarily as instrumental, we still have to acknowledge it is so in a very fundamental way. This why I think that humans do have a moral duty to preserve environmental health, not only for present life on earth, but also with respect to future generations (of humans and animals).

Therefore, to speak of ethical decision-making in zoonotic disease control, we have to take the interests of humans, animals and ecosystems into account. Particularly in zoonotic disease control, it is not hard to envision that conflicts between human and animal interests easily arise. For instance, it might be necessary to cull certain animals to protect human health. In the case of COVID-19, several countries in Europe and in the United States culled mink on infected farms to prevent zoonotic transmission. In that particular

2 In chapter 6, I will elaborate a few arguments from the ongoing debate about moral status of collectives like species or ecosystems.

situation, health authorities considered the interest of human health more important than the interests to life of the mink. In an anthropocentric conception of One Health, human health will always be the trumping value. However, if we adhere to a holistic conception of One Health, it is not so obvious that human health should always prevail. The ethic of One Health that I examine, aims to provide guidelines to deal with these conflicts of interest.

Zoonotic disease control is primarily directed at preventing zoonotic infectious diseases from spreading. In the acute phase of a pandemic, like COVID-19, all forces are applied to stop the disease and to protect human health. Although this strategy is understandable and justifiable, it distracts attention from the actual drivers of most zoonotic diseases. Zoonotic disease outbreaks are often triggered by human actions (Jones et al. 2008). Apart from ethical decision-making in zoonotic disease control, the One Health concept offers opportunities to address these issues as well. I will explore how this prescriptive aspect of the One Health can stimulate a paradigm shift from short term or ad hoc actions to stop actual disease outbreaks towards a fundamental preventive strategy for zoonotic disease. Within the field of bioethics there is a lengthy debate about the application of 'high' philosophical theories (like consequentialism, Kantian deontology or virtue ethics) to resolve practical bioethical problems, like the moral justification of zoonotic disease control measures. The problem is that in case of moral conflicts there often is no consensus on which 'high' theory - if any - should prevail. This is problematic because of the (often pressing) nature of bioethical issues.

My own theoretical starting point is moral pluralism. Moral pluralism is the view that in societies moral values, norms, ideals, duties and virtues are irreducibly diverse. Morality serves many purposes relating to a wide range of human interests and it is therefore unlikely that a theory unified around a single moral consideration will account for all the resulting values. Unlike relativism, however, moral pluralism holds that there are rational constraints on what can count as a moral value (Weinstock 1998). Moral relativism entails there is no objective moral standard to what is right and wrong. Moral values are relative to a person's individual and cultural background or to certain circumstances. Moral pluralism acknowledges there is not one single good or an overarching moral principle and that there can be conflicts in values. This means that it is possible that there are several 'right' but conflicting answers to moral questions. But, contrary to relativism, moral pluralism holds that there can be 'wrong' answers to moral questions and it strives to make reasonable choices between conflicting moral values and to be action guiding in moral dilemmas.

## 1.4 Veterinary responsibilities and professional ethics

Veterinarians are in the frontline of zoonotic disease control. Society and government regard veterinarians as gatekeepers of public health. They obviously have an important role in early detection and control of zoonotic diseases. In this perspective, an effective cooperation with other health professionals is essential to combat emerging infectious diseases that spread from (domesticated) animals to humans. Therefore, the veterinary profession was an early adapter of the One Health concept (Gibbs 2014).

However, veterinarians have to serve many masters. For them, public health is certainly not the only concern. The veterinary profession has a responsibility for other public values too, like animal health and -welfare. Furthermore, veterinarians have to take into account the interests of animal owners. In this respect, veterinarians are also service providers, who are financially dependent on their clients. Moreover, many veterinarians work in corporate private enterprises, which have an economic interest of their own. In zoonotic disease control from a One Health perspective, veterinarians sometimes are confronted with counterintuitive situations. For example, when they are forced to cull healthy animals to protect public health. This raises questions about how veterinarians deal with all these, sometimes conflicting, responsibilities.

Veterinary medicine is regarded as a 'liberal profession'. According to Carr (1999), such professions can be characterized by the following criteria: 1) they provide an important public service; 2) they involve a theoretically as well as practically grounded expertise; 3) they have a distinct ethical dimension which calls for expression in a code of practice; 4) they require organization and regulation for purposes of recruitment and discipline and 5) professional practitioners require a high degree of individual autonomy or independence of judgement, for effective practice.

In order to protect public values, such as on the one hand animal health and -welfare and on the other public health and food safety, society has granted veterinarians with the unique right to practice veterinary medicine. However, the complexity of veterinary medicine has increased over the last decennia. Notwithstanding a wide range of views on our relation with animals and the environment, there is undeniably a shift in the moral status society attributes to animals. At the same time, there are serious concerns about the ecological pressure of animal husbandry on ecosystems. Because the central position of the veterinary profession and its connection with all these areas of policy, society expects veterinarians to play their role as animals' advocate as well as safekeeper of public health. Such societal expectations lead to an expanding set of responsibilities for the veterinary profession (Meijboom 2018). Especially for individual veterinarians this can be overdemanding, because often they are not fully in control of the circumstances that create the need for veterinary interventions. Professional ethics can help to guide professional conduct and support veterinarians in making difficult ethical decisions. As part of my thesis, I will therefore elaborate the professional responsibilities of veterinarians within the One Health framework.

## 1.5 Thesis outline

My aim is to clarify ethical concepts and moral arguments related to the concept of One Health in the context of zoonotic disease control. This thesis is a philosophical reflection in which I, inter alia, make use of empirical data from semi-structured interviews with health professionals. I combine these findings with moral theory to reach normative conclusions with respect to the social practice of zoonotic disease control. The theoretical moral concepts applied in this research are derived from traditional theories within animal and public health ethics. During my research, I assess relevant facts and moral values and

balance them against ethical theory and principles. I examine conceptual and theoretical resources in order to analyse moral dilemmas and to make policy recommendations for a socially responsible zoonotic disease control.

Within this kind of philosophical research a normative empirical form of the reflective equilibrium (RE) is often used as a method for moral justification (Van Thiel and Van Delden 2010). Such an reflective equilibrium consists in working back and forth among our considered judgments about particular instances or cases, the principles or rules that we believe govern them, and the theoretical considerations in order to achieve an acceptable coherence among them (cf. Daniels 2020). The use of empirical data to interpret and evaluate the morality of a social practice is called integrated empirical ethics (Molewijk 2004). Integrated empirical ethics rejects the belief that there is a fundamental distinction between descriptive and prescriptive science, but considers empirical research and normative theory mutually constitutive.

As I have explained in this introduction, there are clear indications that the way the One Health concept is currently applied in zoonotic disease control is morally problematic. Therefore the central question of my research-project is:

*How should a One Health approach in zoonotic disease control be conceived and justified from an ethical perspective?*

The answer to this research question will be derived from the outcome of the following six sub-questions.

1. *What is a One Health approach in zoonotic disease control?*
   To answer this question, I will provide a conceptual analysis of the One Health concept in the context of zoonotic disease control. Besides that, I analyse the use of the concept in national and international policy documents to clarify how the concept of One Health is currently applied. Furthermore, I critically review the use of One Health from an ethical perspective. In chapter II of this thesis, I will present my findings.

2. *What are the moral dilemmas of a One Health approach in zoonotic disease control ?*
   The objective of this part of my research was to collect cases to illustrate and to analyse ethical concerns about the use of the One Health concept in zoonotic disease control. To identify these moral dilemmas, I have studied One Health literature and did interviews with veterinary and public health experts, involved in zoonotic disease control policies in the Netherlands. In will present examples of these moral dilemmas in chapters II and III.

3. *What are the ethical presuppositions in zoonotic disease control and how do these relate to the One Health concept?*
   To answer to this question, I have examined ethical presuppositions in zoonotic disease control and I analysed how these relate to the One Health concept. The focus was on the presumed and prominent position of public health compared

to other values, like animal welfare, biodiversity and economics. I reviewed relevant literature to identify different normative assumptions and moral values associated with the One Health approach of zoonotic disease control. Moreover, I have interviewed a number of experts in the field of public health and veterinary medicine. This qualitative research is conducted according to the standards for semi-structured in-depth interviews and has provided a broad spectrum of moral assumptions and insight in how different underlying values are balanced in practice. I will present the results of my empirical research in chapter III.

4. *How should the precautionary principle be applied in zoonotic disease control according to the One Health concept?*
   To understand the role and the use of the precautionary principle in zoonotic disease control, I have studied relevant literature on the philosophy of risk and analysed how it is applied in practice. The theoretical and empirical insights are used for a critical reflection on the use of the precautionary principle and the distribution of responsibilities of stakeholders. The outcome of this part of the research will contribute to a better insight in the management of risk in zoonotic disease control. The results are presented in chapter IV.

5. *What are the professional responsibilities of veterinarians within the One Health framework?*
   To examine the professional responsibilities of veterinarians within the One Health framework, I have used my experience as a veterinarian and policy officer of the Royal Veterinary Association of the Netherlands. I enriched this experience with a literature research in veterinary and professional ethics. This is combined to develop a roadmap for veterinary professionals as well as veterinary associations to tackle moral dilemmas coming from the current policies in zoonotic disease control This topic will be addressed in chapter V.

6. *How do the non-ideal conditions of the real world influence ethical judgment in moral dilemmas associated with zoonotic disease control?*
   In the concluding chapter VI, I examine how ethical theory can contribute to overcome moral dilemmas associated with zoonotic disease control. The first step in this process is to indicate what, from an ethical perspective, constitutes a socially responsible (sustainable) form of prevention and control of zoonotic diseases. Then I elaborate how 'non-ideal' circumstances affect progress towards that preferred situation. With the use of concepts and theories from public health ethics and animal ethics, I explore what ethical theory can contribute to a socially responsible zoonotic disease control.

I finish my thesis with a summary of the most important findings and relate them with the research questions I have presented here. I then provide the answers and the main conclusions that can be drawn from this dissertation. I also address some discussion points that can be raised as a result of my analysis and the research process. Furthermore, I shall make recommendations for policy-making that could help to construct a more socially responsible zoonotic disease control. Hopefully, this will mitigate some of the moral dilemmas that I have revealed in this dissertation. Finally, I make a few concluding remarks on subsequent research topics that can help to further explore an ethic of One Health.

CHAPTER 2

# One Health as a moral dilemma

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## 2.1 Introduction

In a globalised world where human activity has a devastating impact on ecosystems essential to human and animal life, an interdisciplinary, collaborative strategy to attain optimal health for people, animals and the environment is indispensable. Such a One Health approach is currently considered the worldwide standard to combat epidemic zoonotic threats like influenza, SARS or Ebola (FAO-OIE-WHO 2010). An important reason for this success is that the One Health concept acts as a boundary object (Leboeuf 2011; Cassidy 2016). Star and Griesemer define a boundary object as a multi-interpretable concept that is: 'both plastic enough to adapt to the local needs and the constraints of the several parties employing them, yet robust enough to maintain a common identity across sites' (Star and Griesemer 1989). The power of boundary objects is that they enable people with different perspectives to collaborate, in case of One Health: to promote health. This results in a number of successful One Health practices, for instance, in combatting zoonotic diseases like avian influenza and rabies (Gibbs 2014).

Despite these achievements, several authors have criticised the One Health concept on issues of support and implementation (Stephen and Karesh 2014; Okello et al. 2014). More recently, others have debated that a One Health approach in zoonotic disease control can also cause more fundamental moral dilemmas (Rock and Degeling 2015; Verweij and Bovenkerk 2016). This is because in zoonotic disease control there can be conflicts of interests, for instance, between public health institutions and the food industry. Furthermore, certain One Health strategies lead to the culling of healthy animals. If One Health implies that besides the health of humans, the health of animals and the environment should be promoted as well, this requires justification (Degeling, Lederman, and Rock 2016).

However, current interpretations of the One Health concept neither in literature nor in policy documents provide normative guidance to address these moral dilemmas. Although recent standards like COHERE improve the quality of One Health research and the integration of all domains (Davis et al. 2017), there is still little attention for ethical issues. Lee and Brumme (2013) argue that a possible way forward could be to develop a widely supported operational definition.

We claim that, for two important reasons, this will not overcome the moral dilemmas that originate from One Health strategies in zoonotic disease control. Firstly, it will be complicated to reach consensus on the overall goal of a One Health approach because of underlying moral differences. Secondly, to impose a universal definition can obstruct One Health's function as a boundary object to facilitate cooperation.

To be more than just a call for collaboration and to address the moral dilemmas that can arise in zoonotic disease control, the One Health concept needs a corresponding ethical framework. To start the discussion on such an ethic of One Health, we think it is necessary to first formulate some normative starting points about the moral status of humans, animals and the environment. Thereafter, we argue that this also implies a health concept

that can be used for all elements within the One Health framework and we propose 'resilience' as a fruitful option in this respect.

## 2.2 The merits and criticism of One Health

Many health professionals think the One Health concept is crucial to "win the disease battles of the 21st century while ensuring the biological integrity of the planet for future generations" (Cook et al. 2004). One Health offered global institutions like the World Health Organization (WHO), the Food and Agricultural Organization of the United Nations (FAO) and the World Organization for Animal Health (OIE) an all-inclusive approach to reduce conflicts, defend their legitimacy and facilitate commitment for collaboration (Chien 2013). A shared statement confirmed their partnership to address health risks at the human-animal-ecosystem interface (FAO-OIE-WHO 2010). This shows that One Health can facilitate partnerships and promote interdisciplinary collaboration despite possible conflicts of interest[3].

In the meantime, the One Health approach has also produced actual results in infectious disease control, like the Dutch policy to combat antimicrobial resistance in humans as well as in animals. In 2009 the Dutch government took strict measures to reduce the use of antibiotics in animals to protect public health. These actions were framed as a One Health policy and included: recording and benchmarking of antibiotic use on farms, benchmarking of the prescribing patterns of veterinarians, strengthening the role of veterinarians, taking measures to improve animal health and promoting prudent use in line with official reduction targets. This public-private cooperation has resulted in a significant reduction of 64% in the use of antibiotics in animals in the Netherlands from 2009-2016 (Netherlands Veterinary Medicines Institute 2017). The Food and Veterinary Office of the European Commission concluded the Netherlands showed it was possible to reduce the use of antibiotics in animals and associated antimicrobial resistance, while safeguarding animal health and welfare[4] and the economic viability of producers, and avoiding an excessively legislative approach (FVO 2017).

One Health approach strategies are often more effective than regular public health and disease control measures and also more efficient, because services responsible for human, animal and environmental health can share costs. In 2012 the World Bank concluded that this could add up to a 15% reduction for a global surveillance and disease control system. Due to investments in One Health systems yearly financial benefits could exceed initial costs tenfold. Apart from the financial gains, combatting zoonotic disease with a One

3 The core activity of WHO is global public health, OIE is focussed on animal health and welfare, and the main interest of FAO is food security. Zoonotic disease control can lead to conflicts between, for example, animal welfare and global public health.

4 In 2016 the Dutch Council on Animal Affairs addressed this issue in its advice on the effects and perspectives of antimicrobial reduction policies in animal husbandry. The council concluded that because of a lack of data an objective assessment of suspected animal welfare issues was difficult. Therefore, a causal relation between antimicrobial reduction policies and animal welfare problems could not be determined (Council on Animal Affairs 2016a).

Health strategy would substantially improve public health, food safety and food security as well (York et al. 2012).

Despite these merits of a One Health approach, in recent years several critical notes have been published too. First of all, some authors noticed that the involvement of human medicine in the discussions on One Health was poor (Häsler et al. 2012). Secondly, the lack of involvement of stakeholders from the environmental sector is worrying. Because important environmental determinants of health, like climate change and pollution are then underexposed despite their impact on human and animal health and welfare (Stephen and Karesh 2014). Others point out that there is no shared One Health agenda and global health governance by existing institutions is failing (Lee and Brumme 2013). Finally, there are also worries about the implementation of One Health with respect to national ownership and funding, certainly in the developing countries (Okello et al. 2014).[5]

## 2.3 Moral dilemmas of One Health

The application of the One Health concept in zoonotic disease control also raises important ethical questions (Rock and Degeling 2015; Degeling et al. 2016; Lederman 2016). If One Health implies we should promote the health of humans as well as the health of animals and the environment, how does this work out in the case of zoonotic disease control?

An interesting example is the search and destroy policy for multi-resistant bacteria on pig farms in Norway. Multi-resistant bacteria like livestock-associated meticillin-resistant Staphylococcus aureus (LA-MRSA) can be a threat to human health (Fitzgerald 2012). Especially after introduction in hospitals there is a risk that LA-MRSA causes serious and sometimes untreatable infections in susceptible patients. For this reason, in many countries, pig farmers and veterinarians, who have a higher risk of introducing LA-MRSA into hospitals, are subjected to strict hygiene and quarantine measures to prevent nosocomial infections in vulnerable patients.

LA-MRSA is widespread amongst pigs and cattle in Europe, but the prevalence varies greatly between countries (European Food Safety Authority and European Centre for Disease Prevention and Control 2017). Because in Norway LA-MRSA prevalence in pigs is very low, Norwegian authorities choose to cull all pigs on a farm when LA-MRSA is detected. Prevention of LA-MRSA introduction on pig farms can be more cost-effective than implementing expensive preventive measures in hospitals (Höjgård et al. 2015). However, in the Netherlands such a policy would be devastating for the pig industry because the prevalence of LA-MRSA is more than 70% (Broens et al. 2011).

Until recently, LA-MRSA was considered a serious health threat in hospitals in the Netherlands. But since it has become clear that LA-MRSA doesn't spread as easily in

5 This study shows that in countries like Nigeria, Tanzania and Uganda it generally takes longer to implement One Health strategies, often as a result of the wide institutional and policy changes required. The authors conclude that: 'whilst the "goodwill" is certainly there, the reality of planning, executing and budgeting for joint interventions – particularly at the national or regional level – proves in many cases more difficult than first thought'.

hospitals as was earlier suspected, LA-MRSA policies in Dutch hospitals are mitigated (Meekelenkamp et al. 2017). This raises questions about the proportionality of LA-MRSA policies in Norway. Moreover, research has shown that LA-MRSA infections on pig farms in Norway were introduced by farm workers (Grøntvedt et al. 2016). This implies that the health of pigs, usually not affected by LA-MRSA but culled after detection, is maybe more at risk than the other way around. The discrepancy between Norway and the Netherlands might be justified on the basis of differences of LA-MRSA prevalence, cost-effectiveness and risk perception. However, it is difficult to see how pigs in Norway benefit from this One Health approach.

Apparently, the recognition that human, animal and environmental health are intertwined does not necessarily imply that they are all of similar weight. It often seems as if animal and environmental health are only deemed worthy of protection as long as they contribute to human health. But if this is the case, One Health is in fact nothing more than just another label for protecting public health. If One Health should be regarded as the paradigm shift that some authors envision, safeguarding human health is not enough. Maintenance and improvement of animal health and ecosystem functioning are also primary goals of One Health, with their own inherent value independent from their impact on human health (Barrett and Osofsky 2013). Degeling et al. therefore suggest to regard health as a universal good: a necessary condition for a flourishing life which is shared between species, ecosystems and future generations (Degeling et al. 2016). Contrary to public goods - which only apply to humans - , this means that animals and the environment are considered recipients as well. Just like in public health policies, where there is attention for distributive aspects of health in human populations, the One Health paradigm forces us to think about a fair distribution of health between humans, animals and environment.

## 2.4 Conceptual clarity

The advantage of regarding One Health as a boundary object is that flexibility in interpretation facilitates cooperation and makes the concept applicable for multiple purposes. However, ambiguity about One Health and hence about how One Health strategies in zoonotic disease control should be shaped, contributes to the complexity in case of value conflicts. If it is not clear beforehand what the normative starting points of a One Health approach are, different parties can disagree about the expectations and results for the health of humans, animals and the environment.

In literature and in policy documents many definitions of the One Health concept can be found (Gibbs 2014). The American Veterinary Medical Association defines One Health as 'an integrative effort of multiple disciplines working locally, nationally, and globally to attain optimal health for people, animals, and the environment' (American Veterinary Medical Association 2008). While the Food and Agricultural Organization speaks of 'a collaborative, international, multidisciplinary mechanism to address threats and reduce risks of detrimental infectious diseases at the human-animal-ecosystem-interface' (FAO 2012). Finally, the One Health Initiative defines One Health as 'a worldwide strategy for

expanding interdisciplinary collaborations and communications in all aspects of health care for humans, animals and the environment' (Kahn, Kaplan and Monath 2012).

Cassidy points out that the existing definitions are often strikingly broad. They all promote interdisciplinary collaboration but do not specify who should be collaborating with whom, on what and how (Cassidy 2016). That is why some authors stress the need for an agreed operational definition (Lee and Brumme 2013). Others, like Leboeuf (2011), say the broadness of the concept makes it possible to act as an umbrella under which One Health actors can articulate slightly different visions while working together. Chien (2013) also believes that One Health is sufficiently concrete and flexible enough to facilitate collaboration. However, she does think that its vagueness also allows conflicting interpretations to coexist. This can hinder a paradigm shift in disease policies and tolerates a situation where health professionals keep practising within the dominant technical/biomedical framework without converting to the holistic One Health perspective (Chien 2013). In our view, further conceptual analysis of One Health is indeed necessary to transcend the level of a mere collaboration tool. When the concept of One Health is elaborated as we propose, it can create opportunities to actually contribute to the health of all.

In her historic analysis of zoonotic disease control in the Netherlands (1898-2001) Haalboom argued that interdisciplinary collaboration between veterinary and human medicine was never the issue. Veterinarians and human doctors have cooperated to combat zoonotic diseases long before One Health became fashionable (Haalboom 2017). In this view, the urgent call for collaboration will only partially address the risk of zoonotic diseases for public health. She concludes that the real problem in zoonotic disease control is an underlying conflict of interests. The most prominent in this perspective is the clash between public health and economy. Until the Q-fever outbreak (2007-2012[6]) the food industry proved to be very successful in promoting economic interests and delayed an effective response at the expense of public health (Haalboom 2017).

Public health can also conflict with the health and welfare of animals. Think for instance of the case of culling healthy animals in a zoonotic disease outbreak. Lederman argues that culling as a public health measure can only be justified if there is enough evidence that such an intervention is (cost)effective and socially accepted, but in practice this is not always the case (Lederman 2016). A different interpretation of One Health could potentially replace standard disease control measures like culling, as it provides reasons to extend ethical consideration about public health policies and corresponding economic decision-making processes beyond protecting short-term human interests (Degeling, Lederman and Rock 2016). In our perspective, a One Health strategy should imply preventing zoonotic disease outbreaks by investing in the health of animals and the environment. This may also be helpful to avoid some apparent conflicts between public health and the health of animals.

6 During the Q fever outbreak that struck the Netherlands from 2007-2012 the Dutch government decided to cull 50.000 pregnant goats to stop the disease, that until then infected 4000 people and (with hindsight) caused the death of 95 persons. A vaccination strategy was carried out since the end of 2008, but because a positive effect was not immediately visible and the numbers of human casualties continued to rise, in 2009 the Dutch government switched to culling.

Applying the One Health concept in zoonotic disease control is not morally neutral (Nieuwland and Meijboom 2015). However, the current interpretation of the One Health concept in literature and policy documents lacks normative guidance for health professionals, institutions and governments in case of moral dilemmas. Building on this, we believe a One Health ethic first requires a basic foundation that acknowledges the moral standing of animals and the environment. Current conceptions of One Health are implicit about the question whether or not animals and the environment have independent moral standing at all. They leave room for interpretations that consider the health of animals and the environment as only of instrumental value for humans. Secondly, it is important to reflect on a possible concept of health that is appropriate within the One Health framework. For One Health to act as a boundary object, it may not be necessary to define the concept of health any further. But we think it is essential to address moral dilemmas of One Health strategies in zoonotic disease control. Clarity about a concept of health, that is suitable for humans, animals and the environment, enables us to reach a better understanding about our One Health goals.

## 2.5 The value of moral status of humans, animals and the environment

It is clear that the health of animals and the environment is essential for humans. We know, for instance, that over the last twenty years more than 70% of all emerging infection diseases in humans are zoonotic of origin (Taylor, Latham and Woolhouse 2001). But is animal or environmental health also important in itself? This question is only meaningful when we attribute animals and the environment some kind of moral status. In animal and environmental ethics there is an extensive debate about this topic.

To have moral status implies being a member of our moral community and therefore one's interests should be taken into account. In this context Gruen has introduced the term moral considerability: 'to say that a being deserves moral consideration is to say that there is a moral claim that this being has on those who can recognize such claims. A morally considerable being is a being who can be wronged in a morally relevant sense' (Gruen 2014). In her opinion, this means a being is either morally considerable or it is not. She distinguishes this notion from moral significance, which in contrast to moral considerablility can be a matter of degree. Moral significance indicates how we should assess and adjudicate different interests of morally considerable beings in situations of conflict (Gruen 2014).

The perspective on moral considerability and corresponding moral significance is strongly influenced by the normative theoretical framework that is used (Bovenkerk and Meijboom 2012). Singer, for instance, thinks that the capacity to experience pain or pleasure (sentience) is the one and only relevant feature to attribute moral considerability (Singer 1975). For Regan entities are morally considerable when they are a subject-of-a-life, which means that they have cognitive capacities such as beliefs, desires, memory, intentions and a sense of time and future, in other word that they can experience life subjectively (Regan 1983). Other philosophers emphasize the importance of external

properties, like our specific relations with animals that influence our obligations towards them (Palmer 2010).

In case of conflict, a utilitarian, like Singer, would base his judgement on maximization of the satisfaction of preferences (or interests) of all morally relevant beings involved. If the culling of healthy animals would stop the spread of an infectious disease that could potentially infect many other animals (and possibly humans in case of a zoonotic disease), Singer thinks this is justified (Singer and Dawn 2004). Regan, would strongly reject such practices. On the basis of respect for the inherent value of all subjects-of-a-life, he believes that no individual animal can be sacrificed for the good of the whole.

Some philosophers have tried to extend moral status beyond humans and animals. Aldo Leopold, for instance, argued that moral concern should extend from humans to: 'soils, waters, plants and animals, or collectively: the land' (Leopold 1949). In this perspective the survival of an ecosystem as a whole is of more importance than the fate of individual living beings like humans, animals or plants which are part of this ecosystem. To underpin his claim for the moral relevance of ecosystems, Leopold explained that they could be harmed by human activities in a similar way that a disease could harm a human being (Leopold 1949).

In most societies there is a plurality of views on the moral considerability and -significance of animals and the environment. From the results of a large survey in the Netherlands about people's convictions on the moral status of animals in relation to the culling of healthy animals in an animal disease outbreak, Cohen et al. (2012) distinguished two main categories: those who consider humans superior to animals and those who think human and animal interests should be taken into account equally. Most of the former category have no problems with the culling of healthy animals during an animal disease epidemic, while many of the latter disagree with such policies. When the reason for culling healthy animals was protection of human life, 39% of the people with an egalitarian viewpoint and 19% of the people who think humans are superior rejected this (Cohen, Brom & Stassen, 2012). This shows that moral convictions have a strong influence on the perceived acceptability of certain disease control measures. However, it does not imply that if people consider themselves superior to animals, they all think that animals are not morally considerable. Even for some of those people culling is morally problematic. Moreover, the moral significance that people attribute to animals is case dependent. In cases where human health is at risk, most people justify the culling of healthy animals. In situations where there is no danger that humans become infected, culling is less accepted. Which disease control measures are justified in a One Health strategy to combat zoonotic diseases is therefore strongly dependent on the normative presuppositions people have.

We acknowledge that in our society moral values, norms, ideals, duties and virtues are in general irreducibly diverse. From this one could argue that moral values are only relative to a person's individual and cultural background or to certain circumstances. Moral relativists claim there is no moral truth nor an objective moral standard to decide what is right and wrong; what is right for me does not have to be right for you. On the contrary, moral pluralism acknowledges there can be conflicts in values, but this does not mean

we cannot criticize each other's moral viewpoints. This theory accepts that in case of two or more valid moral positions there is no single overarching principle to judge what is the right thing to do (Wolf 1992). Yet, moral pluralists strive to make reasonable choices between conflicting moral values, to be action guiding in moral dilemmas. Although moral values are not beforehand overriding, under certain conditions some values can be more important than others (Kekes 1993). Even if several conflicting positions can be deemed valid within moral pluralism, it does not follow that no wrong positions can be determined. Moral judgements are justified in a deliberative process searching for coherence between intuitions, moral values and principles and empirical facts: a reflective equilibrium.

With this in mind, we propose to address value conflicts in zoonotic disease control in a similar manner. In a One Health perspective, the principle of 'two factor egalitarianism' that VanDeVeer introduced, could be useful to tackle conflicts of interests between humans and animals (VanDeVeer 1979). VanDeVeer suggests that in promoting overall utility, a difference should be made in the level of importance of interests of humans and animals. In his theory, peripheral interests of humans do not prevail over basic interests of animals. But in the case of a conflict between basic interests, the interests of humans trump those of animals. VanDeVeer justifies this by arguing that 'the interests of beings with more complex psychological capacities deserve greater weight than those with lesser capacities' (VanDeVeer 1979). This implies that the harm that is caused by dying is in general greater for humans than it is for animals[7]. In case of zoonotic disease control this implies that culling animals is only justified when basic interests of humans, like an interest in life or not to severely suffer, are at stake. It may be questionable whether this principle will be applicable to all moral dilemmas in zoonotic disease control. Besides that, it is not entirely clear how environmental interests should be weighted within VanDeVeer's method. However, we believe VanDeVeer's principle can be helpful as a starting point by establishing that basic animal and environmental interests cannot be overridden by peripheral human interests. Certainly, in a pluralist society there will be different opinions about what should be regarded as a peripheral or a basic interest. It can be debated, for instance, if in Western societies eating meat should be considered a peripheral interest or not.

Nevertheless, we think in many situations it will be possible to reach consensus by considering whether or not certain human interests are strong enough to violate basic animal and environmental interests. In our opinion, a One Health strategy in zoonotic disease control entails that basic animal interests can only be overridden if there are no other reasonable alternatives to protect human health, like vaccination. Of course, the costs and the effectiveness of possible alternatives should be taken into account as well. However, economic reasons alone cannot justify culling as a disease control measure.

7 VandeVeer considers that the 'opportunity costs' of dying are far greater for humans than for animals. This notion is derived from economic theory and indicates that in achieving one goal, the cost of doing so can be thought of as opportunities thereby forgone, goods and satisfactions that may not be obtained but which could have been if one's capital or effort were employed in other ways.

## 2.6 Health for humans, animals and the environment

To clarify the normative assumptions in One Health, besides reflections on the issue of moral status we also need to consider which concept of health is most suitable. If we define our ideas about health more specifically, this can give us guidance in determining what we strive for if we want to achieve a better health for humans, animals and the environment. To our opinion, an appropriate concept of health should fulfil at least two requirements: (1) it should be separately applicable to humans, as well as to animals and the environment and (2) supportive to the idea of health of the system as a whole.

In human medicine the concept of health has evolved over time. In 1946 the World Health Organization defined health as a complete state of physical, mental and social wellbeing, not merely absence of disease or infirmity (World Health Organization 1946). Later, Boorse explained health as a condition of statistically normal biological functioning and therefore as absence of disease (Boorse 1977). More recently, the focus is on definitions that see health as instrumental to achieve other goals in life (Nordenfelt 1993). Finally Huber et al., refer to health as the ability to adapt and self-manage in the face of social, physical and emotional challenges (Huber et al. 2011). Nevertheless, to date there is no universally agreed definition for human health.

In contrast to the extensive literature available on human health, there is much less scientific debate about the concept of animal health (Gunnarsson 2006). In veterinary medicine animal health is commonly interpreted in the tradition of Boorse' absence of disease symptoms or as normality in biological functioning. Webster, for instance, refers to health as normality in posture, movement, alertness and appetite (Webster 1987). Others state that animal health is the result of biological, social, and environmental determinants that interact to affect the capacity to cope with change (Stephen 2014). Some definitions include productivity as a parameter of animal health (Blood and Studdert 1999). But paradoxically, animals that have been strongly selected for high productivity seem to be more at risk of behavioural, physiological and immunological problems (Rauw et al. 1998). Few authors, like Nordenfelt, have tried to extend the concept of health from humans to animals. For him animal health is instrumental to attain vital goals for an individual animal, like minimal animal welfare (Nordenfelt 2006). However, up to now there is also no consensus on a comprehensive definition for animal health.

Likewise, the concept of health is used to describe the functioning of an ecosystem[8]. Lu, for instance, sees ecosystem health as 'the status and potential of an ecosystem to maintain its organizational structure, its vigour of function and resilience under stress, and to continuously provide quality ecosystem services for present and future generations in perpetuity' (Lu et al. 2015). Health is then an indicator that is related to the deliverance of ecosystem services, like clean drinking water and fertile soil, for humans. Certainly in case of ecosystem health, most accounts are strictly anthropocentric. The more fundamental question is how to understand ecosystem health when we have to accept that ecosystems are dynamic and species come and go. In that case a good starting point might be to strive

8 An ecosystem can be defined as a complex of living organisms, their physical environment, and all their interrelationships in a particular unit of space ("Ecosystem -- Britannica Academic" n.d.).

for a situation of dynamic equilibrium. A concept that captures this aspect is 'resilience', defined as the capacity or ability of an individual or a system to react to an external force and to maintain or return to a state of equilibrium (Bhamra, Dani and Burnard 2011). The idea of resilience can be categorized within theories of health as some kind of balance (Lerner and Berg 2015). According to Döring et al., resilience is applicable as a measurable criterion for health for all components of our ecosystem: soil, plants, animals and humans (Döring et al. 2015). Furthermore, resilience is also relevant for the ecosystem as a whole. This connection can, for example, be seen in relation to biodiversity. A monoculture of crops, as well as a diminished genetic diversity in pure bred animals or inbred human populations, often show a higher vulnerability to diseases. References to a certain form of resilience is found in health definitions for humans, animals and ecosystems (Huber et al. 2011; Stephen 2014; Lu et al. 2015). Lerner and Berg claim that within a One Health framework health can be defined at least on three different levels: individual, population and ecosystem level (Lerner and Berg 2015). In our opinion resilience is a meaningful concept to describe health at all of these levels.

It is clear that there are many conceptions of health with very different implications. Therefore, Haverkamp et al. propose to consider health concepts as a sort of family in which each concept has a slightly different descriptive and evaluative dimension and is applicable in a different context. In this way they function as a toolbox to reflect on the meaning of health in specific health practices (Haverkamp, Bovenkerk and Verweij 2018). In the context of zoonotic disease control this still leaves room to either choose a narrow account of health, like absence of disease, or a broader definition such as resilience. In general it can be said that the thicker the concept of human health is defined, the more difficult it is to apply to animals or the environment. To regard health as the ability to adapt and self-manage in the face of social, physical and emotional challenges is too ambitious for many domesticated animals. The restrictions related to their use by humans make this definition unrealistic. It is also hard to imagine how this conception can be applied to ecosystems.

To a certain degree, it is possible to assess absence of disease objectively in individual humans and animals. At population level this perspective on health can be translated in epidemiological statistics or morbidity and mortality rates. Nevertheless, to determine ecosystem health in terms of absence of disease can be problematic. After all, pathogens like bacteria and viruses are an essential part of ecosystems. In the context of a One Health strategy in zoonotic disease control, it would therefore be more realistic to consider pathogens as something to work with rather than against (Hinchliffe 2015). Until now, only two infectious diseases have been successfully eradicated on a global scale: smallpox and rinderpest. Actually, even these two viruses still exist because samples are stored in highly secured laboratories for possible vaccine production in case of disease re-emergence. In many other cases, pathogen eradication has proven to be very difficult, certainly when there are non-human reservoirs (Aylward et al. 2000).

In addition, most recent pandemics are of zoonotic origin and they often emerge by ecological, behavioural or socio-economic changes, induced by human action (Morse et al. 2012). Loss of biodiversity, for instance, is one of the factors known to influence pathogen

transmission and disease incidence. There are indications that preserving ecosystems and their biodiversity can reduce prevalence of infectious diseases in humans (Keesing et al. 2010). In case of Lyme disease and West Nile Virus, for instance, it appears that loss of biodiversity can promote the number of the host species for these pathogens. This is because they seem more resistant to factors that reduce biodiversity than other species (Keesing et al. 2010). From a One Health perspective, this implies that by promoting biodiversity in ecosystems, animal and human health are served as well. Biodiversity is considered a critical part of ecosystem resilience (Folke et al. 2004).

Moreover, resilience thinking offers possibilities to shift from control to prevention of zoonotic diseases in animal husbandry. The production of cheap animal protein at minimum costs has compromised animal health and increased zoonotic disease risks (Kimman, Hoek and de Jong 2013). In the light of climate change and food security, Ge et al. concluded that our focus on maximizing production has increased the vulnerability of production systems (Ge et al. 2016). Resilience thinking addresses change, adaptability and transformability on different levels (animal, farm and socio-economical) which can lead to a more sustainable animal husbandry. Consequently, human and environmental health will benefit from this.

## 2.7 Implications for One Health policies in zoonotic disease control

To justify zoonotic disease control measures like the culling of healthy animals, professional health workers and policy makers should make their underlying moral presuppositions about the moral status of animals more explicit, this could for example be achieved through the involvement of ethical expertise in expert committees that advice responsible authorities. This could contribute to more transparency of policy choices and acceptance of certain disease control measures by society. In case of moral dilemmas, it can be useful to apply VanDeVeer's principle of two factor egalitarianism. This means that peripheral human interests are not accepted as a sufficient reason to take zoonotic disease control measures that seriously harm basis interests of animals. Moreover, these measures should not negatively affect long term resilience of animals and ecosystems. To improve further awareness we suggest to emphasize the importance of ethical reflection on the outcome and consequences of One Health studies in standards like COHERE.

In our opinion, the goal of One Health should be to strive for a relatively stable equilibrium in which the health of humans, animals and the environment can be characterised as resilient. Moreover, if we try to understand the underlying mechanisms of resilience this will provide us opportunities to improve the health of humans, animals and the environment by means of prevention rather than cure. This is no easy task in the light of human dominance over animals and ecosystems. Even if you attribute humans a special moral status, the One Health concept, interpreted seriously, will define borders. Sufficient space for animals and the environment implies less room for humans to use animals and the environment only as resources.

CHAPTER 3

# 3

# Ethical decision-making in zoonotic disease control: How do One Health strategies function in the Netherlands?

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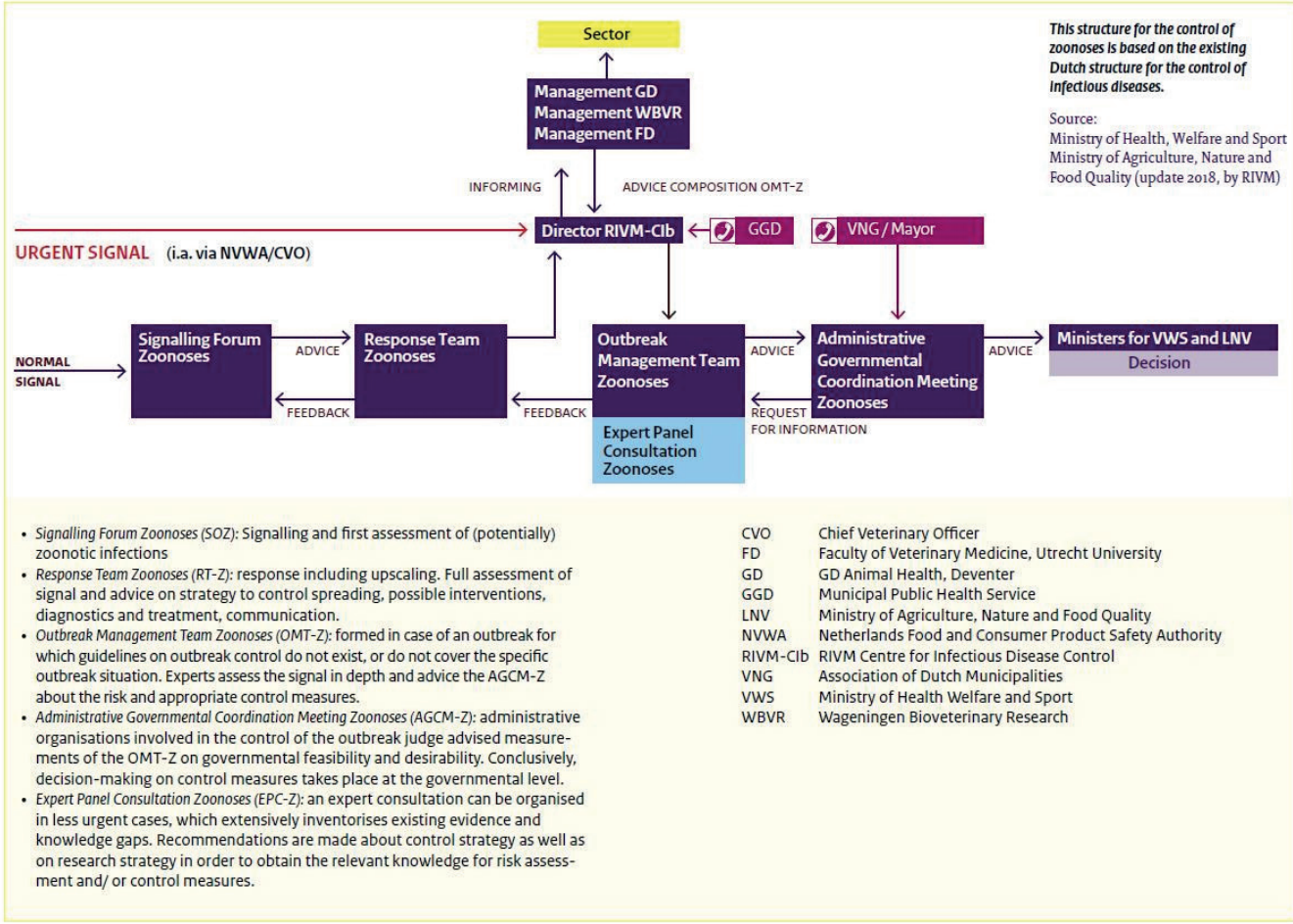
## 3.1 Introduction

No recent zoonotic disease outbreak has caused more public and political debate in the Netherlands than the Q-fever epidemic of 2007-2012. During this period, more than 4000 people became ill and eventually 95 Q-fever patients died due to the *Coxiella Burnetii* infection. Besides human victims, over 50.000 healthy and pregnant goats were culled to stop the disease. Because of its major societal impact and the extensive course of this epidemic, the corresponding process of zoonotic disease control was extensively reviewed and evaluated.

The overall criticism was that a lack of political thoroughness and defective cooperation between human and veterinary health professionals hampered an effective approach to stop the epidemic. The evaluation committee concluded that this was partly due to underlying differences in opinion between the involved ministries of Health, Welfare and Sports and Agriculture, Nature and Food Quality (Van Dijk et al. 2010). To address these issues and to be better prepared for future zoonotic disease threats, the Dutch government introduced a national Zoonoses Structure in 2011 (see figure 1).

Following a systematic One Health approach, the purpose of this new institution was to establish a formal collaboration between veterinary and medical professionals to share, assess and respond to signals of new and re-emerging zoonotic infections (National Institute for Public Health and the Environment 2019a). In this model the final decision-making authority in case of zoonotic disease outbreak is shared between the minister of Agriculture and the minister of Health, in a kind of collegial governance body (Minister of Health, Welfare and Sports 2012). Since its introduction, the Zoonoses Structure has indeed proven its value in early recognition of zoonotic signals (Waegemaekers and van den Kerkhof 2013). At the same time, One Health strategies in zoonotic disease control are becoming the international standard as well (Kelly et al. 2017).

However, as Haalboom points out in her historic analysis of zoonotic disease control in the Netherlands, it can be questioned whether a procedural solution, like the Dutch Zoonotic Structure, will also solve conflicts of interest between, for instance, public health and the economic interests of the agricultural sector (Haalboom 2017). It is known from previous outbreaks that zoonotic disease control can raise moral dilemmas, like the culling of healthy animals to protect public health, which call for ethical reflection and political decisions (Lederman 2016). Framing zoonotic disease control as a One Health approach does not automatically alleviate these dilemmas (Degeling et al. 2015; Lysaght et al. 2017; van Herten et al. 2019).




- *Signalling Forum Zoonoses (SOZ)*: Signalling and first assessment of (potentially) zoonotic infections
- *Response Team Zoonoses (RT-Z)*: response including upscaling. Full assessment of signal and advice on strategy to control spreading, possible interventions, diagnostics and treatment, communication.
- *Outbreak Management Team Zoonoses (OMT-Z)*: formed in case of an outbreak for which guidelines on outbreak control do not exist, or do not cover the specific outbreak situation. Experts assess the signal in depth and advice the AGCM-Z about the risk and appropriate control measures.
- *Administrative Governmental Coordination Meeting Zoonoses (AGCM-Z)*: administrative organisations involved in the control of the outbreak judge advised measurements of the OMT-Z on governmental feasibility and desirability. Conclusively, decision-making on control measures takes place at the governmental level.
- *Expert Panel Consultation Zoonoses (EPC-Z)*: an expert consultation can be organised in less urgent cases, which extensively inventorises existing evidence and knowledge gaps. Recommendations are made about control strategy as well as on research strategy in order to obtain the relevant knowledge for risk assessment and/ or control measures.

| | |
|---|---|
| CVO | Chief Veterinary Officer |
| FD | Faculty of Veterinary Medicine, Utrecht University |
| GD | GD Animal Health, Deventer |
| GGD | Municipal Public Health Service |
| LNV | Ministry of Agriculture, Nature and Food Quality |
| NVWA | Netherlands Food and Consumer Product Safety Authority |
| RIVM-CIb | RIVM Centre for Infectious Disease Control |
| VNG | Association of Dutch Municipalities |
| VWS | Ministry of Health Welfare and Sport |
| WBVR | Wageningen Bioveterinary Research |

**Fig.1** Dutch Zoonoses Structure, source: NIPHE 2019

Societal debates about zoonotic disease control often focus on the easily polarised conflict between safeguarding public health versus serving the economic interests of livestock farming. Although this conflict cannot be ignored, such a conceptualization easily obscures other dimensions of zoonotic diseases. There are several other values at stake too. Think of values like animal welfare and -integrity, autonomy, sustainability or biodiversity. Moreover, a highly polarized debate may create obstacles to finding policies that are reasonable and fair to all stakeholders: consumers, food producers, NGOs, the government and animals.

Speranza et al. rightly argue that: "One Health is grounded in achieving sustainable outcomes" and "even when public health interventions are humanist in orientation, efforts to sustain the health of our ecological communities might require the prioritisation of non-human interests". To evaluate the social sustainability of One Health initiatives, Speranza et al. suggest that; "at the minimum it does not undermine individual needs and capabilities, fosters emancipation, environmental justice, solidarity and social cohesion, and thereby improves human well-being" (Speranza et al. 2018). The question is when and to which extent animal welfare and environmental health are prioritized? And how responsibilities are shaped in the practice of zoonotic disease control? Especially when it is taken into account that culture, religion and economic considerations determine human-animal-ecosystem relationships (cf. Zinsstag et al. 2015).

In 2015 the Dutch Council on Animal Affairs issued a policy assessment framework for a One Health approach in health issues at the human-animal-ecosystem interface (Council on Animal Affairs 2016b). The goal of this tool was to: "give an insight into the elements which, in the Council's view, constitute the One Health assessment framework and the values that have to be taken into account" (pp. 2). However: "the weight that is ultimately assigned to those values remains outside the set of criteria, checks and balances here because the choice has to be made by those who are responsible for the policy" (pp. 2). This makes the Councils' assessment framework a useful instrument to make an inventory of all values at play and to systematically discuss them. It does not offer a guideline on how this evaluation should take place, what could be regarded as a reasonable and socially acceptable outcome and how to make this process transparent to society.

The aim of this paper is to examine ethical decision-making in zoonotic disease control in the Netherlands. Our hypothesis is that moral presuppositions of veterinary and human health professionals play an important role in this process. Therefore, we have studied how these professionals balance certain values in case of moral dilemmas in zoonotic disease control and which role ethical theory plays.

## 3.2 Methodology

In our research we used an interpretive empirical research method consisting of semi-structured in-depth interviews with relevant health professionals: experts, policy- and decision makers involved in zoonotic disease control in the Netherlands. Interpretive research aims to understand how particular humans in particular times makes sense of

their world. Interpretative researchers study (inter)subjective experiences and patterns therein by interpreting communicative behavior, in the context in which they are (co-) constructed (Yanow and Schwartz-Shea 2014). Our study is descriptive as well as explanatory. On the one hand we aim to describe what these professionals consider a One Health strategy in zoonotic disease control, which moral dilemmas they encounter and which moral values and ethical principles they find relevant. On the other hand, we examine how they balance the different values that play a role in zoonotic disease control and how ethical theory is applied. Finally, we explore if and how moral presuppositions of health professionals influence ethical decision making in zoonotic disease control. The empirical data we gathered with the interviews were analysed qualitatively.

### 3.2.1 Literature research

To construct a questionnaire for the interviews, we searched the literature for conceptions of One Health and of moral values and ethical principles that could play a role in zoonotic disease control. The One Health concept is described in the literature in various ways (Gibbs 2014), the core of which can be summarized as improving the health of humans, animals and the environment through interdisciplinary cooperation. We used the definition of the American Veterinary Medical Association (2008) as a point of reference to test our respondents' conception of One Health.

Moral values can be defined as characteristics of persons, organizations or of society as a whole that are in themselves worth pursuing and reflect people's opinion on what construes their version of a good life, for example autonomy. Moral norms or principles are concrete rules of conduct that prescribe what we should do, for instance to have respect for autonomy of humans (Bolt et al. 2003).

Our basic selection of values was derived from the assessment framework of the Dutch Council on Animal Affairs (2016b), who categorized the most relevant values for evaluation of One Health interventions spread across the human-animal-ecosystem domain (see figure 2). It is debatable whether some of the terms (like contamination) could be classified as (moral) values. However, the majority of these values can also be found in other ethical analyses of zoonotic disease control (Cohen et al. 2012; Degeling et al. 2017; Johnson et al. 2019).

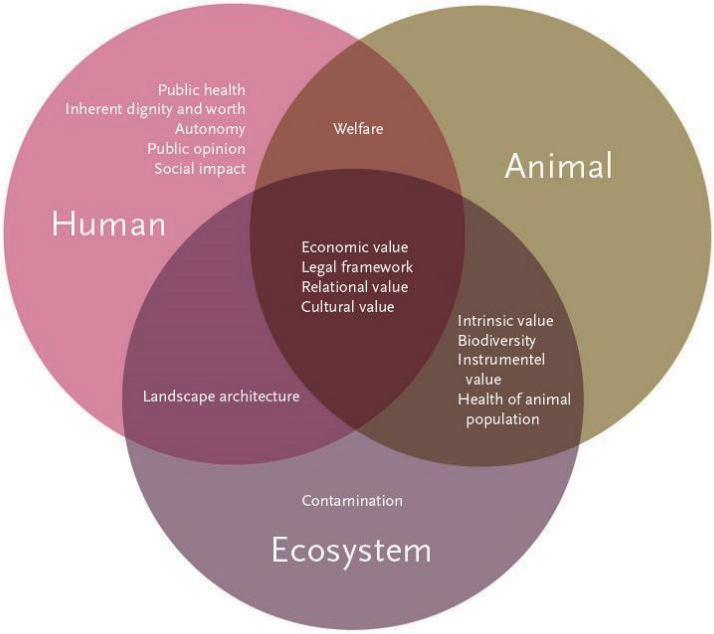



**Fig. 2** Overview of values, source: Dutch Council on Animal Affairs 2016

For the selection of relevant ethical principles, we primarily used the principles of Beauchamp and Childress: *respect for autonomy*, *non-maleficence*, *beneficence* and *respect for justice* (Beauchamp and Childress 2013). These mid-level principles mediate between different high-level ethical theories and low-level common morality. They are considered as *prima facie* action guiding and are used to reflect on particular cases, especially in human and veterinary medicine (Mullan and Main 2001; Spike 2018).

In his 'ethical matrix', which was designed to structure ethical dialogue, Mepham has adapted these principles to apply them to animals. He introduced the principle of *wellbeing*, a combination of the principles of non-maleficence and beneficence, that implies: to avoid harm and promote benefits. In his view the principle of *autonomy* means that animals should be able to perform natural behaviour. And finally, he suggested a principle of *fairness,* meaning respect for justice and respect for the intrinsic value of animals (Mepham et al. 2006).

Another important ethical principle often invoked in zoonotic disease control is the precautionary principle: when scientific evidence about the consequences is not yet available, but it is likely that a zoonotic disease will cause harm to the health of people, animals or the environment, measures shall be taken to diminish that harm (European Commission 2000). For this reason, we added this principle to our list. An overview of the ethical principles as presented during the interviews is given in figure 3.

| **Autonomy** | **Non-maleficence** |
|---|---|
| • *Respect for the autonomy of humans*:<br>To repect decisions of autonomous humans/ informed consent.<br><br>• *Respect for the autonomy of animals*:<br>To respect the intrinsic value /natural behavior of animals. | • *Do no harm principle*:<br>Not to harm humans/animals.<br><br>• *Precautionary principle*:<br>To take measures to prevent expected harm to humans/animals in case of scientific uncertainty. |
| **Justice** | **Beneficence** |
| • *Principle of justice*:<br>To treat like cases alike. | • *Principle of utility:*<br>To promote overall welfare of humans/animals |

**Fig. 3** Matrix of ethical principles

### 3.2.2 Semi-structured in-depth interviews

We used a semi-structured list of open questions to guide the interviews. The questions were divided into six items: the concept of One Health, zoonotic disease control policies, values, principles, ethical decision making in practice and human-animal relations. Apart from questions about the respondents' moral presuppositions towards the One Health concept and zoonotic disease control, we also used questions on the respondents' view on the human-animal bond, to reveal their basic moral attitude towards animals. To identify which moral values the respondents think are important in zoonotic disease control, we first asked this in an open question. Additionally, we presented them the list of values we derived from literature and asked them to choose the five most important values. We also prompted for ethical principles via an open question. Subsequently, we offered them our matrix of ethical principles and asked the respondents to point out the three most important ones and to rank them.

### 3.2.3 Selection of respondents

The respondents were either policymakers or -advisors, all involved in the Dutch Zoonoses Structure. They were pre-selected, based on their professional involvement in zoonotic disease control. Despite the fact that our research concerns a relatively small group of people, these professionals all play a key role in Dutch zoonotic disease policies. Of the thirteen respondents we interviewed, six (three male and three female) worked in the human domain and seven (five male and two female) in the veterinary domain. The length of the interviews was on average 1,5 hour. The interviews were done by the first two authors from December 2018 – March 2019 on a location preferred by the respondent, often their own work environment.

### 3.2.4 Data processing and analysis

The interviews were recorded and transcribed verbatim. Subsequently, the transcripts were processed and analyzed using the three cycle coding method described in Miles et al. (2013). During the coding process Word, Excel and the qualitative data analysis program ATLAS.ti were used. Coding was done by the first two authors separately to improve reliability of data processing and the outcome was discussed with the other authors, to finally end up with a uniform list of labels. First cycle coding was descriptive, which means that relevant fragments in the text received a label, mostly a short summary that characterizes the fragment. During second cycle coding trends and patterns within the data set were identified. Labels were classified in sub-themes based on their interrelationship (pattern coding). In the third cycle coding phase we searched for relations and consistency between the sub-themes. Eventually, this resulted in five main themes: 1) One Health, 2) zoonotic disease control, 3) moral dilemmas, 4) values and 5) principles and decision making. Thereafter, we applied the results of the coding process to answer our research questions.

## 3.3 Results

### 3.3.1 What is a One Health strategy in zoonotic disease control?

Different interpretations of One Health can lead to divergence of objectives in zoonotic disease control and can complicate cooperation (Kingsley and Taylor 2017). To understand how policymakers and advisors in the Netherlands interpret the concept in the context of zoonotic disease control, we have asked the respondents about their own definition, their ideas on One Health policies and cooperation with other professionals. Furthermore, we have discussed what zoonotic disease control according One Health principles would ideally look like. Finally, we asked whether the respondents think more preventive measures are needed to avert zoonotic diseases. This provided information to answer our first research question: what is a One Health strategy in zoonotic disease control according to health professionals?

When asked about their definition, nearly all respondents indicated that they understand One Health as a call for multidisciplinary collaboration to combat zoonotic diseases (n=11). The majority endorsed the holistic starting point of One Health that the health of humans, animals and the environment is promoted (n=8). One respondent adhered a strictly anthropocentric view and states that: *"It's really all about human health"*. Subsequently, when confronted with the definition of the American Veterinary Medical Association: "One Health is defined as the collaborative effort of multiple disciplines – working locally, nationally and globally – to attain optimal health for people, animals and the environment" (American Veterinary Medical Association 2008), all respondents subscribed this statement. Although one respondent noticed that: "*Optimal for animals is not always the same as optimal for humans or the environment"*.

Regarding cooperation: veterinary as well as human health professionals appreciated working together in the Zoonoses Structure and acknowledged that much progress is made since the Q-fever epidemic. Several respondents pointed out that mutual trust

(n=2) and careful handling of data (n=3) are important conditions in this respect. Both human and veterinary professionals admitted that in the current system there is too little involvement of other professionals, like ecologists (n=6). To further improve zoonotic disease control, they indicated that more funding was necessary for research and early detection (n=4).

Contrary to their support for a holistic conception of One Health, zoonotic disease control policies in practice seem overwhelmingly anthropocentric, or in other words human health driven. According to several respondents (n=4), keeping animals healthy is mainly important for public health reasons. Both human- and veterinary professionals stated that only when disease control measures contribute to public health or when it is economically interesting, public authorities will invest in animal health. Moreover, they indicate that human disease burden must be substantial to make such an investment. Zoonotic disease policies are therefore dominated by public health and economic considerations. Although, these interests can sometimes conflict, as we have seen in the Q-fever case, they are both anthropocentric in nature. Veterinary professionals are sometimes frustrated that there seems no willingness to improve animal health without clear human benefits (n=4). On the other hand, as one of them pointed out: *"We are not going to invest in animal health at the cost of humans"*. This can also imply that, for the sake of public health, animal health and welfare can be infringed. For instance, one respondent mentioned that: *"For public health reasons it would be better to keep all animals indoors"*.

In answer to our question about preventive measures against zoonotic diseases, several respondents emphasized that early detection is the most effective strategy (n=7). Although one respondent emphasized it is in fact difficult to predict what the next zoonotic disease outbreak will be. To protect farm animals and humans, a high level of biosecurity on farms was considered essential. Two respondents, both human health professionals, argued that, to decrease the risk of zoonotic diseases, biosecurity is more important than reducing the number of farm animals. Vaccination of animals and/or humans can sometimes be an option but must be cost-effective and proportional in comparison with the health risks (n=2).

Although our research did not reveal a definitive answer to what according to our respondents a One Health strategy in zoonotic disease control exactly entails, there is a discrepancy between theory and practice. In theory, most respondents adhered to a holistic view on One Health. In practice, the drivers for zoonotic disease control were predominantly anthropocentric. The main objective for One Health strategy in zoonotic disease control seems to be a better multi-disciplinary collaboration to promote public health. No differences between veterinary and human health professionals were found.

### 3.3.2 What are the moral dilemmas of One Health strategies in zoonotic disease control?

Zoonotic disease control can raise moral dilemmas, like the culling of healthy animals to protect public health (Cohen et al. 2012; Degeling et al. 2016 ; van Herten et al. 2019). To examine their source and nature, we asked the respondents which moral dilemmas and ethical questions they encountered during zoonotic disease control. We inquired whether

they had experienced difficult professional or societal debates about certain zoonotic disease control measures and how they look at measures like the culling of healthy animals. Finally, we inquired about possible friction between personal and professional views in decision making or advising during a zoonotic disease outbreak.

Especially veterinary respondents acknowledged that zoonotic disease control can impair animal welfare, for instance by culling or keeping animals indoors to stop the spread of a disease (n=8). Another dilemma that was mentioned concerned the confidentiality of data (n=6). In the Netherlands, certain laboratories and research institutes are private companies used by veterinarians and farmers to diagnose animal diseases. Although they are legally bound to provide data of notifiable diseases, this sometimes leads to tensions. For instance, in case of a (new) zoonotic disease that is not mandatory to report, as was the case at the start of the Dutch Q-fever epidemic in 2007. Certainly, in times where public health risks are not clear yet a conflict of interests can arise, for instance between economics or privacy and public health.

Several respondents pointed out that a response to zoonotic disease signals was only initiated when it led to serious illness in human patients (n=4). When a zoonotic disease mainly affects animals and there is little disease burden in humans, the Dutch Zoonoses Structure will not advice action. A respondent illustrated this by posing the question: *"How many humans must become sick before action is taken against the animal disease source?".* This has primarily to do with reasons of cost-effectiveness. The question when to interfere in the animal production chain with stringent measures is also problematic from a legal and economic point of view. It was argued that farmers run business enterprises and there is a threat of legal liability procedures when there appears not enough scientific proof for certain disease control measures. This touches upon the issue of responsibility and bearing the costs of zoonotic disease control. One respondent mentioned that: *"Farmers are paying the price for zoonotic disease control while the benefits are on the human side"*.

Most respondents (n=11) did not experience any issues of cognitive dissonance, here interpreted as an internal conflict between their professional- and their personal opinion. They indicated that it is their job to provide professional advice based on available scientific evidence. They refrain from actual political decision making, because this is seen as a governmental responsibility. Many of the respondents recognized that zoonotic disease control can lead to public debate (n=9). However, some of them (n=3) regret the fact that in general many people form opinions without sufficient knowledge about zoonotic disease control. They observe a lack of mutual understanding between opposing parties in the societal debate and insufficient trust in expert opinions. One respondent indicated that: *"Public opinion influences the answer to the question whether interference is necessary but has no impact on how the disease is controlled".* Whether or not zoonotic disease control leads to public debate is also dependent on the species that is involved, some respondents (n=6) suggested.

Part of the respondents expected that problems could arise with killing horses or companion animals in zoonotic disease control because of the human-animal bond (n=3), although others did not experience this as an issue (n=3). Several respondents (n=4) found

killing of healthy food producing animals less problematic because these animals would be killed anyway. However, nearly all claimed that killing animals can only be justified when there is a serious public health threat and no alternatives are available (n=12). Some of the respondents (n=5) held the opinion that killing healthy animals does not affect their wellbeing. Arguments for this were that they believed animals do not have any awareness of future welfare and if the killing is performed *'lege artis'* these animals will not feel any pain or discomfort. Others (n=4) do think that killing affects animal wellbeing because we take away their future life and happiness. There was no difference in professionals from the human or veterinary domain in this respect, nor between men and women. However, we did note some discrepancies in the answers. Respondents who earlier stated that culling healthy animals was an animal welfare issue, had no problems with killing animals when this is done in a proper way and with a good reason.

### 3.3.3 What moral values are related to a One Health strategy in zoonotic disease control?

Our hypothesis is that moral presuppositions influence ethical decision making in zoonotic disease control. We were specifically interested in the effect of One Health in this context. Did the One Health concept add non-anthropocentric values in the decision-making process? Prior to our questions, we explained to our respondents that we defined values as situations worth pursuing or desirable characteristics of people, organizations or the society as a whole. Honesty and independence were mentioned as examples. We started with inquiring which values our respondents spontaneously associated with One Health strategies in zoonotic disease control. Thereafter, we confronted them with our list of values (see fig. 2). We asked them to choose the five most important values and rank them. Finally, we included questions about human-animal hierarchy, dietary patterns and keeping animals, to study their general attitude towards animals and the human-animal relationship.

Almost all respondents pointed out public health and/or human welfare as the most important value in zoonotic disease control (n=12). As one respondents described it: *"If we are not healthy [...] nothing else is important"*. Only one respondent thought public health was not necessarily an absolute trumping value in this context. In practice, economics appeared an important factor too. Many of the respondents (n=7) acknowledged that financial consequences always bear a heavy weight in the decision-making process. Several respondents (n=4) emphasized that honesty and transparency are important values. They stated that these values are necessary to give insight in all risk factors and to make the right considerations. Honesty and transparency also generate (interprofessional) trust and support from society for difficult decisions in zoonotic disease control. A favourable public opinion was mentioned several times as an important value to consider (n=7). Part of the respondents (n=5) expected that being more open about risks and consequences would contribute to a more socially acceptable zoonotic disease control.

During the interviews we did not encounter respondents with divergent views on the meaning of the values we presented. Values like animal health, animal welfare, the intrinsic value of animals, human-animal relations and environmental health were all mentioned by the respondents. However, most of them acknowledged that these values were not

decisive. For some (n=2), animal and environmental health were merely instrumental to public health and economy, as can be derived from this statement: *"Healthy food of animal origin is a prerequisite for public health"*. Values associated with the ecosystem were sometimes (n=4) interpreted as landscaping to minimize public health risks, for instance by moving animal production away from urban areas.

To reflect on moral presuppositions, we have also added questions about human-animal relations. All respondents placed humans hierarchically above animals. At the same time, they concluded that this does not imply that people could treat animals in any way they would like. Society should take good care of the farm animals and respect animal welfare. The arguments that our respondents brought forward to underpin this hierarchy varied from: *"We humans decide everything", "Humans have a life expectancy and a self-image, animals do not", "As long as we use animals for food we are not equal", "If we have to choose whose life to protect we decide for humans"* and *"I have stronger emotional relations with other humans than with animals"* to *"I cannot explain this, it is just my feeling"*.

When asked for a definition of health, all the respondents adhered to a holistic view. This implies that for humans, as well as for animals, health is more than just absence of disease. Wellbeing and social interactions are considered as constituent factors of health too. They did not feel there is a distinction between humans and animals in this respect. Many respondents, for instance, argued that besides good health the ability to perform natural behaviour is an important criterion for animal welfare. Only one respondent referred to a more instrumental version of animal health and stated that: *"An animal is in good health if it grows and produces well"*.

All but one respondent ate meat and other animal products. Many of them indicated that nowadays they try to eat less animal products because of the impact on the environment. For this reason, but also for animal welfare, these respondents buy organic products. Nearly all respondents have or have had companion animals. Only one respondent keeps animals for production purposes.

### 3.3.4 How are these moral values balanced in case of moral dilemmas related to One Health strategies in zoonotic disease control?

To understand ethical decision making in the practice of zoonotic disease control, we asked our respondents about balancing different values and the use of ethical principles. We first explained that ethical principles are derived from ethical theories and can be helpful in solving moral dilemmas and conflicts of interests. Then we asked them if they could spontaneously recall any examples of ethical principles. None of the respondents could clearly answer this. Thereafter, our overview of relevant ethical principles was presented (see figure 3).

Of these principles, most respondents appointed the precautionary principle as the most important action guiding principle in zoonotic disease control (n=10). One respondent explained: *"With a zoonotic disease outbreak there are always knowledge gaps, that is why the precautionary principle is important"*. Another respondent noted that: *"By appealing to*

*the precautionary principle we don't waste precious time discussing whether we know enough to take action".*

Other principles mentioned were the "do no harm"-principle (n=10), respect for autonomy (n=9), the principle of justice (n=4) and the utility-principle (n=2). Since the "do no harm"-principle and the precautionary principle are strongly related, it is clear that the notion of non-maleficence for humans is viewed as most important. No distinct ranking of the other principles could be derived from the answers. Some respondents considered that the "do no harm"- principle should be applied to humans as well as animals. This would imply that animals should not be unnecessarily harmed by zoonotic disease control measures. However, most respondents use ethical principles purely from an anthropocentric perspective. One respondent, for instance, declared that: *"The "do no harm"-principle applies to animals as long as there is no human suffering".*

Although some respondents claim that most of the principles on our list were implicitly used in the decision-making process, others hold the opinion that the use of ethics in zoonotic disease control is underdeveloped. From the way our respondents reflected on ethical principles, we question a uniform use of ethical principles in general and of the precautionary principle more particularly. Some respondents frame this last principle as taking precautions to prevent a zoonotic disease outbreak. This interpretation can be understood as the principle of prevention, which entails that it is generally preferable and cheaper in the long term, to prevent social impacts and ecological damage than having to restore and rectify damage after an event (Vanclay 2003).

Others specifically refer to precautionary actions to mitigate public health risk in times of scientific uncertainty. This view is derived from a general definition of the precautionary principle: when an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically (Wingspread 1998).

These differences in interpretation call for further research on the role and meaning of the precautionary principle in zoonotic disease control. For other principles we also found differences in interpretation. The principle of utility was sometimes used as a simple cost-benefit analysis. In other interviews it was explained as promoting overall (human) wellbeing. By some, the principle of justice was a substantiated outcome when balancing conflicting human and animal values. Others indicated that justice requires treating certain categories of animals the same as others. In case of avian influenza, for example, the question is whether it is justified to apply different rules for commercial and backyard poultry.

When asked about trade-offs in zoonotic disease control, six respondents point out public health as the most important and decisive value in zoonotic disease control. One (human health) respondent regarded loss of animal health and welfare as purely economic. Another (veterinary) respondent pointed out that: *"No concessions are made to human interests in order to improve animal or environmental health".* According to most respondents, human morbidity or mortality is an indispensable driver to start zoonotic

disease control measures. Animal interests are taken into account, as far as the effect of disease control measures on animal welfare is concerned. These control measures must be proportional in relation to the risk for public health. One respondent argued: *"You have to have good reasons to cull healthy animals in case of a zoonotic disease outbreak".*

## 3.4 Discussion

### 3.4.1 Professional background and gender

Our research population represents policymakers and advisors from both the human and the veterinary domain involved in the Dutch Zoonoses Structure. Beforehand, we expected to find differences in responses between these two groups. Professionals from the veterinary domain were thought to value animal interests more than their human counterparts. However, our research did not reveal much difference in this respect. Only when asked about moral dilemmas, human professionals mentioned a field of tension between economics and public health more often, frequently referring to the Q-fever case. The same goes for gender differences. Only in case of the "do no harm"-principle, most of the respondents, considering it should apply to humans as well as animals, were male (six out of the seven). This is inconsistent with literature, that finds that women, on average, show higher levels of positive attitudes towards animals (Herzog 2007). Otherwise, no difference in response was noted between human and veterinary health professionals, nor between male and female respondents. This can partly be explained because our respondents are a selective group involved in One Health policymaking. The context in which our respondents operate probably influences their balancing of values related to humans and animals (van Asselt et al. 2019). The answers of our respondents are therefore not representative for the view of the general public.

### 3.4.2 Is-ought distinction

In certain cases, it was not clear if the respondents answered the questions from the perspective of the actual or the desired situation. For instance, when a respondent states that: *"No concessions are made to human interests to improve animal or environmental health".* Sometimes the context or further questioning revealed the respondents real position. Because this situation occurred more than once, we think this could imply that some health professionals struggle with a so-called "is-ought" distinction. In other words, how is the present situation related to what - in their view - ought to be the case? In ethics descriptive and normative statements are considered independent, which means that no "ought" can be derived from an "is" (Spielthenner 2017). A possible explanation for the conflation of is and ought, that we sometimes encountered, is that health professionals do not think they can change the present situation and therefore accept this as a given fact. Furthermore, the role of our respondents as health professionals and experts might limit them in expressing normative opinions.

### 3.4.3 Public health as trumping value

Considering a One Health approach in zoonotic disease control, the results indicate a strong focus on public instead of individual health. This is compliant with the overall aim of the Dutch Zoonoses Structure to protect public health rather than the health of individual

animal keepers, veterinarians, consumers or animals. In theory, nearly all respondents endorsed a holistic idea of One Health: to promote the health of humans, animals and environment. However, in practice zoonotic disease control is predominantly aimed at protecting the health of humans. Animal and environmental health are only instrumental to safeguarding public health. As a result, the Netherlands operationalized One Health by structuring interdisciplinary collaboration in zoonotic disease control to protect public health.

This anthropocentric interpretation of One Health is also reflected in the moral presuppositions of human and veterinary health professionals involved in the Dutch Zoonoses Structure. The respondents convincingly point out public health as the most important value. Values related to animals or the environment do play a role in the decision-making process, but only a secondary one. At best, the effect of zoonotic disease control measures on animals and the environment is considered. However, in this approach public health is still the trumping value. These findings are consistent with reflections (Meijboom and Nieuwland 2018) and empirical research (Lysaght et al. 2017; Degeling et al. 2017) of other authors. Several scholars have promoted interspecies equity (Rüegg et al. 2017) or more-than-human solidarity (Rock and Degeling 2015) to emphasize the importance of including non-anthropocentric values in One Health strategies to combat zoonotic diseases. Our results show that apparently in practice this is not self-evident. The respondents indicate that the most pressing conflict of interest in zoonotic disease control is that of public health versus the financial interests of the livestock industry, both human-directed values. These results are consistent with the findings of a historical analysis of dealings with zoonotic diseases of livestock in the Netherlands (Haalboom 2017).

We did not specify the meaning of the values that we presented in advance. Nevertheless, during the interviews we did not experience much difference in interpretation. Just a few times, we discussed briefly the meaning of certain values, like autonomy. From this we conclude that interpretational differences did not affect the outcome of our results. In general, the values we presented were all considered as important factors in zoonotic disease control. For some values incorporated in the assessment framework of the Dutch Council on Animal Affairs, like social impact, contamination or landscape architecture, it is debatable whether these are actually moral values. In addition to our list of values, several respondents mentioned honesty, trust and transparency as core values in zoonotic disease control. On the one hand these values are regarded as a basic requirement for cooperation between different professional disciplines, on the other hand these notions are seen as necessary to establish societal support for difficult control measures. We therefore suggest adding these values to the assessment framework of the Dutch Council on Animal Affairs to evaluate One Health strategies.

### 3.4.5 The ambiguity of the precautionary principle

Regarding the use of ethical principles, the results illustrate that professionals in the current Dutch Zoonoses Disease Structure have little ethical knowledge. Just one ethical principle is dominantly present in the decision-making process: the precautionary principle. This principle is regularly invoked by policymakers to justify drastic zoonotic disease control measures, like culling of healthy animals (Mepham 2015; Bruschke et al. 2016). However,

some respondents applied the precautionary principle to promote measures to prevent zoonotic diseases. Asked for the need and the nature of zoonotic disease prevention the answers differed. Many respondents (n=7) said that improving of farm biosecurity was important to prevent zoonoses. Vaccination of farm animals (n=3) and early warning (n=3) were mentioned less frequently. There was little attention for possible underlying causes of zoonotic disease outbreaks, although some respondents suggested drastic redesigning of animal production systems (n=3), reducing the total amount of farm animals (n=1) or separation of food production and residential areas (n=1). Four respondents added that proportionality was an important prerequisite in the selection of disease control measures based on the precautionary principle.

The use of the precautionary principle is a much debated issue in public health ethics (Resnik 2004; Termeulen 2005). Although it is beyond the scope of this paper to fully analyze its application in zoonotic disease control, the respondents often present the precautionary principle as an objective tool to justify quick interventions in zoonotic disease control. However, as we can learn from the Q-fever outbreak in the Netherlands, in practice these interventions are often postponed for other reasons than lack of scientific evidence. For instance, the fact that the government needs to underpin disease control measures to counter possible liability claims. Moral values like economy, privacy and animal welfare play a role in the decision making process and therefore the precautionary principle is of course not morally neutral (cf. van den Belt 2003). Its use in zoonotic disease control confronts us with extra scientific value judgments and triggers questions like: which harm do we prevent, which measures do we apply if this (and the underlying causal relations) is not fully established? Therefore, in our opinion further research is needed to analyze the ethical implications of the use of the precautionary principle in zoonotic disease control.

**3.4.6 Moral status of animals**

To understand the respondents' basic attitude towards animals, we asked about their view on human-animal health and hierarchy. Moral convictions concerning animals influence people's judgements about disease control measures, like culling (Cohen et al. 2012). None of the respondents declared that humans and animals were equal. This differs remarkably with views of the general public, of which between 32% (Cohen et al. 2012) and 24% (Council on Animal Affairs 2018) consider humans and animal as equals because they think that humans and animals are both sentient beings and are all part of the natural world. Despite their preference, most respondents were convinced that in zoonotic disease control animal interests should be considered. In practice, the decision-making process is limited in this respect. Zoonotic disease control in the Netherlands is subject to strict EU regulations, in which human interests prevail. This can be explained from the fact that these regulations originate from the principle of liberal trade, one of the starting points of the European Union, and Dutch agriculture highly depends on its export position.

Even when regulations leave room for selection in disease control measures, as was the case in the Q-fever epidemic, our research shows that human interests are overriding. This can partly be explained by our respondents' background. These professionals all work

in zoonotic disease control, where public health takes a central place (National Institute for Public Health and the Environment, 2019a). This context plays a significant role in the decision-making process. From their reactions on questions about human-animal relations it appears that our respondents, just like the majority of the general public, do attribute animals moral status. This implies that their interests should be taken into account, in other words animals are morally considerable. However, health professionals experience zoonotic disease risks differently than laypeople. Although the question remains whether this is only a matter of knowledge or of different world views.

Other research has clarified that within the general public there is a significant heterogeneity concerning values related to One Health strategies in zoonotic disease control (Johnson et al. 2019). Johnson et al. found that food security, animal welfare and economic development are all considered important values by the general public. Furthermore, in case of value conflicts people were willing to accept trade-offs between these different values. In certain situations, part of the general public seemed to tolerate a somewhat higher morbidity and mortality in humans in favour of other values like food security. Their findings also suggest some willingness to accept certain burdens in order to ensure the health of animals and the environment (Johnson et al. 2019).

Our respondents however, work within a regulatory framework that prioritizes public health and economics. This is probably why they eventually value these interests more than animal interests, when making decisions in zoonotic disease control. The suggestion that attitudes towards animal interests are context dependent is also described elsewhere in literature (Cohen et al. 2012; Knight et al. 2010; van Asselt et al. 2016). Besides context, animal species can influence the decision-making process as well. For instance, several respondents (n=6) foresee a societal debate around the culling of companion animals and horses. While culling of farm animals is considered less controversial because these animals are destined to be killed anyway.

The dominance of human interests is reflected by the method of prioritization of zoonotic diseases, which the National Institute of Public Health and Environment has developed (fig. 4). This risk score was based on seven criteria, reflecting assessments of the epidemiology and the impact of zoonotic pathogens on society. Criteria are weighed, based on the preferences of a panel of judges with a background in infectious disease control (Havelaar et al. 2010). The following criteria are part of the assessment: 1) probability of introduction into the Netherlands, 2) transmission in animal reservoirs, 3) economic damage in animal reservoirs, 4) animal-human transmission, 5) transmission between humans, 6) morbidity in humans and 7) mortality in humans. None of these criteria include features that are intrinsically directed towards animals or the environment. In this method animal disease cases are only measured in term of economic loss (criterion 3), while human morbidity and mortality count as separate criteria. In other proposals to rank zoonotic diseases, like the One Health Zoonotic Disease Prioritization tool (Rist et al. 2014), the disease burden in animals is also translated into economic costs only. This demonstrates that in this context animal and environmental interests are of secondary importance.

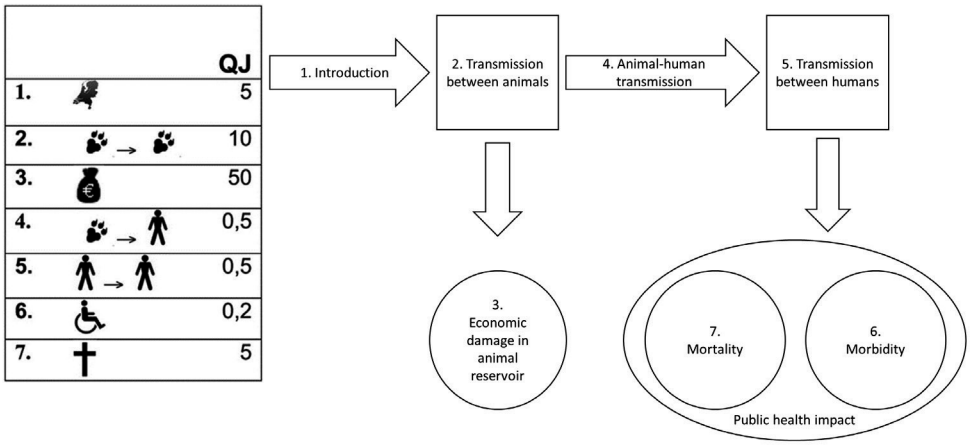



**Fig.4** Example of randomly created scenario used to determine relative weight (QJ) of zoonotic disease criteria, source: Havelaar et. al 2010

## 3.5 Conclusions

In the Netherlands, One Health strategies in zoonotic disease control have translated into improvement of interdisciplinary cooperation to safeguard public health. This has resulted in a well- functioning system to detect zoonotic disease signals as soon as possible. However, the current Dutch Zoonoses Structure is not very well equipped to tackle the inevitable moral dilemmas that can arise in zoonotic disease control. It appears that in theory the holistic One Health paradigm is broadly supported amongst human and veterinary health professionals. In practice anthropocentric views are dominant. Public health and to a lesser extent economics are at the heart of current One Health strategies to combat zoonotic diseases. In general, animal- and environmental interests are subordinate to human interests. It is questionable whether society always shares this conception.

The assessment tool of the Dutch Council on Animals Affairs can be helpful to structure ethical decision making but does not give guidance in ethical reflection. Moreover, values like honesty, trust and transparency which are at the core of interdisciplinary cooperation and societal acceptance, are not considered yet. Serious discussion of ethical issues should be an integral part of deliberations preceding decisions about measures to prevent and fight zoonosis. Although such discussion may not always make a difference to the final decisions reached, it is important in a democracy to ensure that the ethical assumptions underlying the decision-making process are transparent (cf. Wright, Meijboom and Sandøe 2010). The role of ethicists includes identifying ethical dilemmas and corresponding moral values. Furthermore, they can facilitate ethical discussion by providing relevant ethical principles, analysis of arguments and considerations for action perspectives.

CHAPTER 4

# The precautionary principle in zoonotic disease control: Implications of taking One Health seriously

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## 4.1 Introduction

In recent years it has become evident that animal husbandry can have a negative impact on public health. These public health risks vary from zoonotic diseases like avian influenza and Q-fever, to antimicrobial resistance and particulate emissions (Anomaly 2015; O'Neill 2016; National Institute for Public Health and the Environment 2017). Moreover, not only the health of animals and humans is involved. Intensive livestock production has proven to have a detrimental effect on our ecosystem as well (Seinfeld et al. 2006). For this reason, intensive animal husbandry has received most of the attention. However, public health risks like zoonotic diseases are also associated with organic farming, and keeping of companion animals and horses (Vlaanderen et al. 2019).

The international standard to address these health issues is called One Health. Within a One Health perspective it is recognized that the health of animals, humans and the environment is inseparably intertwined. Therefore, all health issues at the human-animal-environmental interface should be tackled in a collaborative effort of multiple disciplines - working locally, nationally, and globally - to attain optimal health for people, animals and our environment (American Veterinary Medical Association 2008).

In the interest of public health, health professionals frequently employ the precautionary principle to justify drastic measures to counter zoonotic disease threats (Degeling et al. 2019; Van Herten et al. 2020). The general idea of the precautionary principle is that scientific uncertainty should not stand in the way of actions to prevent potential grave harm to the health of humans, animals and the environment (cf. European Commission 2000). However, zoonotic disease control measures to protect public health can have a negative impact on the health and welfare of animals. Examples of such measures are the culling of healthy animals, restricting the use of certain antimicrobials in animals or confining animals and implementing transport bans.

This raises questions about use of the precautionary principle in relation to the concept of One Health. Can precautionary measures still be justified when protection of public health harms animals or the environment? And what does a One Health perspective teach us about risk and prevention of zoonotic diseases?

In this paper, we illustrate how precautionary measures to combat zoonotic health problems can lead to certain moral dilemmas, especially within the One Health framework. Thereafter, we analyze the use of the precautionary principle in the context of public health and discuss its constraints. We argue that to respect the rationale behind One Health, the use of the precautionary principle in zoonotic disease control should be bound to specific criteria. Then, we will reflect on the societal perception of zoonotic disease risks and prevention strategies following the concept of One Health. Finally, we provide some guidance for the application of the precautionary principle in zoonotic disease control.

## 4.2 Ethical issues of precautionary measures in zoonotic disease control

There are many examples of the use of the precautionary principle to prevent or stop the spread of zoonotic diseases. Most recently, in the Netherlands and other European countries all animals on infected mink farms were culled to prevent them becoming an animal reservoir for COVID-19. This was done after a comparison of viral DNA that suggested that mink had infected employees (Oreshkova et al. 2020). Although there was no direct threat to public health and experts acknowledged that human-human transmission remained the most important driver of viral spread, mink were culled for precautionary reasons. Even though infected mink showed clinical signs of COVID-19, many of them did seem to recover from this illness. However, because it was not clear if they would then be permanently protected against COVID-19 and no longer infectious for humans, the government decided to take action.

Culling (healthy) animals has become a standard in zoonotic disease control (Degeling, Lederman and Rock 2016). Often this practice is justified on the basis of the precautionary principle. During the outbreak of Bovine Spongiform Encephalopathy (BSE) in the United Kingdom, for instance, 4,7 million cattle were culled as part of an eradication programme to protect public health. This was done because there were indications that by eating meat from cattle affected by BSE, commonly called 'mad cow' disease, humans could acquire Creutzfeldt Jakob's disease. Although at that time the complete aetiology of Creutzfeldt Jakob's disease was not fully clear, policymakers decided that the death of approximately 200 people in that period (1985-1999) justified such drastic measures (Jones 2001). In other European countries precautionary measures were implemented too. In the Netherlands, where the incidence of BSE was much lower, the government resisted an EU proposal to cull healthy cows to ensure public trust and to prevent a drop in meat prices (Oosterveer 2002). However, the Dutch government did implement measures like post-mortem BSE testing and removal of risk material from slaughter cattle. In hindsight, mainly the cost-effectiveness (in euros per life year saved) of BSE control was debated (Benedictus et al. 2009). This shows that political and economic considerations are often dominant in the risk management of zoonotic diseases in livestock that threaten human health.

A similar situation occurred during the Q-fever outbreak in the Netherlands. From 2007-2012 approximately 4000 people became infected with *Coxiella Burnetii*, the bacterium that causes this disease. Moreover, in that period the death of 95 people was related to Q-fever. Before long, goat farms in the South East region of the Netherlands were identified as the probable source of the infection. To stop the outbreak, in 2008 the government started with the introduction of strict hygiene-protocols and vaccination of the animals. However, the number of infected patients kept rising. On the basis of the precautionary principle the Dutch Institute for Public Health therefore advised to kill all the goats on 90 goat farms in this region at the end of 2009 (Bruschke et al. 2016). In total 50.000 animals were culled, many of them in gestation. Although it was not clear if all of them were infected, authorities decided to make no exemptions because testing was too time-consuming and costly. In the Netherlands, the government was subject to strong public criticism about their (slow) response to this zoonotic disease (Van Dijk et al. 2010). This indicates that according to societal opinion public health generally trumps other values.

Apart from culling healthy animals, the use of the precautionary principle has other problematic implications as well. For instance, to prevent outbreaks of avian influenza free range poultry is regularly confined for several months a year. This can seriously impact animal welfare because the housing system in these free-range farms is often not adapted for this. Another example are (European) policies to reduce antimicrobial use in animal husbandry in order to fight antimicrobial resistance. These include restrictions of the use of certain antimicrobials in animals because they are critically important for public health. Although over- and misuse of antibiotics in livestock is acknowledged as a public health threat, veterinarians as well as farmers address concurrent health and welfare risks for animals. They point at a rise of mortality and morbidity rates because animals receive suboptimal medical treatment. In this perspective, the Dutch Council on Animal Affairs warned that: 'the wish to achieve major reduction in antibiotic use in animal husbandry should never lead to the attitude that higher disease incidence and mortality are acceptable' (Council on Animal Affairs 2016a, pp.9).

Ethical questions regarding the use of the precautionary principle do not only arise in animal husbandry. In 2019 the Dutch Food Safety Authority detected *Brucella Canis* in dogs that were bred in the Netherlands. Until then, this zoonotic infection only occurred in dogs imported from Eastern European countries, where the disease is endemic. As a precautionary measure, authorities decided to euthanize all dogs in the breeding kennel that was the source of infection. *B. Canis* is a bacterial infection that can cause inflammation of reproductive organs and abortion in dogs, sometimes with ocular disease or discospondylitis. The bacteria usually persists in these animals even after treatment with antimicrobials. Experts therefore advice neutering, isolation or euthanasia (in breeding kennels) (Spickler 2018). In humans *B. Canis* infections cause flu-like symptoms that normally respond well to antimicrobial treatment. Especially immuno-supressed people and young children are vulnerable. Because the number of human *B. Canis* cases is low, even in regions where the disease is endemic, not many countries have developed control plans. Instead of culling infected dogs, vaccination could significantly reduce the health risk for dogs as well as humans (Hensel et al. 2018). However, because of the low zoonotic risk the disease receives low priority from institutions such as the World Health Organization. As a result, pharmaceutical companies do not recognize a commercial interest in vaccine development for dogs, contrary to cattle for which Brucellosis vaccines are available.

Decision making in zoonotic disease control can cause value conflicts, for instance between values like animal welfare, public health or economy (Capps et al. 2015; Degeling et al. 2017; van Herten et al. 2020). The use of the precautionary principle raises ethical questions, especially in the light of current One Health thinking. First of all, from a One Health perspective one could question whether it is justified to apply the precautionary principle in such a way that it harms animals or the environment. Or does the One Health paradigm prescribe certain restrictions to prevent this? Furthermore, the precautionary principle is normally evoked concerning human actions that could possibly harm public health or the environment. For instance, to justify regulations on genetic modification of crops, like the EU ban on CRISPR-Cas gene editing in plants. In those cases, the principle prescribes to refrain from these actions or to adjust them to prevent this harm. But as

we have seen, the precautionary principle is also used in case of zoonotic infectious diseases that often arise suddenly and unpredictably. What is the role of human actions in these situations? Does it make a difference if the cause of a zoonotic disease outbreak is anthropogenic instead of 'natural'? We will address these issues in the rest of this paper and offer some guidance in applying the precautionary principle in the context of zoonotic disease outbreaks, but first we will elaborate on the use of the precautionary principle in public health policies.

## 4.3 The precautionary principle and public health policies

How should we act to prevent potential harm in times of scientific uncertainty? This is basically the question that underlies the idea of the precautionary principle. In the light of possible future environmental damage through human actions, the first formulation of the precautionary principle was coined during the United Nations 'Rio'-conference in 1992: 'Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost effective measures to prevent environmental degradation' (United Nations 1992). The 'Wingspread' conference in 1998 developed another yet similar version, including the notion of public health: 'when an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause-and-effect relationships are not fully established scientifically' (Science and Environmental Health Network 1998). Since then many different versions and interpretations have evolved. To date no specific definition is formulated for the application of the precautionary principle in zoonotic disease control. There are, however, more tailored descriptions of the principle in the public health setting.

Horton (1998, pp. 252) for instance, interpreted the principle as follows: 'We must act on facts, and on the most accurate interpretation of them, using the best scientific information. That does not mean that we must sit back until we have 100% evidence about everything. Where the state of the health of the people is at stake, the risks can be so high and the costs of corrective action so great, that prevention is better than cure. We must analyse the possible benefits and costs of action and inaction. Where there are significant risks of damage to the public health, we should be prepared to take action to diminish those risks, even when the scientific knowledge is not conclusive, if the balance of likely costs and benefits justifies it'. In 2000 the European Commission has published guidelines for the use of the precautionary principle (European Commission 2000). In this document it is stated that the principle is applicable to prevent harm to the health of humans, animals, plants and the environment. The Commission stresses the importance of structured decision procedures and the use of all available scientific evidence. Although helpful in some aspects, these EU guidelines leave many ethical questions unanswered. For instance, how to deal with conflicting values? Is public health always dominant over animal and ecosystem health? Or how to weigh the benefits of prevention of public health harms on the short term, against long term negative effects of disease control measures on animal and environmental health?

In the context of public health, the impact and consequences of using the precautionary principle has been debated extensively. Some authors consider the principle not applicable in clinical human medicine nor public health policy. According to Ter Meulen (Termeulen 2005) physicians have an obligation to do good to their patients and have to weigh the benefits against possible harms and burdens. The basic virtue of medical decision making is not avoidance of risks, as stated in the precautionary principle, but the prudent assessment of benefits, burdens, and harms, in relation to other ethical principles like respect for autonomy and justice. Ter Meulen believes the precautionary principle does play a role in health care, but it should never rule medical decision making as an absolute principle. In contrast, Resnik (2004) thinks the precautionary principle can offer physicians and patients a useful tool in making decisions about treatments. When physicians lack adequate scientific proof relating to the potential outcomes associated with various choices, they should take reasonable measures to avoid health threats that are serious and plausible. According to Resnik, the reasonableness of a response to a health threat depends on several factors, including benefit vs. harm, realism, proportionality, and consistency (Resnik 2004). The precautionary principle is also widely adopted in drug development to prevent unwanted negative side-effects on human, animal and environmental health. As a consequence of this risk averse attitude, the introduction of new therapies could be slowed down and therefore harm patients (Bailey 2001). In the race to develop an effective vaccine against COVID-19, we have seen that these precautionary regulations are stretched when needed (European Commission 2020). Finally, some authors warn that careless use of the precautionary principle to protect public health could result in the opposite. It is claimed, for example, that the ban on insecticides like DDT has caused a resurgence of malaria in developing countries (Bate 2003).

The main reason for public health professionals to appeal to the precautionary principle is to prevent harm to public health, since this is the primary objective of public health policies. In practice, the precautionary principle functions as a decision-making tool. When public health professionals, due to a lack of scientific evidence, cannot base their decisions on the basis of a standard cost-benefit analysis they often use the precautionary principles as a guideline. An example of this is the advice to wear face masks to prevent COVID-19 transmission. Although it is scientifically contested whether it will reduce viral transmission significantly or not, health authorities in many countries think that the seriousness of the COVID-19 pandemic justifies an obligation to wear non-medical face masks in public (Greenhalgh et al. 2020).

In such cases the function of the precautionary principle can best be described as an heuristic tool for decision-making under uncertainty (Tickner 2002). Often without explaining the rationale behind their decisions, public health professionals tend to justify disease control measures by referring to the precautionary principle (Rosella et al. 2013). However, an appeal to the precautionary principle is not a carte blanche. Several scholars have pointed out that there are certain constraints around the use of the principle in health settings. In the next paragraph we will discuss these limitations.

## 4.4 Conditions and constraints for the precautionary principle

As seen earlier, the precautionary principle comes in many forms and applications. In general, for each version of the precautionary principle at least three conditions must be met (Kramer, Zaaijer, and Verweij 2017).

First, there must be some kind of *harm,* that does or might occur. Within the context of zoonotic disease control and public health policies this harm is often primarily understood as harm to human health. However, starting from the concept of One Health, harm to the health of animals and the environment should be taken into account too, especially, because the health of living beings and ecosystems is inextricably linked. One Health teaches us that preventing animal and environmental health damage will eventually benefit human health too. Traditionally, the precautionary principle was directed to anthropogenic actions in order to prevent harm to the health of humans, animals or the environment. Typically, in the case of a zoonotic disease outbreak such a harm can also originate as a non-anthropogenic event. However, in many cases the drivers of these outbreaks are in fact traceable to human activity, such as deforestation, climate change, wildlife trade, etc. [9].

Secondly, to evoke the precautionary principle it has to be (theoretically) plausible that without interference the health of humans, animals or the environment is indeed harmed. This *knowledge* condition requires that there is at least a minimal amount of scientific evidence that with taking precautionary measures health harms can be prevented. This approach contains the risk that a theoretical and minimal chance of a serious health threat, would immediately lead to the implementation of drastic precautionary measures. Wilson and Atkinsons recognized this danger of overreaction where the measures to prevent the harm might be more harmful than the event itself. They proposed a framework for calibrated precaution where the theoretical risk is balanced against the potential harm of the risk mitigating policy (Wilson and Atkinson 2017). From a One Health perspective this assessment should also include the health risks for animals and the environment. In this respect, the emphasis should not only be on the impact of the zoonotic disease itself but also on the effect of disease control measures.

This brings us to the third condition of the precautionary principle which is focused on the element of *precautionary action*. This condition concerns the precautionary measures that are indicated when the harm and knowledge condition are met. Logically, the consequences of these actions may not be worse than the harm they should prevent. Kramer et al. (2017) proposed three criteria to evaluate possible mitigating measures. To begin with, they argue that the precautionary principle cannot prescribe safety measures and, considering the potential harms involved in those measures themselves, advise against them at the same time. In other words, the precautionary principle has to be

9 We argue that human actions are often the direct or indirect cause for zoonotic disease transmission. Therefore, our conclusion is that zoonotic disease outbreaks often have anthropogenic drivers. However, the actual transmission from animals to humans is in many cases not directly anthropogenic. Examples of non-anthropogenic zoonotic disease transmission are West Nile virus, where humans become infected by a vector (mosquito-bite) and rabies, where humans are bitten by an infectious rabid animal (dog, cat, racoon etc.).

applied in a *consistent manner* and one cannot simultaneously prescribe and forbid certain safety measures. However, in the case of zoonotic disease control this often seems more or less inevitable. As we have seen earlier, many common disease control measures, like culling or containing, do have a negative impact on animal health or welfare. Moreover, the broader the definition of harm, the more difficult it will become to prescribe disease control measures that don't have any negative consequences.

This leads us to the second criterion for precautionary measures, which is to *avoid counterproductivity*. Precautions should not cause more harm than they ought to prevent. For instance, in the case of COVD-19, effective disease control measures such as a lockdown have led to serious socio-economic harms. Some studies even suggest that the numbers of lives saved by measures, like a total lockdown, are overridden by the number of lives lost by the consequences of these policies (Gupta Strategists 2020). And although at first sight the environment has seemed to benefit from the shutdown of human activity, it is unclear what the effects in the future will be. Further steps to mitigate the effects of climate, for instance, will require major financial investments. In times of economic depression this could be difficult for many countries.

Finally, the criterion of *proportionality* forbids precautions that are more harmful than other alternatives. In a One Health approach this implies that the effect of certain measures to protect public health on animals and the environment, should be taken into account. Along this line of argumentation, an intervention such as vaccination of humans and/or animals is a better alternative than culling practices. Again, this assessment will be more difficult when the definition of harm is considered broader than direct health effects. At the same time, it will imply difficult trade-offs between short- and long-term interests of humans and animals. To let the precautionary principle function as a useful instrument for policy makers addressing zoonotic disease risks these criteria provide some guidance. However, as Kramer et al. (2017) state, accepting these constraints will imply that a certain degree of risk has to be accepted. In the case of safety of donor blood, for instance, this can imply that a small risk on certain transferable diseases is tolerated because the costs of complete testing are irrationally high. In the next paragraph, we will explain that in case of zoonotic disease risks this can be complicated.

## 4.5 Ethical acceptability of zoonotic disease risk

On the ethical acceptance of risk, Hansson (2003) posed that in principle everyone has a prima facie right not to be exposed to risk. However, this right can be overridden if the risk-exposure is part of an equitable system for risk-taking that on balance works to the advantage of the individual risk-exposed person as well. In many parts of the world the practice of animal husbandry for the production of food is, to a certain extent, socially accepted and sometimes even necessary for survival. The vast majority of the global human population benefits from this social system. This could imply that the exposure to public health risks associated with livestock production, like zoonotic diseases, is likewise acceptable.

However, in a number of (Western) societies there are a considerable number of people who oppose the consumption of animal proteins for moral and/or environmental reasons. In Europe approximately 5% of the population follows a vegetarian or vegan diet (Nielsen 2016). Besides that, in most parts of the world animal protein is no longer a necessary ingredient of a healthy diet. On the one hand, this could imply that in these societies public health risks of farm animal husbandry are not ethically acceptable after all. On the other hand, most people accept that we use animals for other reasons like companionship or sport. As said earlier, zoonotic diseases are associated with these types of animal keeping too. Moreover, the greatest risk for emerging zoonotic diseases comes from the wildlife reservoir (Jones et al. 2008). This implies that where (domesticated) animals and humans live closely together, there will always be a certain risk of zoonotic disease transmission. As a matter of fact, zoonotic diseases are and always will be a natural part of any ecosystem on the planet.

Therefore, we have to conclude that as long as we live in a world with wild and domesticated animals, a certain level of zoonotic disease risk is unavoidable and should be considered as a fact of life. Of course, this does not exempt animal keepers from their duty to prevent zoonotic diseases to spread. In principle, this duty is equal for farmers, horse-keepers or owners of companion animals. In this respect, all animal owners have a moral obligation to take preventive measures like securing biosecurity, vaccination and veterinary care. In situations where zoonotic disease risk is considered higher, for instance in intensive animal husbandry, a greater effort and perhaps stronger regulations to prevent zoonotic spill over are justified. At the same time, this implies a moral obligation of society as a whole to protect the natural habitat of wildlife. Not only to prevent the spillover of pathogens to humans, but from a One Health perspective also to safeguard the health and welfare of animals in the wild and our environment. Hinchliffe and Ward translate this as follows: 'biosecurity, or what we call the making of safe life, is constituted through an ability to work with rather than against a complex microbial environment' (Hinchliffe and Ward 2014, pp. 136)

So, the question is how much – or little - zoonotic risk from animal husbandry should public health authorities accept before they can appeal to the precautionary principle and take control measures? In this respect, a general critique of the precautionary principle is that it can be unrealistically intolerant for risk and requires unreasonable sacrifices in the name of safety (Kramer, Zaaijer, and Verweij 2017). It would be unreasonably for example, to cull a large number of healthy animals, only to avoid a small risk for humans of contracting a minor flu. To establish a reasonable threshold can be difficult. Depending on the ethical framework, the outcome of such an assessment will differ. In a utilitarian calculus, for instance, there will be a certain tolerance for human casualties, as long as overall utility of animal husbandry overrides these losses. A deontological perspective, on the other hand, may offer more support for a zero-tolerance approach of zoonotic disease risk. In general, public health authorities will take an anthropocentric approach in such assessments. However, from a One Health perspective harm to animals and the environment should be included as well.

How difficult these considerations can be for the responsible authorities, can be illustrated by the debate about public health risks of residents living in the vicinity of (goat and poultry) farms in the Netherlands. Research has pointed out that there is a higher incidence of pneumonia (5-7%) in people living close to these farms (< 2 km) (National Institute for Public Health and the Environment 2017). Although the exact cause of this effect is not identified yet, a higher level of endotoxins in the air is supposed to play a role. Besides an increased risk of pneumonia, researchers also found that people living close to farm had less asthma and less allergies. At the same time, it is known that in certain regions in the Netherlands 70-90% of the farms lie within 250 meters form residential buildings. To banish the risk of pneumonia related to animal husbandry completely in these regions, drastic measures would be necessary and probably require a radical change in urban development and rural planning. This seems unrealistic in the short term. Furthermore, the trade-off between the risk of pneumonia and the prevalence of asthma and allergies, is something to take into account too.

Local governments, however, do have the authority to make decisions about land use planning and environmental licensing. In the Netherlands, this resulted in regional bans for goat farms to expand. The public concern about goat farms was already elevated because of the Q-fever epidemic (2007-2012) in the Netherlands. The results from further research concerning the public health risks of animal husbandry, established a new but unidentified relation with goat farming. Altogether this urged local governments to invoke the precautionary principle and take preventive action. In the following decision-making process, human interests like public health and economics were balanced. However, the interests of the animals were hardly taken into account. The effect of withholding licenses to expand, confronted farmers with housing problems causing welfare problems, especially for young male goats. These animals are economically of little value and therefore worst off. As often in case of zoonotic disease control, it seems that animals are at the losing end.

Even if zoonotic disease risks might sometimes be inevitable, there is still a moral obligation to compensate and reduce zoonotic disease risks whenever possible, and to adequately inform the people at risk about the situation (cf. Hansson 2003). This places a special burden on those responsible for potentially harmful activities (Raffensberger and Tickner 1999). In the context of animal husbandry, it implies that farmers have to take all the preventive measures they possibly can to mitigate zoonotic disease risks. This includes inter alia: optimal biosecurity, housing and management that supports animal health, preventive veterinary care like vaccination. Furthermore, public health authorities should implement early warning systems to detect (unexpected) disease outbreaks. Living with uncertainties concerning zoonotic disease risk can be stressful and lead to societal tensions, for instance in communities with intensive animal husbandry. After analyzing the public health response against West Nile fever in the United States, Tickner therefore concluded that zoonotic disease control cannot remain the exclusive domain of experts (Tickner 2002). Especially because zoonotic disease control can lead to value conflicts and experts' values are not necessarily more weighty than non-experts' values, policy-making will benefit from a broad and informative public dialogue, acknowledging unavoidable risks, uncertainties and trade-offs, because this creates transparency and hence trust and public support.

## 4.6 Operationalizing the precautionary principle in zoonotic disease control

What can we learn from these insights for the application of the precautionary principle in zoonotic disease control? To answer this question it is helpful to distinguish between two rational approaches to risk: prevention and preparedness (cf. Lakoff 2007). In situations where a standard cost-benefit analysis is impossible because of scientific uncertainties, authorities often fall back on precaution as the basis for decision-making. Precaution typically entails avoidance of risk by refraining from certain actions or taking measures to prevent associated risks. As we have seen, in case of zoonotic disease risks, this is not always feasible. Zoonotic diseases can strike unexpectedly and as COVID-19 has proven, it is nearly impossible to predict which pathogen will cause the next pandemic nor when or where this will happen. For these kinds of zoonotic disease risks, preparedness is probably a much better approach. As Lakoff states: "Preparedness does not seek to prevent the occurrence of a disastrous event but rather assumes that the event will happen. Instead of constraining action in the face of uncertainty, preparedness turns potentially catastrophic threats into vulnerabilities to be mitigated" (Lakoff 2007, pp. 253).

In case of zoonotic disease control, we therefore propose to differentiate between two supplementary approaches, each with their own interpretation of the precautionary principle. The first policy is that of preparedness. This approach is applicable in the situation of an acute and/or unexpected zoonotic disease outbreak. In principle, it doesn't matter whether this disease emerges from animal husbandry, companion animals or wildlife. The goal of this strategy is to be prepared and to respond and mitigate the effects of such a zoonotic disease as effectively as possible. Depending on the scientific and empirical knowledge that is available, disease control measures in this approach are either based on a standard cost-benefit analysis or when uncertainty is too high on the precautionary principle. Within this approach there is a strong focus on short term risk management. We refer to this approach as 'precaution-as-preparedness'.

The version of the precautionary principle that is applicable here reflects the definition of the United Nations that: "in case of threats of harm to human health, precautionary measures should be taken even if some cause-and-effect relationships are not fully established scientifically" (United Nations 1992). To justify interventions on the basis of the precautionary principle, the harm and the knowledge condition have to be sufficiently met. For instance, to take measures that affect animals a plausible link between human disease and the animal population has to be established. Furthermore, to select and justify certain precautionary measures the criteria of consistency, proportionality and counterproductivity have to be met. From the perspective of One Health, this implies that the effect of interventions on animals and the environment have to be taken into account as well. This could lead to the conclusion that the culling of animals is sometimes counterproductive and disproportional, like in the case of culling badgers to prevent the spread of zoonotic bovine tuberculosis in cattle in the United Kingdom. In hindsight, this strategy has proven to be neither cost-effective nor effective and even counterproductive because of the consequential damage to biodiversity which is a key factor in zoonotic disease spread (Lederman 2016). An assessment of the effect of precautionary measures should be integrated in the standard decision-models of public health authorities.

Moreover, to ensure societal support these considerations and the trade-offs they contain should be transparent and open for dialogue, with the involved stakeholders as well as with the general public.

Degeling et al. characterized the 'precaution-as-preparedness' approach as 'managing risk'. They recognized that under this regime policy-makers try to avoid the risk of over-reacting to the threat, such that precaution acts as an epistemic rule (Degeling et al. 2019). This knowledge driven strategy is reactive in nature because it bases decisions and interventions on the scientific evidence that is at hand. This in contrast to what they call the regime of 'managing uncertainty', which is directed towards promoting system resilience while at the same time protecting those at immediate risk from disease emergence (Lysaght et al. 2016). In this respect, resilience can be defined as the capacity or ability of an individual or a system to react to an external force and to maintain or return to a state of equilibrium. Striving for resilience can have a stabilizing effect on pathogen behaviour (Heymann, Jay and Kock 2017). In the latter way of thinking, the focus is more on averting zoonotic disease outbreaks than on response. This brings us to a second approach of zoonotic disease control: prevention. Without underestimating the importance of a well-functioning mechanism to react to zoonotic disease outbreaks, we believe there currently is a lack of effort to address the causes of these events. To encounter the increasing risks of zoonotic diseases in our modern world, a more long-term approach is needed. This strategy should be aimed at improving and maintaining the resilience of ecosystems, of which animals and humans are inseparable elements.

As we have seen, applying the precautionary principle in zoonotic disease control can lead to trade-offs between human and animal health. From a One Health perspective this is problematic. In our non-ideal world, the consequences of zoonotic disease control are often distributed unequally between humans, animals and the environment. The policy we refer to as 'precaution-as-preparedness' is reactive in nature and disease control measures are sometimes detrimental to animals and the environment. Although such measures can be necessary to stop the disease, in our view such an approach is only justified in combination with a policy directed at 'precaution-as-prevention'. This implies that we should pay more attention to the underlying human drivers of zoonotic disease outbreaks. Moreover, because the risk of single zoonotic disease outbreaks cannot be completely eradicated, it is more effective to examine and address the root causes of zoonotic disease at the system level (Tickner 2002).

In our view such an approach follows the core principles of One Health to promote the health of humans, animals and the environment (van Herten, Bovenkerk and Verweij 2019). Within this perspective, 'precaution-as-preparedness' should always be accompanied by 'precaution-as-prevention'. The focus of the latter should be on possible human activities that could potentially harm the health of humans, animals or the environment. It also requires that certain precautionary measures to prevent zoonotic disease risks should be taken even if some cause-and-effect relationships are not fully established scientifically. This implies inter alia that health authorities and governments should critically assess all human activities that could contribute to possible zoonotic disease outbreaks, like globalization, food production, land use, urbanization etc. On a national level, such an

impact assessment could be part of licensing systems, for instance for food production, transport or construction.

## 4.7 Conclusion

In this article we have given many examples to illustrate that the use of the precautionary principle in the context of zoonotic disease outbreaks can have problematic ethical implications, particularly when we take the One Health perspective seriously. Currently, when the precautionary principle is applied, there often is a one-sided focus on human health and economic considerations, and precautionary measures can lead to unwanted outcomes or trade-offs. In other words, the application of the precautionary principle in zoonotic disease control can cause value conflicts. Appeal to the precautionary principle, furthermore, has certain limitations; it must be clear that there is harm, there has to be a certain amount of scientific evidence for a cause and effect relation and the proposed precautionary measures should be effective, consistent, proportional and avoid being counterproductive. These limitations show that in practice, we have to accept a certain degree of risk. Establishing what level of risk is acceptable, amongst other things, calls for a public dialogue, as value judgments need to be made and this cannot only be left up to experts.

The fact that a certain level of zoonotic disease risk is unavoidable, forces us to think about managing these risks. In our view it is not enough to be well prepared for (re-)emerging zoonotic disease threats. Such a reactive approach will inevitably lead to value conflicts and trade-offs that are often not consistent with the concept of One Health. We promote that this preparedness should be supplemented with a more fundamental approach that addresses the root causes of zoonotic disease risks. This strategy, that we call 'precaution-as-prevention' must be aimed at improving the health and resilience of animals and ecosystems primarily, to ultimately benefit the health of humans as well. That is what it implies when you take One Health seriously.

CHAPTER 5

# 5

# Veterinary responsibilities within the One Health framework

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## 5.1 Introduction

The motto of the Royal Veterinary Association of the Netherlands (RVAN) is: 'hominem animalumque saluti', which stands for: 'to the health of humans and animals'. This motto reflects the veterinary profession's responsibility for the health of both humans and animals.

In this case, the order of words might suggest that human health is the primary concern of veterinarians. However, in our opinion, the health of humans and animals should not be addressed separately and the One Health paradigm seems to confirm this. In this paper we assess the impact of the One Health concept on the professional responsibilities of veterinarians.

One Health can be defined as the collaborative effort of multiple disciplines - working locally, nationally, and globally - to attain optimal health for people, animals and our environment (American Veterinary Medical Association 2008). In this view, especially veterinary and human medicine should cooperate to address health challenges at the human-animal-environmental interface. One Health's starting point is the awareness that the health of humans, animals and the environment are intertwined. Up till now, ideas about One Health have been developed in the context of zoonotic diseases and beyond (Lerner and Berg 2015; Meijboom and Nieuwland 2017). Comparative or translational medicine and the positive effects of interaction with animals on the health of humans in hospitals, prisons or elderly homes, can all be covered under the One Health umbrella. Recently, this has even led to a proposal to stretch the concept towards 'One Welfare' (García Pinillos et al. 2016).

In this paper, we focus on the added value of the One Health paradigm in the debate on veterinary responsibilities in the context of public health threats from livestock farming. We argue that (a) a One Health approach has direct consequences for veterinary responsibilities and (b) a holistic approach on One Health is necessary to deal with moral problems that arise from this. First, with regard to the point of professional responsibility, we claim that the veterinarian still remains primarily responsible for the health and welfare of animals. However, a One Health approach urges the veterinarian to look beyond the level of the individual animal and of disease symptoms. This entails, for instance, that the veterinarian's responsibility should include publicly addressing the underlying causes of the negative externalities of livestock farming. Due to the strong interconnectedness of human, animal and ecosystem health, keeping our animals healthy and caring for their welfare will automatically contribute to the reduction of health risks for all involved. This link is especially clear in the context of zoonotic diseases: healthy animals will reduce the risks of zoonotic disease transfer and thereby indirectly promote human health. This is the 'encapsulated health' argument.

Second, already in the current context veterinarians are confronted with moral problems in zoonotic disease control. For instance, when values of animal health and human health are in conflict (cf. Wright et al. 2010). One Health make these problems more complex, because this approach stresses that both animal and human health should be addressed

in an integrated way. However, the One Health concept does not automatically provide moral guidance in these situations of conflict. One Health suggests *that* we should address health issues that affect humans, animals and the environment in a coherent way, but not *how* and *why* (Meijboom and Nieuwland 2018). The concerns about the lack of a normative framework for One Health have been addressed elsewhere in literature (Stephen and Karesh 2014; Degeling, Lederman and Rock 2016; van Herten, Bovenkerk and Verweij 2019). Important topics in this debate are the understanding of the concept of health and the view on the moral status of humans versus animals and the environment. A central question is whether or not health can be considered a universal good, shared by humans, animals and the environment (Degeling, Lederman and Rock 2016). If not, then perhaps One Health means nothing more than promoting public health. We argue that a holistic perspective on the One Health concept can be of relevance in the debate about veterinary responsibilities (van Herten and Meijboom 2018). Although One Health is not an ethical framework, the concept does help to search for innovations to deal with value conflicts that veterinarians encounter, such as the switch to a more preventive approach towards animal and human health.

To elaborate on the 'encapsulated health' argument and the proposal for an holistic perspective on the One Health concept we will use a case study focussing on the role of the veterinary profession in antimicrobial resistance policies in the Netherlands.

## 5.2 Veterinary responsibilities

Societal expectations with regard to the professional responsibilities of veterinarians are changing. The work of veterinarians is no longer restricted to curative medicine in the interest of individual animals and their owners. A modern veterinarian must also have the competence to take collective and global perspectives into account and has responsibilities to care for animal welfare and public health as well (Meijboom 2017). According to Rollin, the most fundamental question of veterinary ethics is whether a veterinarian morally owes primary allegiance towards the owner or the animal (Rollin 2006). Nowadays, veterinarians in animal food production also have to consider the interests of the food companies, retail, consumers and society. Mostly, neither veterinary legislation nor professional codes offer veterinarians much support in case of conflicting values or interests. For instance, the Dutch Animal Law states that veterinarians have a duty of care towards animals (Ministry of Agriculture, Nature and Food Quality 2011). However, how they should act when this duty of care conflicts with other responsibilities, that society imposes on veterinarians, is not clear from the legal text. In their Code of Conduct, the Federation of Veterinarians of Europe (FVE) acknowledge that on occasions, obligations may conflict with each other and therefore the veterinarian may be presented with a dilemma. In such situations, FVE indicates that it is the individual veterinarian's responsibility to balance these obligations (Federation of Veterinarians in Europe 2009). In reality, many veterinarians are struggling with this plethora of responsibilities. In daily practice veterinarians often have to deal with situations where human and animal interests are in conflict and no easy solutions are available.

Within the profession this has opened the discussion on veterinary responsibilities and how to deal with expectations from society. In the Netherlands, for instance, an open letter of a group of veterinarians organised in "The Caring Vets" led to an intense internal debate about the role of the profession in the transition towards a more sustainable type of animal husbandry (Caring Vets 2017). The Caring Vets claim that a veterinarian's main interest should be animal welfare. Many Dutch farm animal veterinarians do not deny the importance of animal welfare, but consider themselves to be also responsible for food safety, public health and increasing the economic profit of farmers. The tendency towards a stronger emphasis on the veterinary responsibility for animal welfare is also reflected by a position paper of the British Veterinary Association (BVA), in which the authors argue that neither emotions nor economic factors may trump animal welfare considerations (British Veterinary Association 2016). For instance, when a dog owner has emotional problems to euthanize his/her companion who is suffering an incurable disease, this should not withhold a veterinarian to do what is best for the animal. If emotions of animal owners and societal expectations of the profession result in a conflict of professional responsibilities, this can be a source for moral dilemmas. The BVA argues that improving animal welfare should be the profession's primary aim and motivation. The profession's increased concern for animal welfare seems one of the answers to deal with the complex of societal expectations regarding veterinary responsibilities. However, if this would turn into a one-dimensional focus on either animal welfare or economics, it would do no justice to the broader spectrum of public expectations towards the veterinarian. Veterinarians are expected to promote public health and the health of the environment too. This is not only a public expectation, it is also acknowledged as a professional responsibility by the profession. It is broadly recognized that with their cross-species pathobiological expertise, veterinarians can make an essential contribution to public health.

However, to make all these veterinary responsibilities operational if concerns for health of humans, animals and nature are in conflict, is not easy. For example, in the case of antimicrobial resistance this becomes apparent when vets prescribe colistin to cure post-weaning diarrhoea (PWD) in piglets. PWD is an important economic problem in the swine industry, associated with a proliferation of enterotoxigenic E. Coli bacteria in the pig intestine. Although treatment with colistin is effective, its use has also led to the development of (multi)resistant E. Coli strains in swine. Moreover, in human medicine colistin is considered a 'last resort' therapy for certain bacterial infections. The discovery of new resistance genes, which can be easily transferred to other bacteria, has therefore raised concerns about the use in animal husbandry. However, alternative strategies to control PWD are complex, costly and depend on the competence, possibilities and willingness of farmers. For this reason, alternative strategies to control PWD are not as effective as antimicrobials (Rhouma et al. 2017). Despite the risks for public health, veterinarians therefore still treat PWD with antimicrobials like colistin to safeguard the health and welfare of piglets. Many veterinarians are aware of this dilemma but feel that, when they are not able to change the circumstances responsible for the disease, they have a strong duty to ensure the health of the piglets. Therefore, they often do not see other options on the short term than to treat the piglets with antimicrobials.

This example shows that veterinarians are constantly struggling to balance all these different professional responsibilities. Many veterinarians have great difficulty weighing all the interests in play. Without bad intent, this sometimes leads to unintended (but foreseeable) negative consequences for either public or animal health. Decisions become even more complicated when other interests join in as well. Veterinarians working in the context of the food industry, for instance, also have to deal with the economic interests of farmers and other parties in the food chain. At first glance, it seems that One Health only adds up to this complexity. The One Health framework requires veterinarians to cooperate with other health professionals to combat zoonotic diseases in order to protect public health. Within a narrow interpretation of the One Health concept this could imply that veterinarians should prevail human interests over animal health and welfare. However, we argue that these conflicts and difficulties are not the result of the One Health approach. It only makes the existing complexity explicit. In our view, the One Health concept can provide answers to mitigate these moral problems that veterinarians are facing.

## 5.3 What One Health has to offer

It is clear that in cases as described above, a straight forward application of the One Health concept will not lead to an easy fix. On the contrary, current interpretations of One Health give veterinarians little moral guidance to deal with the responsibility conflicts they experience. It clearly specifies *that* human, animal and ecosystem health have to be addressed in an integrated way, but it does not yet prescribe *how* exactly the relation between human, animal and ecosystem health should be shaped. This step, however, is essential to guide veterinarians in real life cases, such as the example on post-weaning diarrhoea. The question than is: how can the One Health concept support veterinarians to strengthen their position?

To find some common ground on the normative aspects of One Health, we start on the level where there is consensus. That is with regard to the claim that it requires a closer cooperation between veterinary and human medicine. In the case of zoonotic diseases, this resulted in sharing and assessing disease signals. However, although the importance of these integrated human-veterinary risk analysis structures cannot be denied, this only covers part of the answer, because (a) the cooperation as such is not novel and (b) it represents a reactive strategy to address zoonotic health risks.

With regard to the first point, collaboration between veterinarians and human medicine is not as new as presented. In an historic analysis of zoonotic disease control in the Netherlands (1898-2001) Haalboom concludes that the interdisciplinary cooperation was not the biggest concern. She claims that the real problem of ineffective zoonotic disease control was an underlying conflict of interest between public health and economic interests of the food industry (Haalboom 2017). The serious consequences of these conflicts of interest became evident in the Q-fever epidemic that affected the Netherlands from 2007-2012. A difference of opinion between the Ministries of Health and Agriculture on the causality and the scientific evidence for interventions hindered an adequate approach. Finally, the continuous increase in human patients forced the government to cull 20.000

healthy and pregnant goats. Yet, there were indications that a vaccination strategy could have stopped the epidemic as well, if it was applied earlier (Van Dijk et al. 2010).

This leads to the second problem: in its current form the cooperation leads to a reactive strategy to public health risks. Some interpretations of the One Health concept, especially in zoonotic disease control policies seem to suggest that veterinarians should mainly identify and combat zoonotic disease threats for the sake of human health (National Institute for Public Health and the Environment 2019a). This view can be recognized in prominent One Health strategies to combat zoonotic diseases in livestock, like avian influenza, Q-fever or antimicrobial resistance. The focus is on public health and the approach mainly reactive and curative. Monitoring and controlling zoonotic diseases with the use of methods like screening, restrictions of animal movement, post-outbreak vaccination and culling is still standard in official Dutch policy documents (Ministry of Agriculture, Nature and Food Quality 2019). The economic considerations that underlie the non-vaccination policies and EU-regulations only further stress the central position that human interests have in the current situation.

We agree on the importance of One Health in stimulating cooperation between specialisations and contributing to openness and combining different perspectives. However, we argue that this is not enough. In our opinion, the debates on zoonotic disease control and the role of the veterinary profession would benefit from a broader, more holistic perspective on One Health. First, this entails the recognition of the independent value of animal health and environmental health, rather than considering animals and nature as mere sources of infectious diseases or other public health risks. In our view, a true One Health approach to zoonotic diseases should not only promote public health but should result in better health of animals and the environment as well. Second, it entails attention to underlying health risks rather than a focus on disease symptoms only. Such a frame offers opportunities for veterinarians to address the underlying reasons for public health threats coming from animal husbandry. This is a more effective approach to deal with public health issues than reactive strategies to signal and control outbreaks. To structurally improve human and animal health, it is therefore necessary to publicly discuss the negative externalities of livestock farming [10].

10 Apart from the impact on public health, intensive livestock farming is also responsible for environmental problems like climate change, soil degradation and loss of biodiversity (Seinfeld et al. 2006a). However, in this paper, we predominantly focus on issues concerning human and animal health.

Based on their expertise, veterinarians can and should play an important role in this debate by explaining the impact of livestock farming on human and animal health, e.g., by stressing the animal and human health costs of certain types of types of animal production. Moreover, in the long run this strategy could help individual veterinarians to prevent certain value conflicts between animal health and public health as they encounter in practice. Rather than solving all problems, this implies that veterinarians should share their concerns with society via recommendations to public policy, formulating and communicating position papers and hands-on advice to animal owners. In this way the veterinary profession can contribute to the public debate on sustainable livestock production. The Dutch approach to tackle antimicrobial resistance is an example of how this could work.

## 5.4 One Health in practice: the need for a system approach

In a small country like the Netherlands, the number of farm animals (125 million) exceeds the number of humans (17 million) by a sevenfold (Central Bureau of Statistics, PBL Netherlands Environmental Assessment Agency, and Wageningen University & Research 2016). In this context, animals and humans have a direct and mutual impact on each other's health. If we focus on the effects of animals on human health, especially food producing animals are associated with several public health risks. Sometimes, this comes with far-reaching consequences, e.g., from 2007-2012 a Q-fever epidemic infected more than 4000 people and resulted in the death of 95 persons (National Institute for Public Health and the Environment 2019b). The fast increase of goat farms in the south eastern part of The Netherlands was one of the main causes of this severe outbreak of human Q fever (Roest et al. 2011).

The risk of zoonotic disease transmission from farm animals to humans is greatly influenced by the current system of intensive livestock farming (Kimman, Hoek, and de Jong 2013). Over the past decades, intensification of livestock farming in the Netherlands was predominantly driven by reducing costs. Because of the pressure of global markets on food prices, retail and food producers forced farmers to scale up and focus on maximizing production against the lowest possible costs. Within this system, veterinarians and farmers still attempt to keep animals healthy. However, due to these suboptimal economic circumstances addressing health problems with high use of antimicrobials seemed to be most effective. It simply was a cheaper option to (prophylactically) treat bacterial diseases with antimicrobials than to invest in biosecurity, feed or housing.

As a result, until 2007 the Netherlands led the European charts of antimicrobial use in farm animals (Grave, Torren-Edo, and Mackay 2010). It is clear that the use of antimicrobials in animals causes antimicrobial resistance in pathogenic and commensal bacteria in animals. Although it is difficult to prove a direct link between the use of antimicrobials in farm animals and antimicrobial resistance in human patients (Tang et al. 2017), there is scientific and public consensus on the importance of restrictive use of antimicrobials in animal husbandry due to its potential impact on public health. Especially the misuse of antimicrobials in healthy animals is considered a threat to human health because of the

possible loss of effective antimicrobials for human medicine (World Health Organization 2017). Because of this risk, the Dutch government has issued strict policies for antimicrobial use in animals. This resulted in the so-called 'Dutch Model' which appeared to be very effective and led to a significant reduction of antimicrobial use. Internationally this policy has even been presented as an example for antimicrobial reduction policies in animal husbandry (Sheldon 2016) The success of the strategy can be partly attributed to a stronger position of veterinarians on farms (mandatory one-on-one contract, herd health plan and regular farm visits), registration and benchmarking of antimicrobial use, vaccination strategies and better biosecurity (Food and Veterinary Office 2016).

Although initially farmers and veterinarians were worried about the negative effects of antimicrobial reduction policies, it seems that to date, there is little evidence that animal health is seriously affected (Council on Animal Affairs 2016a). Apparently, veterinarians and farmers were able to safeguard animal health in other ways, such as vaccination and improving biosecurity. This seems to fit perfectly in a One Health perspective, because eventually the health of humans, animals and the environment has benefited from the reduction of antimicrobial use. However, in spite of the success, new questions arise. Dutch politicians argued that to protect public health, antimicrobial consumption in livestock should be as low as possible. As a result, the current question in the Netherlands is whether it is possible to reduce antimicrobial use any further than the 64,4% decrease that is achieved so far (year of reference 2009). The Dutch government and the Veterinary Medicines Authority both indicate that additional reduction is indeed possible, certainly on farms that currently are registered as structural high users (Ministry of Agriculture, Nature and Food Quality and Ministry of Health, Welfare and Sport 2016; Netherlands Veterinary Medicine Institute 2018) This will probably be true, although it is not realistic to expect that antimicrobial use in animals could be banned totally. As long as society considers livestock farming socially and ethically acceptable, a certain amount of antimicrobials will always be necessary to treat bacterial infections in farm animals.

Veterinarians are regarded as a key factor in current and future antimicrobial reduction policies in the Netherlands. Still, even on farms with a structural high use, veterinarians will consider it their professional responsibility to treat sick animals with antimicrobials. So as long as farmers are not willing or able to implement the veterinarian's advice about alternative measures to prevent bacterial infections, it will be difficult to make further progress. We therefore argue that to achieve a level of antimicrobial use in livestock farming that can be considered as low as reasonably possible, requires an approach on a system level. In our view, the main underlying problem in livestock farming is a one-sided focus on maximizing production at minimum costs to produce cheap animal protein. This leads to animal health (and -welfare) problems and risks. Moreover, it substantially reduces the farmers' ability to change and innovate. As a consequence, veterinarians' recommendations to make more fundamental changes in management or housing, in order to reduce disease problems, are not followed. Quite often this is not a problem of unwillingness of farmers, but the result of financial inability.

Since veterinarians still consider it their moral obligation to treat sick animals, this situation forces them to prescribe antimicrobials, which brings along human health risks. To stop

this race to the bottom, a holistic view on the One Health perspective can teach us two lessons. First, it is necessary to address the fundamental problems of intensive livestock farming, rather than attempting to maintain animal health with the use of antimicrobials under difficult circumstances. Second, we should get rid of the dichotomy from which it seems one has to choose between either human health or animal health. If we address the cost-only perspective of animal husbandry and start from an 'encapsulated health' perspective, i.e., keeping our animals healthy and caring for their welfare, this will automatically contribute to the reduction of zoonotic disease risks and thereby promote human health. In this process, veterinarians should play an important role. They already have their Aesculapian authority (cf. Rollin 2002) that enables them to inform the public about the underlying causes of problems, such as antimicrobial resistance, in order to start a change.

## 5.5 Health: a matter of resilience

A holistic conception of One Health could provide veterinarians further tools to address the negative aspects of intensive livestock farming and to stimulate more sustainable and socially acceptable production systems. A prerequisite of such a system would be: not to harm the health of humans, animals and the environment. Therefore, the starting point for any livestock production system should be that the health of animals is central. However, One Health does not come with a standard definition of health. Nonetheless, conceptual clarity on this level is important to respond to problems such as antimicrobial resistance in a way that takes animals, humans and nature into account.

There are many definitions of human, animal and environmental health. In veterinary medicine health is sometimes defined in terms of production or reproduction (Gunnarsson 2006). From this perspective, one could maintain that a focus on production automatically implies that animals have to be healthy if a farmer wants to keep his or her farm profitable. However, it is clear that pushing animals towards high productivity increases the risk of certain diseases (Rauw et al. 1998). Within the context of zoonotic diseases and antimicrobial resistance it seems appropriate to understand health as the absence of disease (cf. Boorse 1977). This definition is understandable for veterinary practioners and gives them a reason to promote disease prevention. However, applying this definition to characterize the health of ecosystems, is difficult because bacteria and viruses, that can cause (zoonotic) diseases, are an essential part of balanced ecosystems. Therefore, within the One Health framework some have proposed to understand health as resilience (Döring et al. 2015; van Herten, Bovenkerk, and Verweij 2018).

Resilience can be interpreted as the persistence of systems and their ability to absorb change and disturbance and still maintain the same relationships between populations or state variables (Holling 1973). From this perspective one can, for instance, learn that in many situations in intensive livestock farming external forces like insufficient housing, food and management have outbalanced the internal capacities of animals to react and stay healthy. Ge et al. describe that current animal production systems are developed to maximize production and efficacy under standard conditions, which

makes them vulnerable to (unanticipated) external influences. Inadequate functioning or overstimulation over longer periods of time can lead to disease (Ge et al. 2016). These production related diseases can therefore be considered as a sign that current intensive animal production systems are not resilient.

The concept of resilience can be applied to all components of One Health: humans, animals and ecosystems. For this reason, Döring et al. present resilience as a universal criterion for health (Döring et al. 2015). They emphasize the importance of an animal's ability to react, balance and restore itself to a certain degree, given that the surroundings allow this, to reach a status that can be described as healthy. This view is compatible with modern definitions of animal welfare, of which health is an inseparable part. Ohl and Van der Staay, for instance, argue that an individual animal is in a positive welfare state when it has the freedom to display normal behavioural patterns, allowing it to adapt to the demands of the prevailing environmental circumstances and enable it to reach a state that the animal perceives as positive (Ohl and van der Staay 2012). Nowadays, in human medicine comparable balance theories of health are prominent as well. In this perspective, Huber advocates to define health as the ability to adapt and self-manage (Huber 2011). Finally, others applied the concept of resilience to characterize the health of ecosystems. Constanza considers an ecological system healthy if it is stable and sustainable, i.e. if it is active and maintains its organization and autonomy over time, and is resilient to stress (Costanza 2012). Since it is universally applicable to humans, animals and the environment, we believe the idea of health as resilience contributes to operationalizing a One Health strategy to tackle antimicrobial resistance. This is because in the context of animal husbandry it provides grounds to transform animal production systems in a way that resilience of animals is promoted. Consequently, human and environmental health will benefit from this as well.

## 5.6 Veterinary organizations and One Health

With its specific expertise, the veterinary profession is qualified to guide this transition towards a sustainable animal husbandry in which antimicrobial use can be minimized further.

For individual veterinarians starting this process can be problematic. This is not rooted in moral indifference. For most veterinarians the main concern is the health and welfare of the animals under their care. However, the influence of farm animal veterinarians is sometimes limited because of their role as service-provider: they provide veterinary care on request of farmers. Farmers primarily expect veterinarians to do what they are consulted for. Therefore, interventions are sometimes only directed at solving disease problems in the short-term. Of course, veterinarians will advise farmers how to prevent diseases and have healthier animals in the long-term as well. However, this can be difficult because in this context veterinarians are dependent on the will and the (financial) possibilities of farmers to change circumstances for the better of their animals. Moreover, public health problems like antimicrobial resistance are of global concern and go beyond the sphere of influence of individual veterinarians. On such a scale their impact is limited. Although

the commitment of individual veterinarians is essential in national reduction policies, to effectively address the issue of antimicrobial resistance on a global level a more collective approach in necessary.

Therefore, we propose to start this change at the level of professional organizations of veterinarians. They have a different position. They can translate veterinary concerns into position papers that transcend the problems on individual farms. Veterinary organizations should publicly address structural underlying causes in the food production chain that precede diseases in animals, like the transport of veal calves or growth rate in broilers. They should call on all responsible parties in the food production chain (farmers organizations, food producers, banks and retail) as well as the government and consumers to take action. By doing so, veterinary associations will support individual veterinarians in their daily work to improve animal health and welfare on the farm level. Veterinarians truly contribute to the idea of One Health if they collectively promote livestock systems that are not primarily focussed on production results and cost-reduction but on animal health and welfare.

However, not many veterinary organizations publicly address the problems of intensive animal husbandry in the name of One Health. Just like many individual farm animal veterinarians, national veterinary professional organizations seem reticent to take an explicit stand for animal health and welfare. In 2017, the World Veterinary Association (WVA) adopted the so-called declaration of Incheon that described the role of the veterinary profession in One Health and Eco Health initiatives. The WVA emphasizes the importance of policy engagement and professional leadership to address One Health issues. Moreover, the veterinary profession should "assertively advocate for and protect the welfare of all animals living in all environments. Veterinarians are educated to skilfully evaluate animal health and welfare, which are dependent upon proper housing, management, nutrition, disease prevention and treatment, responsible care and humane handling" (World Veterinary Association 2017). In relation to antimicrobial resistance, the FVE endorse the idea of 'prevention is better than cure' by stating that "animals that are well cared for and appropriately housed, will experience better welfare, be less prone to infections and will need fewer antimicrobials" (Federation of Veterinarians in Europe 2016). FVE acknowledges the need to improve biosecurity and hygiene in animal husbandry to reduce bacterial infections and corresponding treatments with antimicrobials. Moreover, FVE recommends to promote positive welfare steps to reduce stress and therefore susceptibility to infections. Besides productivity, farm animal breeders should incorporate breeding goals on health and longevity, including disease resistance, to decrease the need for antimicrobial treatments (Federation of Veterinarians in Europe 2016).

Despite these clear and urgent calls from international veterinary organizations, it seems that on a national level not much progress has been made. A limited desktop research[11] on websites of national veterinary organizations did not reveal publications that addressed the negative externalities of livestock production systems and the need to change for the benefit of human, animal and environmental health. Up till now, we don't know of a successful campaign from the veterinary profession that advocates radical

11 Online search strategy looking at media publications and position papers of national veterinary organizations in Europe, Canada and the United States.

change of animal production systems. Currently in the Netherlands, a relatively small group of veterinarians organised in the 'Caring Vets' has taken a stand on several animal welfare issues like calf-cow seperation, tail docking in pigs and mega-farms (Nalon 2017). However, they focus primarily on animal welfare and leave public or environmental health out of the discussion. In Germany, a comparable veterinary organization, Tierärztliche Vereinigung für Tierschutz, mainly criticizes livestock farming because of the related animal welfare issues, like castration of piglets, animal transport and dehorning of cattle. In a recent position paper on disease surveillance the BVA acknowledges the importance of animal health and welfare for public health and trade in animal products. In line with OIE, they advocate the important role of veterinarians in monitoring diseases by acting as sentinel for wider human and animal health, underpinned by a common One Health' rationale to minimise harm (British Veterinary Association 2018). Although improvement of veterinary surveillance will certainly contribute to animal as well as public health, unfortunately in this paper the BVA did not point out the underlying reasons for many public health threats coming from intensive livestock farming. In our opinion, a missed opportunity to fundamentally apply One Health thinking.

Of course occasionally individual veterinarians have spoken out for preventive population health to reduce the need for curative interference, like the prescription of antimicrobials (Davies 2017). However, on the level of national veterinary organizations there seems to be a relative silence about the need to change livestock production in the context of One Health. One of the reasons for this could be that just like veterinarians, who are financially dependent on their clients, veterinary organizations are equally dependent on their members. Without a considerable representation of the veterinary profession, veterinary organizations are often not successful in influencing policy making and contributing to public debate. Furthermore, because of differentiation and specialisation in the profession, veterinary organizations have a very diverse membership. For instance, companion animal veterinarians often have totally different views about the ethical acceptability of livestock production systems than their colleagues in farm animal medicine. This moral plurality sometimes makes it difficult to publish very pronounced statements.

## 5.7 Professional integrity and leadership

In the case of antimicrobial-resistance the relationship between veterinarian and farmer is of great influence on the success of reduction policies. An important factor here is the level of independency and authority of veterinarians to resist the demand of certain farmers to prescribe antimicrobials when there is no strict veterinary need (Speksnijder et al. 2015).

In this context, the notion of professional integrity plays an important role. When veterinarians are confronted with a conflict of interest between the profession's core values (animal health, animal welfare and public health), they have to be able to balance between accommodation of their client's wishes and professional integrity. Professional integrity, in terms of a commitment to the profession's aims and principles, can help veterinarians to motivate their actions and to show why decisions are not just arbitrary

or opportunistic (Meijboom 2018). Professional standards or position papers can support individual veterinarians with these, sometimes, difficult decisions on the farm.

In the Netherlands, veterinary organizations often cooperate with farmer organizations and representatives of the pharmaceutical industry to realize their goals. At the same time, they consult with the government and animal welfare organizations. The influence of veterinary organizations and whether they are successful in promoting the interests of their members depends greatly on the relationship with these stakeholders. However, in our opinion just like individual veterinarians, veterinary organizations should be aware of maintaining their integrity. A certain independence of veterinary organizations is a prerequisite to preserve the trust of the general public. For this reason, the profession needs a well-functioning self-regulatory system (May 2018). To promote the long-term interests of the veterinary profession, veterinary organizations should overcome short term (economic) interests of some individual members or certain stakeholders. Instead, veterinary organizations have to develop and show professional leadership to meet societal expectations and to maintain professional autonomy. Rather than addressing symptoms and solving moral problems that arise from intensive livestock farming, this idea of leadership entails that the veterinary profession makes these moral issues, including the underlying system problems, visible to society. This step is not a kind of buck passing, but to show that dealing with current challenges cannot be a task of farmers and veterinarians only. After all, existing livestock production systems are shaped by societal developments and demands. Therefore the responsibility for innovation and transformation of livestock farming into a practice that does justice to human, animal and ecosystem health is not restricted to one group in society, but requires an integrated approach. Still, in this debate the veterinary profession has an independent position to promote animal health, which arises from their professional veterinary responsibilities. By doing so they encapsulate human and environmental health as well.

## 5.8 Conclusion

To tackle zoonotic disease threats from intensive livestock farming, like antimicrobial resistance, One Health strategies are indispensable. However, the One Health concept does not yet prescribe exactly *how* the relation between human, animal and ecosystem health should then be shaped to fundamentally address zoonotic diseases. We argue that these health issues require a system level approach. Furthermore, it is essential to use an integrated view on health, rather than focussing solely on human health. Such a perspective forces us to address the underlying health risks of intensive livestock production instead of treating only the symptoms. Veterinarians can play an important role in this context.

In our opinion, to optimally promote One Health the primary interest of veterinarians should be: to promote animal health. We call this the 'encapsulated health' argument. Instead of the current curative and control focussed perspective in zoonotic disease control, veterinarians should advocate that healthy animals are an essential precondition of any type of livestock production system. If these systems are constructed to secure

animal health this will eventually benefit human and environmental health. Interpreted as such, One Health offers a way out of the dichotomy between public and animal health that is at the basis of many moral dilemmas in zoonotic disease control.

This transition starts with veterinarians who give animal health and -welfare priority over (economic) interests of farmers and the food production chain when human health is at stake. On an individual level this is a difficult task for veterinarians since they are financially dependent on farmers. Moreover, to initiate a change on a system level, individual veterinarians often fall short in power and capacities. This would overburden individual professionals. Therefore, we proposes that professional organizations of veterinarians should play an important role here. By joining forces, veterinarians within these organizations have more power, scope and options. As a result, they can publicly address health issues, call for the necessary structural changes and support individual veterinarians and farmers in making a step from a curative control-based approach to a strategy that focuses on prevention. In this way, our idea of 'encapsulated health' functions on an individual as well as on an organizational level. In the long run, we expect that such a preventive approach can mitigate possible conflicts between animal health and public health that veterinarians are confronted with.

CHAPTER 6

# Conclusions, discussion and recommendations

## 6.1 Main objective of research project

The objective of this research was to contribute to the development of an ethic of One Health. Within the broad scope of themes that the One Health concept covers, I focussed specifically on the ethical dimensions of zoonotic disease control. In the general introduction, I have explained why the current use of the One Health-concept in zoonotic disease control is morally problematic. If we understand One Health as an holistic approach to promote health for humans, animals and ecosystems, we should include non-human interests in our considerations and evaluate zoonotic disease control along these lines as well. My goal was to clarify the ethical assumptions of a One Health approach in zoonotic disease control, to explore how these can be coherently understood and justified and to indicate what this implies for policymaking.

Zoonotic diseases are infections that are naturally transmissible between animals and humans, either directly or indirectly. It is estimated that 75% of all new and emerging infection diseases is of zoonotic origin (United Nations Environment Programme 2020). To combat these zoonotic disease threats a One Health strategy is considered essential. However, the circumstances in the real world greatly influence and undermine the idea of One Health and create moral dilemmas in zoonotic disease control. First of all, there is no clarity about the moral status of humans, animals and ecosystems within One Health strategies. Secondly, there is a lack of a clear and action guiding conception of health. Moreover, there are many underlying drivers of zoonotic diseases which are entangled in a complex manner and often resulting from human activity: food production, wild life habitat encroachment, decreasing biodiversity, land use, globalisation and climate change (United Nations Environment Programme 2020). These non-ideal circumstances cannot be altered here and now. This has consequences for the ethical justification of zoonotic disease control following One Health strategies. I examine possibilities to bridge the gap between the actual situation in the real world and what an ethic of One Health would require us to do. My research aims to guide ethical decision making in zoonotic disease control, while acknowledging these non-ideal circumstances.

## 6.2 Research questions

Before I will summarize the most important findings of my research, I will shortly recap the questions that are at the basis of my dissertation. The central question within my research is: *How should a One Health approach in zoonotic disease control be conceived and justified from an ethical perspective?*

To address this question and to draft the starting points of an ethic of One Health in zoonotic disease control, I have divided my research questions into six, interconnected, sub-questions:

1. What is a One Health approach in zoonotic disease control?
2. What are the moral dilemmas of a One Health approach in zoonotic disease control?

3. What are the ethical presuppositions in zoonotic disease control and how do these relate to the One Health concept?
4. How should the precautionary principle be applied in zoonotic disease control according to the One Health concept?
5. What are the professional responsibilities of veterinarians within the One Health framework?
6. How should the non-ideal conditions of the real world influence ethical judgment in moral dilemmas associated with zoonotic disease control?

This breakdown has helped to structure my research and to elaborate different aspects of my research theme. The elaboration of these sub-questions all contribute to answer the overall question of my research and the conclusions I will draw in this chapter.

## 6.3 Summary of findings

### 6.3.1 One Health as a moral dilemma

In chapter II, I have described the results of my conceptual analysis of One Health in the context of zoonotic disease control. This first step was essential to analyse what a One Health approach in zoonotic disease control actually implies. Without a proper understanding of what One Health means, specifically in the context of zoonotic disease control, it is impossible to coherently study the ethical aspects of this concept. My analysis revealed that, to date, there is no universally accepted definition of One Health. Moreover, One Health functions as a boundary object. The advantage of a boundary concept is that it is flexible in interpretation. This makes such a concept applicable for multiple purposes and facilitates cooperation. However in my opinion, ambiguity about One Health and hence about how One Health strategies in zoonotic disease control should be shaped, contributes to the complexity in case of value conflicts. If it is not clear beforehand what the normative starting points of a One Health approach are, different parties can easily disagree about the expectations and results for the health of humans, animals and the environment.

A much cited definition of One Health is that of the American Veterinary Medical Association (American Veterinary Medical Association 2008). They define One Health as: "an integrative effort of multiple disciplines working locally, nationally, and globally to attain optimal health for people, animals, and the environment". Essentially, this is a holistic conception of One Health and therefore I used this definition as the starting point for my research. In literature one can find other but similar definitions (Gibbs 2014). However, the existing interpretations of the One Health concept in literature and policy documents, like that of the AVMA, all lack normative guidance for health professionals, institutions and governments. In chapter II-V, I have presented several cases that illustrate the ethical concerns related to the uncritical use of the concept of One Health in zoonotic disease control. Examples of ethical problematic cases are the culling of healthy animals, restricting the use of certain antimicrobials in animals, confining animals to unfit housing systems and implementing transport bans that lead to overcrowding.

### 6.3.2 An idea about moral status of animals and ecosystems

To tackle the moral dilemmas associated with a One Health approach of zoonotic diseases, it is necessary to develop starting points for an ethic of One Health. Firstly, I argue that such an ethic of One Health requires a foundation, that acknowledges the moral status of animals and the environment. Current conceptions of One Health are implicit about the question whether or not animals and the environment have independent moral status. They leave room for interpretations that regard the health of animals and the environment as only of instrumental value for humans. As I have showed in chapter II, animal ethics offers convincing arguments to grant at least animals moral status. This entails that their interests should be taken into account when making decisions in zoonotic disease control. As I have explained in chapter I, the philosophical debate about the question whether ecosystems have an independent moral status is inconclusive. Nevertheless, since healthy ecosystems are at the basis of all life on this planet, it is evident that within a One Health paradigm the effect of zoonotic disease control on ecosystems must be considered. Even if environmental health is only of instrumental value, it is so in the most fundamental way.

In most societies there is a plurality of views on the moral status of animals and ecosystems. This affects the way moral dilemmas in zoonotic disease control are handled. Which disease control measures are justified within a One Health strategy, is strongly dependent on the normative presuppositions people have. In chapter III, I have described that health professionals assign priority to human health. However, because of shifting societal views regarding the moral status of animals, certain disease control measures raise public debate and controversy. To make zoonotic disease control socially acceptable, a transparent and balanced decision procedure is needed. Addressing value conflicts in zoonotic disease control requires a deliberative process, searching for coherence between intuitions, moral values and principles and empirical facts. I propose VandeVeer's 'two factor egalitarianism' as a method to handle value conflicts between humans and animals in zoonotic disease control (VandeVeer 1979). VanDeVeer suggests that in promoting overall utility, a difference should be made in the level of importance of interests of humans and animals. In his theory, peripheral interests of humans do not prevail over basic interests of animals. But in the case of a conflict between basic interests, the interests of humans trump those of animals. To guide ethical decision making procedures in zoonotic disease control, I advise the involvement of ethicists.

### 6.3.3 Health as resilience

To clarify the normative starting points for an ethic of One Health, besides reflections on the issue of moral status we also need to consider the concept of health. If we define our ideas about health more specifically, this gives us guidance in determining what we strive for if we want to achieve optimal health for humans, animals and the environment. An appropriate concept of health, to be used in a One Health context, should fulfil at least two requirements: (1) it should be applicable to humans, as well as to animals and ecosystems and (2) it should be supportive to the idea of health of the system as a whole.

It is clear that in human medicine, veterinary medicine and ecology there are many conceptions of health with very different implications. Therefore, Haverkamp et al. propose to consider health concepts as a sort of family in which each concept has a slightly different

descriptive and evaluative dimension and is applicable in a different context. In this way these concepts function as a toolbox to reflect on the meaning of health in specific health practices (Haverkamp, Bovenkerk and Verweij 2018). Within the context of One Health and zoonotic disease control, resilience is a promising candidate. Resilience is defined as the capacity or ability of an individual or a system to react to an external force and to maintain or return to a state of equilibrium (Döring et al. 2015). The concept of resilience fulfils both criteria I mentioned above. It is a concept that functions as an interpretation of health for humans as well as for animals and ecosystems. Moreover, it contributes to the idea of interconnectedness and indicates a uniform goal for One Health approaches. In my opinion, the goal of One Health should be to strive for a relatively stable equilibrium in which the health of humans, animals and the environment can be characterised as resilient.

### 6.3.4 Value conflicts and ethical decision making in zoonotic disease control

In chapter III, I have provided an insight in the underlying normative assumptions and moral values of health professionals who are active in zoonotic disease control in the Netherlands. I conducted an empirical study to clarify which moral values and ethical principles professionals in animal and human health apply in zoonotic disease control. The most important outcome of this part of my research was that these professionals in general adhered to a holistic view of the One Health concept. This means that, in theory, they acknowledge that the interests of animals should be taken into account when making decisions in zoonotic disease control. However, in practice an anthropocentric approach was still dominant. It turned out that human interests almost automatically outweigh those of animals. Thus, although these health professionals endorsed a holistic definition of One Health, this was not reflected in their decisions in zoonotic disease control.

It is remarkable that there was little difference between health professionals with a background in human medicine and those with an education in veterinary medicine. Professionals from the veterinary domain were expected to value animal interests more than their human medicine counterparts. However, my study did not reveal much difference in this respect. Only when asked about moral dilemmas, human medicine professionals mentioned a field of tension between economics and public health more often, frequently referring to the Q-fever outbreak in the Netherlands (2007-2012).

Public health and to a lesser extent economics are at the heart of current strategies to combat zoonotic diseases. The most pressing conflict of interest in zoonotic disease control is that of public health versus the financial interests of the livestock industry, both human-directed values.

In general, animal- and environmental interests are subordinated to human interests. It is questionable whether society always shares this conception. My research shows that there is a difference in valuation of public health between health professionals working within the context of zoonotic disease control and the general public. This is confirmed by other research that indicates that within society there seems to be more willingness to accept certain burdens in order to ensure the health of animals and the environment (Johnson et al. 2019). Health professionals work within a regulatory framework and

political environment that prioritizes public health and economics. This is probably why they eventually value these interests more than animal interests, when making decisions in zoonotic disease control.

In general, I found there was a lack of ethical expertise in the decision making process. Existing assessment tools can be helpful to structure ethical decision making, but they often do not give guidance in ethical reflection and do automatically not lead to morally considered judgments. Moreover, values like honesty, trust and transparency which are at the core of interdisciplinary cooperation and societal acceptance, are often not considered in current models. Furthermore, from the results of my empirical research, I conclude there is no uniform use of ethical principles in general and of the precautionary principle more particularly. Some frame this principle as taking precautions to prevent a zoonotic disease outbreak. Others specifically refer to precautionary actions to mitigate public health risk in times of scientific uncertainty. In addition, the use of ethical principles seems to be dictated by an anthropocentric perspective. Values like economy, privacy and animal welfare play a role in the decision making process related to zoonotic disease control, therefore the use of the precautionary principle is not morally neutral (cf. van den Belt 2003). Its application in zoonotic disease control confronts us with extra scientific value judgments and triggers questions like: which harm do we prevent, and which measures do we apply if this harm (and the underlying causal relations) is not fully established?

### 6.3.5 The use of the precautionary principle in zoonotic disease control

From my empirical research, I learned that the precautionary principle is an important ethical principle used by health professionals to justify, sometimes controversial, zoonotic disease control measures, like the culling of healthy animals. For this reason, I elaborate the use of the precautionary principle in chapter IV. My aim was to gain a better insight in the role of risks and responsibilities in zoonotic disease control. This analysis reveals that the main reason for public health professionals to appeal to the precautionary principle is to prevent harm to public health, since this is the primary objective of public health policies. In practice, the precautionary principle functions as a decision-making tool. When public health professionals, due to a lack of scientific evidence, cannot base their decisions on a standard cost-benefit analysis they often use the precautionary principle as a guideline. Often without explaining the rationale behind their decisions, public health professionals tend to justify disease control measures by referring to the precautionary principle. However, applying the precautionary principle is not a morally neutral act. It is therefore important that health authorities are transparent about their considerations and are aware of the ethical constraints of the use of the precautionary principle.

First of all, to evoke the precautionary principle there must be a certain harm that is to be prevented or mitigated. In zoonotic disease control strategies that are based on a holistic One Health concept, this implies that the harm condition should be extended from merely harm to public health to harm to animals or the environment. Secondly, to evoke the precautionary principle it has to be plausible that without interference the health of humans, animals or the environment will indeed be harmed. This knowledge condition requires that there is at least a minimal amount of scientific evidence that with taking precautionary measures health harms can be prevented or mitigated. From a One

Health perspective such an assessment should also include the health risks for animals and the environment. In this respect, the emphasis should not only be on the impact of the zoonotic disease itself but also on the effect of disease control measures. Thirdly, there is the precautionary action condition which concerns the precautionary actions that are indicated when the harm and knowledge condition are met. Logically, the consequences of these measures may not be worse than the harm they should prevent. They therefore should be applied in a consistent manner, avoid counterproductivity and be proportional.

However, many common zoonotic disease control measures, like culling or containing, do have a clear negative impact on animal health or welfare. Moreover, the broader the definition of harm, the more difficult it will become to prescribe disease control measures without negative consequences. This suggests that the requirement to meet all necessary conditions before applying the precautionary principle is overdemanding. Nevertheless, I argue that within a One Health approach the effect of certain zoonotic disease control measures on animals and the environment, should be taken into account. From this it follows that interventions such as vaccination of humans and/or animals are a better alternative than culling practices. We have to realize, though, that such an assessment will be more difficult when the definition of harm is considered broader than direct health effects.

### 6.3.6 Zoonotic disease risk as a fact of life

As long as we inhabit this world together with animals, wild and domesticated, a certain level of zoonotic disease risk is unavoidable and should be considered a fact of life. This inevitably raises the question: how much - or little - zoonotic disease risk should public health authorities accept before they can appeal to the precautionary principle and take control measures? To answer this question and to establish a reasonable threshold is difficult and will depend on the ethical framework that is used and even more on corresponding political considerations. Although it is not easy to provide a satisfying and general answer, I argue that we do have a moral obligation to reduce zoonotic disease risks as much as possible. This places a special burden on those responsible for potentially harmful activities. In the context of animal husbandry, for example, this implies that farmers have to take all the preventive measures they reasonably can to mitigate zoonotic disease risks. Moreover, authorities have to adequately inform the people at risk about their situation. As we have seen, zoonotic disease control can lead to value conflicts. In this sense, experts' values do not necessarily carry more weight than non-experts' values. Policy-making will therefore benefit from a broad and informative public dialogue, acknowledging unavoidable risks, uncertainties and trade-offs, because this creates transparency, trust and public support. Furthermore, these policies have to be embedded in the democratic decision making process concerning zoonotic disease control.

### 6.3.7 Precaution is preparedness and prevention

For zoonotic disease control, I propose to differentiate between two supplementary approaches, each with their own interpretation of the precautionary principle. The first policy is that of preparedness. This approach is applicable in the situation of an acute and/or unexpected zoonotic disease outbreak. In principle, it does not matter whether this disease emerges from animal husbandry, companion animals or wildlife. The goal of

this strategy is to be prepared and to respond and mitigate the effects of such a zoonotic disease at an early stage and as effectively as possible. Depending on the scientific and empirical knowledge that is available, in this approach disease control measures are either based on a standard cost-benefit analysis or when uncertainty is too high on the precautionary principle. Within this approach there is a strong focus on short term risk management. I label this approach 'precaution-as-preparedness'.

Without underestimating the importance of a well-functioning mechanism to react to zoonotic disease outbreaks, more can be done to address the causes of these events. To encounter the increasing risks of zoonotic diseases in our modern world, a more long-term approach of prevention is needed. This strategy should be aimed at improving and maintaining the resilience of ecosystems, of which animals and humans are inseparable elements. As we have seen, applying the precautionary principle in zoonotic disease control can lead to trade-offs between human and animal health. From a One Health perspective this is problematic. In our non-ideal world, the consequences of zoonotic disease control are often distributed unequally between humans, animals and the environment. The policy I refer to as 'precaution-as-preparedness' is reactive in nature and disease control measures are sometimes detrimental to animals and the environment. Although such measures can be necessary to stop the disease, in my view such an approach is only justified in combination with a policy directed at 'precaution-as-prevention'. This implies that we should pay more attention to the underlying human drivers of zoonotic disease outbreaks. Moreover, because the risk of single zoonotic disease outbreaks cannot be completely eradicated, it is eventually more effective to examine and address the root causes of zoonotic disease at the system level.

**6.3.8 Professional responsibilities of veterinarians within the One Health framework**

Veterinarians play an important role in zoonotic disease control. Moreover, safeguarding animal health and welfare forms the basis of their profession. However, authorities and the general public expect veterinarians to protect public health as well. This makes that, more than other health professionals, veterinarians are often confronted with ethical dilemmas of zoonotic disease control. Therefore, I specifically examined the role and responsibilities of veterinarians within the One Health framework. In chapter V, I have presented the outcome of this part of my study. I suggest that a holistic perspective on One Health can help veterinarians to deal with moral dilemmas and to strengthen their position in society. I argue for an 'encapsulated health' argument: the best way to safeguard human health is to promote the health of animals and the environment.

At the moment, neither veterinary legislation nor professional codes offer veterinarians much support in case of conflicting values. How veterinarians should act when their duty of care towards animals conflicts with other professional responsibilities is often not clear. In practice, individual veterinarians are regarded as autonomous professionals, who have the knowledge and the skills to balance different interests and come to considered judgements. At first instance, the One Health framework only seems to complicate the situation because it emphasizes the interconnectivity of human, animal and environmental health. Moreover, the concept itself does not provide moral guidance. It clearly specifies *that* human, animal and ecosystem health have to be addressed in an integrated way, but

it does not yet prescribe *how* exactly the relation between human, animal and ecosystem health should be shaped. However, these conflicts and difficulties are not the result of the One Health framework. One Health only makes the existing complexity explicit. At the same time, the One Health concept can also help to mitigate certain moral dilemmas that veterinarians are facing.

First, this entails the recognition of the independent value of animal health and environmental health, rather than considering animals and ecosystems as mere sources of infectious diseases or other public health risks. A holistic One Health approach to zoonotic diseases not only promotes public health. It also aims for optimal health of animals and the environment. Second, it entails attention to causal factors rather than a focus on disease symptoms only. Such a frame offers opportunities for veterinarians to address the underlying triggers for public health threats coming from animal husbandry. Eventually, this is a more effective approach to deal with public health issues than reactive strategies to signal and control outbreaks. To structurally improve human and animal health, it is therefore necessary to publicly discuss the current practice of animal husbandry.

Based on their expertise and societal position, veterinarians can play an important role in this debate by explaining the animal and human health costs of certain types of animal production. Moreover, in the long run this strategy helps individual veterinarians to prevent certain value conflicts between animal health and public health that they encounter in practice. Rather than solving all problems, this implies that veterinarians should share their dilemmas and concerns with society via recommendations to public policy, formulating and communicating position papers and hands-on advice to animal owners. The veterinary profession can stimulate more sustainable and socially acceptable production systems. A prerequisite of such a system would be: not to harm the health of humans, animals and ecosystems. Therefore, the starting point for any livestock production system should be that the health of animals is placed central. In chapter II, I argue that we must understand health as resilience. If we understand health as resilience, One Health provides us with a valid reason to transform animal production systems in a such a way that resilience of animals is promoted.

With its specific expertise, the veterinary profession is qualified to guide this transition towards a sustainable and resilient animal husbandry. For individual veterinarians starting this process can be problematic. This is not rooted in moral indifference. For most veterinarians the main concern is still the health and welfare of the animals under their care. However, the influence of farm animal veterinarians is sometimes limited because of their role as service-provider, which makes them financially dependent on famers. Therefore this change should start at the level of veterinary professional organizations. They have a different position and can translate veterinary concerns into position papers that transcend the problems on individual farms. In the long run, I expect that such an approach can mitigate possible conflicts between animal health and public health that veterinarians are confronted with, because of its focus on prevention rather than cure. A change on system level that leads to a more sustainable and resilient animal husbandry which operates within the boundaries of the ecological carrying capacity, will not only benefit animal health and welfare. It also promotes the health of humans and ecosystems.

In this way, the idea of 'encapsulated health' functions on an individual as well as on an organizational level.

Of course veterinarians or veterinary organizations cannot enforce a transformation on system level by themselves. The structure of animal husbandry is the consequence of economic and political choices. In a democratic society important decisions about a transition towards a more sustainable animal husbandry are made by the elected government. Veterinarians can fuel the preceding societal and political debate about animal husbandry with their knowledge and expertise about animal health and welfare and veterinary public health. However, especially in a pluralistic society this is not an easy process. Different worldviews and the complexities of our modern world can make it difficult to bring about the necessary changes. In the following paragraph, I will elaborate how an ethic of One Health can help us to move forward in a non-ideal world.

## 6.4 Discussion

During the evaluation of the main findings of my research, I have identified several topics that are open for discussion. Before I come to the main conclusions of my research and my recommendations for policy making, I will subsequently reflect on: zoonotic disease control in a non-ideal world, the role of animal production systems, the moral status of ecosystems, resilience as another boundary concept, ethical decision making in acute situations and the limitations of my empirical research.

### 6.4.1 Zoonotic disease control in a non-ideal world

First, I want to address the following question: how can ethical theories, that usually reflect some kind of ethical ideal, help us to cope with moral dilemmas in a complex and non-ideal world? For instance, an apparently simple solution to mitigate zoonotic disease risk could be to abandon most if not all animal production. As we know, keeping large numbers of genetically homogeneous species like swine and poultry densely together creates a significant threat for the emergence of influenza outbreaks which potentially can lead to new pandemics (United Nations Environment Programme 2020). By (drastically) reducing the number of these domesticated animals for food production, the risk of zoonotic disease like would likewise be reduced. Moreover, reducing animal production would also be beneficial for human and ecosystem health, inter alia because of the reduction of greenhouse gas emissions coming from animal husbandry (Seinfeld et al. 2006). Although this solution might sound convincing and would probably be empirically effective too, reality is not that simple. Due to global population growth and increasing welfare in low and middle income countries, it is expected that the demand for animal proteins will increase over the coming decades (OECD and FAO 2018). In that perspective, it seems unrealistic to maintain that ending animal production is an achievable option to reduce zoonotic disease risk on the short term.

In the following, I will assess the possibilities of a non-ideal approach to establish a One Health strategy to tackle zoonotic diseases in a non-ideal world. To do so, I will briefly

explain the idea of ideal ethical theories and their possibilities and limitations to help us to deal with moral dilemmas in our non-ideal world.

The concept of ideal theory was introduced by John Rawls. He defined his theory of justice as an ideal theory, which he described as a conception of a fully just society (Rawls 1999). In Rawls' view, this theory of justice was based on two assumptions. Firstly, all relevant agents comply with the demands of justice applying to them. And secondly, all natural and historical conditions are favourable, which implies that society is sufficiently economically and socially developed to realize justice (Rawls 1999). In this context, an ideal theory can be interpreted as a "full compliance" theory. In situations where one or both of these assumptions are not met, one can speak of "partial compliance" and hence non-ideal theory (Valentini 2012). As we know, in the real world it is rare that both these conditions are actually met. This suggests that ideal theory is often not suitable for solving the complex moral dilemmas we encounter in real life, like the question of how to construct just and sustainable practices in zoonotic disease control. In (bio)ethics ethical theories, like Kantian deontology or utilitarianism, can be considered as ideal theories. These ethical theories provide us with distinctive moral standards, that we can use to come to moral judgements. However, it is not clear on what grounds we should choose a particular higher ethical theory to give us moral guidance. Moreover, since different higher theories sometimes provide us with different answers to our moral dilemmas, the choice to apply a certain ethical theory is decisive for the outcome of our moral justification. Most societies are morally pluralistic and there is no simple democratic procedure to prefer one ethical theory above another (Flynn 2020). This makes the choice for a certain ideal theory even more complex. Furthermore, the moral standards that we can derive from higher ethical theories are not always well-equipped to deal with practical decision making in real world situations, such as zoonotic disease control.

This is not to say that ideal theories have no function in bioethics. Because they describe an ideal world, ideal theories can give us inspiration and reasons for change. They describe a kind of 'end-state' towards which we can strive. An ideal theory can therefore provide us with a long-term goal for (institutional) reform (Valentini 2012). This idea of an 'end-state' theory is debated by Sen who argued that an 'end-state' theory is neither necessary, nor sufficient for a transitional theory. Sen states that it is not necessary to establish what a fully just world would look like, in order to understand that certain situations in our actual world are unjust and should be altered. Moreover, he thinks that an 'end-state' theory is not sufficient because it would also require some kind of measuring system, to determine whether our actions are improving the situation in the actual world in relation to the supposed ideal situation (Sen 2009). Others have criticised Sen by claiming that ideal theory is necessary to provide us with a certain goal against which we can measure what actions are permissible and contribute to achieving our ideals. In other words, to know we are on the right path and to give meaning to our journey (cf. Simmons 2010). In this thesis, I therefore argue that the One Health concept provides us with a moral reason to not just reactively combat zoonotic diseases, but also to proactively work at prevention by addressing the underlying drivers. At the same time, we must accept that the necessary changes are not always practically and simultaneously feasible in the short term. However, to promote the health of humans, animals and ecosystems in a sustainable manner we

must do what is reasonably possible to alter our way of life. In the light of zoonotic disease control, the idea of One Health and the ethical starting points that I formulated can therefore be seen as an ideal perspective.

In the meantime, zoonotic disease outbreaks will continue to occur. This implies that in order to prevent human an animal suffering we need to act and combat zoonotic disease outbreaks now and in the future. As I described in chapter II and III of my thesis this leads to ethical dilemmas, for instance regarding animal culling policies. In chapter IV, I explain that the precautionary principle is often used to justify particular zoonotic disease control measures. Although I acknowledge that in certain acute situations it can be necessary to cull healthy animals to protect public health, I also argue that in a holistic One Health perspective, such actions should be accompanied by other actions directed at the long term prevention of zoonotic diseases. In the case of influenza, for instance, this also implies we should invest in vaccination strategies to prevent influenza outbreaks in domesticated species like swine and poultry. In this manner, we do not only protect our domesticated animals but we also reduce the risk of new influenza pandemics.

In a non-ideal approach to zoonotic disease control, serious efforts that contribute to structural change are part of the justification for disease control measures that are perhaps inevitable but harmful for animals or ecosystems. This implies that to justify these disease control measures we are morally obliged to address the underlying drivers of zoonotic diseases. In the next paragraph, I will explore the role of animal production systems, which are often identified as one of the main factors in the epidemiology of zoonotic diseases.

### 6.4.2 The role of animal production systems[12]

Animal production systems and zoonotic disease are closely related. That does not mean that animal husbandry is always directly responsible for zoonotic disease events. For instance, even though it is considered most likely that the virus originally emerged from a spill over event after zoonotic exposure in China (Andersen et al. 2020), the world wide spread of COVID-19 is since then due to human-to-human transmission. And although there is some evidence of animal to human transmission during the course of the pandemic, for example at mink farms in the Netherlands (Oreshkova et al. 2020), the general scientific opinion is that after the start of the COVID-19 pandemic animals did not play a significant role as drivers of disease spread (FAO 2020). Nevertheless, our disturbed relation with animals and the environment is regarded as the root cause of many zoonotic disease events which can turn into devastating pandemics (Morens and Fauci 2020).

Of all human infection diseases around 60% is of animal origin. Moreover, more than 75% of new and emerging infectious diseases are caused by pathogens that jump from animals to humans, mostly via food systems (Jones et al. 2008). In fact, this is not a new situation. Zoonotic diseases, often resulting in major plagues, are notorious since humans started to domesticate animals in Neolithic times. Most serious zoonotic threats classified as priority diseases by the WHO, like Ebola, Crimean-Congo haemorrhagic fever or Lassa, have a reservoir in wild-life. However, domesticated animals still play a crucial role in zoonotic disease outbreaks amongst humans. Together with peri-domestic (pest) animals

12 This section is largely based on a contribution to the EURSAFE newsletter of June 2021

and insect vectors they often act as bridge for zoonotic pathogens to make the final jump to the human population.

In this context, animal husbandry deserves our special attention. Recently, the United Nations Environment Program (UNEP 2020) identified seven main drivers for zoonotic disease emergence: 1) the increasing demand for animal protein; 2) unsustainable agricultural intensification; 3) increased use and exploitation of wildlife; 4) unsustainable utilization of natural resources, urbanization and land use change; 5) travel and transportation; 6) changes in food supply chains and 7) climate change. All of the above are both essentially anthropogenic and mutually amplifying their impact. Moreover, these drivers often are intertwined around food systems. Unsurprisingly, one of UNEP's main recommendations is: "to build resilient agroecological food systems that rely on natural synergies and harness biological diversity for food production while protecting important wildlife habitats".

The Food and Agricultural Organization of the United Nations (FAO) defined sustainable agricultural development as: "agricultural development that contributes to improving resource efficiency, strengthening resilience and securing social equity/responsibility of agriculture and food systems in order to ensure food security and nutrition for all, now and in the future" (FAO 2016). A problem with this transition is that global food systems are enormously complex and very different, depending on the region and culture. Furthermore, there is a lack of global governance to direct this change. To achieve overall sustainable food systems and at the same time address the underlying drivers of zoonotic disease control is a global challenge (Brookes et al. 2015).

How to achieve this transition? Since all these drivers are interconnected, such an assignment can easily be labelled as a wicked problem. These kind of issues are characterized as: difficult to define, socially complex problems with multiple causes and interdependencies. Moreover, attempts to solve wicked problems as altering global food production often have unforeseen consequences (Peters and Pierre 2014). Social scientists have suggested several ways to deal with wicked or unstructured problems. Contrary to a structured problem, in case of an unstructured problem there is often no consensus on the facts or the values that are involved in a certain policy problem. Uncertainty about scientific facts and normative differences in opinion, will make it very difficult to address these issues (Hisschemöller and Hoppe 1995). Peters and Pierre (2014) suggest two strategies to find a way out of this complex situation. First, they argue that it can be helpful to set priorities and to structure these priorities into concrete short- and long-term goals. In setting these priorities it is necessary to involve society and to start public debate about the future of food production on a national and international level. This will not be easy since society is so divided.

Another strategy is to find an encompassing concept to address many of the (contradictory) issues that are involved in food production. My research has identified One Health as a possible concept to fulfil this role. I therefore propose to use One Health as a kind of touchstone to assess if certain developments in food systems indeed contribute to the (future) health of humans, animals and ecosystems. Whether animals should be part of

future food systems or not, for moral, environmental reasons or because of food security, I will not address here. However, one thing is clear: if animals are included then their health cannot be compromised.

### 6.4.3 On moral status of ecosystems

I formulated two starting points for an ethic of One Health: the interests of animals and ecosystems should be taken into account in any kind of One Health strategy and the concept of health in One Health should be interpreted as resilience. As I explained in the introduction and the paragraph above, animal ethics provides solid arguments to grant sentient animals a moral status. Hence, their interests have to be balanced against human interests in zoonotic disease control.

To include ecosystems into our moral considerations too, one question to be discussed is whether or not such collectives have a direct moral status? There is an ongoing philosophical debate on the supposed moral status of ecosystems (Nolt 2006; McShane 2014; Bovenkerk and Verweij 2016). Some philosophers argue that, contrary to humans and animals, ecosystems cannot experience pain or suffering nor do they have conscious experiences on their own. Since ecosystems have no sentience, they also do not have experiential interests. And if ecosystems are not conscious of what is happening to them, why should we then take their interests into account?, Nolt asks (Nolt 2006). Others have claimed that interests do not have to be experiential or conscious to count as morally relevant (Dierks 2015). Dierks argues that just having biological interests, like reproduction, metabolism or self-defence, is enough. But it is hard to imagine how we could morally wrong ecosystems if they are not aware of these interests. It is therefore not self-evident that, without sentience, characteristics like being alive or having a good of one's own are a reason for our direct moral obligations. Moreover, McShane explained that only individuals have biological interests (McShane 2014). This provides another reason why wholes, like species or ecosystems, are not morally considerable.

In my view, this debate has not yet delivered persuasive arguments that support an independent moral status for ecosystems. But do we require such status as a basis for our obligations to protect ecosystems? I argue we do not. Because of their fundamental value for humans and animals, ecosystems are indirectly morally relevant. Healthy ecosystems are the basis of all life on earth. For this reason I argue that the interests of ecosystems matter to human and animal health in an instrumental manner. That implies that in One Health strategies to combat zoonotic diseases, the consequences of control measures on ecosystems should be assessed too. Apart from the philosophical objections, there are also practical reasons not to attribute ecosystems a direct moral status. In my opinion, it would make ethical decision making in zoonotic disease unnecessarily complex. If ecosystems have a direct moral status, this would imply that we should balance their interests against the interests of humans and animals. And when these interests conflict, we should find a way to justify our choices in relation to all the interests in play. I have suggested that in such situations VandeVeer's two factor egalitarianism could be of help. However, in its current form this tool does not accommodate the interests of ecosystems. Moreover, I see no options to incorporate the interests of ecosystems in VandeVeer's model nor to divide ecosystem interests in basic and peripheral types. I rather regard healthy ecosystems as a

'conditio sine qua non'. A healthy ecosystem is a basic interest for human as well as animal life. Therefore, I argue that the philosophical discussion about an intrinsic moral status for ecosystems, does not contribute much to making sound moral decisions in zoonotic disease control.

### 6.4.4 Resilience is just another boundary concept

As I have elaborated in the previous paragraph, we should incorporate ecosystem health in our considerations about One Health strategies in zoonotic disease control. I propose to interpret health as resilience. This should provide more guidance in formulating goals of One Health strategies. However, one could argue that the concept of resilience is just as vague or ill-defined as the concept of health. Therefore, to replace health with resilience would just create another catch-all term (Brand and Jax 2007). However, as we have seen, health can be defined in many different ways. As Haverkamp et al. propose, we should consider health concepts as a sort of family in which each concept has a slightly different descriptive and evaluative dimension and is applicable in a different context (Haverkamp, Bovenkerk, and Verweij 2018). In this way they function as a toolbox to reflect on the meaning of health in specific health practices. I argue that resilience captures the essence of health within the context of One Health and zoonotic disease control. Striving for resilience will not only align the goals of One Health strategies for humans, animals and ecosystems, it also offers possibilities to shift from control to prevention of zoonotic diseases. Furthermore, resilience is connected with concepts like adaptation, circularity and carrying capacity, which are at the basis of many new forms of sustainable animal husbandry (De Boer and De Olde 2020).

Holling described resilience as: "a measure of the persistence of systems and of their ability to absorb change and disturbance and still maintain the same relationships between populations or state variables" (Holling 1973). From its descriptive nature, over time the concept of resilience evolved into a more or less normative concept. Nowadays resilience is often seen as a desirable value, something that is worth pursuing (Brand and Jax 2007). Resilience thinking reflects the importance of adaptation and coping mechanisms for our current social-ecological systems. Due to the changing conditions in our living environment, like climate change, in the future resilience will become more and more important for our survival.

At the same time, resilience developed into a boundary concept, which facilitates communication and cooperation between disciplines (Star and Griesemer 1989). However, just as the concept of One Health itself, the notion of resilience bears the risk of hiding value conflicts and power relations. To avoid this pitfall, it is important that the normative aspects of resilience are made explicit and ethically justified (Brand and Jax 2007). Further research is necessary to specify what resilience entails for specific socio-ecological systems where humans, animals and ecosystems interact, like animal husbandry. Besides that, it is important to clarify what ethical assumptions are made if we understand health as resilience. Moreover, to be action guiding, resilience needs to be contextually defined and criteria and indicators must be developed to measure and influence progress.

### 6.4.5 Ethical decision making in acute situations

Making justifiable decisions in zoonotic disease control can be difficult due to lack of information and the societal and political pressure to act as soon as possible. Zoonotic disease control can therefore feel like "navigating through the mist" as Dutch prime minister Rutte phrased it (Hartog and Soest 2020). Although this may be partly true, is does not justify immoral decision making. COVID-19 may have taken the world by surprise, but there have been enough warning signs for future pandemics as we encountered outbreaks of SARS, MERS, Ebola etc. since the beginning of this millennium. For some reason, health authorities and governments ignored the lessons from earlier pandemics. Now the COVID-19 pandemic seems relatively under control by disease control measures and vaccination, we need to reflect on how to be prepared for the next pandemic. As I argue, this means that we have to be precautious in two ways. First, we need to prepare for the next pandemic and set up early warning systems, identify risk areas and hot spots, invest in vaccine development and biosecurity, and last but not least use social science to understand the socio-behavioural aspects of a pandemic. Besides that, we can implement the results of ethical research and improve the models and processes that structure decision making in zoonotic disease control. We could test them in scenario's and practice drills, so that health professionals are familiar with the moral dilemmas they could encounter. In this way moral assessments could become a standard operating procedure in zoonotic disease control. Secondly, we should work on structural change of food systems, climate change and other drivers of zoonotic diseases to prevent pandemics to arise in the first place. Surely, we will not be able to prevent them all. However, as many drivers of zoonotic disease are anthropogenic, we have a moral responsibility to act accordingly and address them. Nevertheless, sometimes it can still be necessary to take difficult decisions to stop an acute zoonotic disease outbreak, for instance, culling healthy animals to protect public health. As I explained in chapter III and IV this can only be justified when it is clear that no other interventions, less harmful for animals, available. Moreover, this needs to be accompanied with prevention strategies.

### 6.4.6 Limitations of empirical research

Key players in zoonotic disease control need to be involved in such prevention strategies and as I argued on the basis of my empirical research ethical experts need to be included in the decision making process. My empirical research was directed at a restricted number of these key players in zoonotic disease control in the Netherlands. Due to limitations of time and budget within this research project, I have not extended my empirical work to veterinary or human practioners, animal welfare NGO's or the general public. Although, this would have enriched my research on ethical presuppositions in zoonotic disease control, I do not think the outcome would have been different. First of all, my respondents form a representative and important part of the Dutch zoonotic structure, who is responsible for zoonotic disease control in the Netherlands. Second, my findings are supported by other research on this topic, national as well as international (Cohen, Brom and Stassen 2012; Degeling et al. 2017; Johnson et al. 2019). Nevertheless, it would be interesting to expand the empirical research to veterinary and human practioners, animal welfare organizations and the general public to examine how One Health strategies are experienced and shaped in the field.

## 6.5 Main conclusions and recommendations

Now that I have presented my main findings and have discussed a number of issues I encountered during my research, I come to my final conclusion. I will first provide the definitive answers to my consecutive research questions. Finally, I will explain how a One Health approach in zoonotic disease control be constructed and justified from an ethical perspective and provide my recommendations for policy-makers.

### 6.5.1 What is a One Health approach in zoonotic disease control?

The answer to my first research question is provided in chapter II of my dissertation. However, the response to this question is not straightforward, because there is no universal conception of what a One Health approach in zoonotic disease control exactly entails. In chapter II, I describe that zoonotic disease control policies that are based on current interpretations of the One Health concept create moral dilemmas. These moral dilemmas arise from value conflicts that are inherently connected with certain disease control measures, like the culling of healthy animals. Such measures are difficult to justify from an holistic One Health perspective. In zoonotic disease control, human values like public health and economic interests can easily conflict with animal welfare or ecosystem health. These value conflicts are especially salient in the case of veterinarians, who are expected to serve not only animal health and welfare, but public health and food security as well.

Contemporary interpretations of One Health conceal normative differences in case of value conflicts because they are merely focussed on collaboration between professional disciplines that are important to tackle zoonotic diseases. Used in this way, One Health functions as a boundary concept to unite health professionals while leaving difficult ethical discussions to society and politics. To help health professionals and policymakers deal with moral dilemmas in zoonotic disease control One Health needs a corresponding ethical framework. Such an ethic of One Health starts with acknowledging the moral status of animals and the indirect moral obligations we have towards ecosystems. Furthermore, it is necessary that we find an appropriate definition of health, which encompasses all three components of One Health: humans, animals and ecosystems.

Trying to establish an universally accepted definition will not overcome the moral dilemmas that originate from One Health strategies in zoonotic disease control. Firstly, it will be complicated to reach consensus on the overall goal of a One Health approach because of underlying moral differences. Secondly, to impose a universal definition can obstruct One Health's function as a boundary object to facilitate cooperation. Therefore, I propose to start by finding consensus about the normative starting points of One Health. First of all, we need to agree about the moral status of humans, animals and the environment. I conclude that we should at least award animals moral status, which means animal interests should be taken into account while drafting zoonotic disease control policies. In case of ecosystems, I suggest that because of their fundamental value for life on earth, we should strive for zoonotic disease control policies that support healthy ecosystems.

I argue that this implies a health concept that can be used for all elements within the One Health framework. In my view, the concept of 'resilience' is a fruitful option in this respect. Resilience is applicable to humans, animals and ecosystems. Moreover, it encourages us to invest in a more preventive rather than reactive approach to zoonotic diseases. In case of unavoidable moral dilemmas, it can be useful to apply VanDeVeer's principle of two factor egalitarianism. This implies that peripheral human interests are not accepted as a sufficient reason to take zoonotic disease control measures that seriously harm basic interests of animals. Moreover, these measures should not negatively affect long term resilience of animals and ecosystems.

### 6.5.2 What are the moral dilemmas of a One Health approach in zoonotic disease control ?

In chapter II-V, I have presented several cases that illustrate the moral dilemmas that arise from a so-called One Health approach in zoonotic disease control. My empirical research revealed that health professionals recognize these ethical concerns. Moral dilemmas arise from value conflicts. In zoonotic disease control these do not only evolve around human centred values like public health or economy. If we take One Health seriously, then we must consider the interests of animals and indirectly also those of ecosystems. Health professionals acknowledge this. However, because of their professional context they are predominantly focussed on promoting public health. Value conflicts in zoonotic disease control lead to difficult trade-offs and cause public debate. Examples of disease control measures that provoke moral dilemmas are: the culling of healthy animals, restricting the use of certain antimicrobials in animals, confining animals in unfit housing systems and implementing transport bans that lead to overcrowding.

### 6.5.3 What are the ethical presuppositions in zoonotic disease control and how do these relate to the One Health concept?

In chapter III, I presented the results of my empirical research. These results indicate that health professionals in zoonotic disease control in general adhere to a holistic view of the One Health concept, however, in practice an anthropocentric approach is dominant. Public health was identified as the trumping moral value, which reveals an inherent field of tension with the core of One Health thinking.

To implement One Health strategies in zoonotic disease control, many countries set up early warning systems, in which human and veterinary health professionals cooperate. These systems, like the Dutch Zoonoses Structure, can be successful to detect emerging disease threats. However, these systems are not well equipped to handle moral dilemmas that can arise in zoonotic disease control, like the culling of healthy animals. Assessment tools can be helpful to structure ethical concerns in zoonotic disease control. However, these assessment tools are often not action guiding. Moreover, as I have showed they sometimes lack important values at stake. The COVID-19 pandemic has shown that honesty, trust and transparency are core values in zoonotic disease control. I therefore recommend adding these values to assessment tools to evaluate One Health strategies, like the framework of the Dutch Council on Animal Affairs.

Serious discussion of ethical issues should be an integral part of deliberations preceding decisions about measures to prevent and combat zoonosis. Although such discussion may not always make a difference to the final decisions reached, it is important in a democracy to ensure that the ethical assumptions underlying the decision-making process are transparent. Therefore, I argue that ethical expertise should be added in the decision making process concerning zoonotic disease policies. The role of ethicists includes identifying ethical dilemmas and corresponding moral values. Furthermore, they can facilitate ethical discussion by providing relevant ethical principles, analysis of arguments and considerations for action perspectives. The lack of ethical expertise in control systems for zoonotic diseases can lead to misconception of ethical principles, like the precautionary principle which is frequently evoked to justify disease control measures.

### 6.5.4 How should the precautionary principle be applied in zoonotic disease control according to the One Health concept?

From an ethical One Health perspective, the use of the precautionary principle in zoonotic disease control can have problematic consequences. Currently, there is a one-sided focus on human health and economic considerations. Precautionary measures to prevent or mitigate zoonotic diseases can lead to unwanted outcomes or trade-offs. In other words, the application of the precautionary principle in zoonotic disease control can cause conflicts between human, animal and environmental values. The use of the precautionary principle has certain ethical restrictions; it must be clear that there is a harm, there has to be a certain amount of scientific evidence for a cause and effect relation and the proposed precautionary measures should be effective, consistent, proportional and not counterproductive. An assessment of the effect of precautionary measures should be integrated in the standard decision-models of public health authorities. Moreover, to ensure societal support these considerations and the trade-offs they contain should be transparent and open for dialogue, with the involved stakeholders as well as with the general public.

Because zoonotic disease risk is unavoidable, we have to accept a certain degree of risk. Establishing what level of risk is acceptable calls for a public dialogue because it involves value judgments, which cannot only be left to experts. For instance, how much public health risk we are willing to accept to accommodate animal welfare is a societal and political question. The fact that a certain level of zoonotic disease risk is unavoidable, forces us to think about managing these risks. In my view it is not enough to be well prepared for (re-)emerging zoonotic disease threats. Such a reactive approach will inevitably lead to trade-offs that are often not consistent with the concept of One Health. I argue that this preparedness should be supplemented with a more fundamental approach that addresses the root causes of zoonotic disease risks. This strategy, that I call 'precaution-as-prevention' must be aimed at improving the health and resilience of animals and ecosystems primarily, to ultimately benefit the health of humans as well. The focus of these prevention policies should be on possible human activities that could potentially harm the health of humans, animals or the environment. It also requires that certain precautionary measures to prevent zoonotic disease risks should be taken, even if some cause-and-effect relationships are not fully established scientifically. This implies inter alia that

health authorities and governments should critically assess all human activities that could contribute to possible zoonotic disease outbreaks, like globalization, food production, land use, urbanization etc. On a national level, such an impact assessment could be part of licensing systems, for instance for food production, transport or construction. Of course, this requires (international) political and democratic decision making to establish what is economically and socially acceptable on the short and the long term.

### 6.5.5 What are the professional responsibilities of veterinarians within the One Health framework?

Societal expectations regarding the professional responsibilities of veterinarians are sometimes overdemanding and lead to moral dilemmas often caused by underlying economic systems in animal husbandry. On the basis of an 'encapsulated health' argument, I argue that the best way to safeguard human health is to promote the health of animals and the environment. This also holds for the responsibility of the veterinary profession: to serve public health, the primary responsibility of veterinarians should be to be experts in animal health and welfare. This essence must be reflected in veterinary codes of conduct and professional guidelines. Because individual veterinarians have few possibilities to force system level change, veterinary organizations on a national and international level have to speak out. They should advocate that healthy animals are an essential precondition of any type of animal husbandry. If these systems are constructed to secure animal health this will eventually benefit human and environmental health. Interpreted as such, One Health offers veterinarians a way out of the dichotomy between public and animal health that is at the basis of many moral dilemmas in zoonotic disease control.

### 6.5.6 How do the non-ideal conditions of the real world influence ethical judgment in moral dilemmas associated with zoonotic disease control?

In the previous paragraph, I have elaborated on the relation between the often non-ideal conditions in the real word and the contribution of ideal ethical theory to handle moral dilemmas in zoonotic disease control. I argue that we have to acknowledge that in zoonotic disease control we sometimes have to take drastic measures to safeguard public health, like the culling of healthy animals. At first sight, this seems contrary to the ideal of One Health. However, if we are forced to take such radical measures, this can only be justified when at the same time precautionary measures are taken to prevent future zoonotic disease outbreaks. Before we decide to implement certain disease control measures, an ethic of One Health requires that we first balance all possible interventions, and choose those interventions that have the least impact on the health of animal and ecosystem health, while they are still effective enough to stop the disease. Unfortunately, at the moment economic considerations still dominate animal disease policies in the European Union. For this reason, not all opportunities to prevent mass culling are sufficiently exploited, like the use of preventive vaccination. It must be noticed too that at the moment the efforts to prevent zoonotic disease outbreaks by addressing their underlying drivers are insufficient. This is morally problematic and makes it difficult to justify current zoonotic disease control policies.

This brings me to my overall research question:

### 6.5.7 How should a One Health approach in zoonotic disease control be conceived and justified from an ethical perspective?

As I elaborated, a One Health approach in zoonotic disease control should at least acknowledge that animals have moral status and that healthy ecosystems are essential for human and animal health. This implies that their interests should be taken into account when deciding about zoonotic disease control. The effect of control measures for the health of animals and ecosystems should therefore be part of the decision making procedure. The starting point of every One Health strategy should be to do justice to all relevant values of humans as well as of animals and ecosystems. The best way to achieve this is to create the necessary conditions that promote health for all: humans, animals and ecosystems. In this context, I propose to interpret health as resilience. One Health strategies in zoonotic disease control should therefore be directed to promote long term resilience of humans, animals and ecosystems. In this thesis, I advocate that such a holistic interpretation of the One Health concept will ultimately promote human health more than the current anthropocentric conception.

The contemporary conception of One Health is necessary but insufficient to address the future emerging zoonotic diseases that will continue to arise sooner or later. Of course, it is of utmost importance to invest in pandemic preparedness. The COVID-19 pandemic has revealed that this is an essential step to counter future zoonotic disease outbreaks. Better cooperation between veterinary and human medicine, ecologists, social scientists etc. on national and international level is necessary to achieve this. Precaution as preparedness is an inevitable part of One Health approaches in zoonotic disease control. However, as I argue in this thesis, it is not enough. To reduce the risk of pandemic outbreaks, we need to work on prevention at a system level as well. This implies that more scientific research and political action is needed to address the drivers of zoonotic diseases: climate change, land use, animal husbandry, globalization, urbanization etc. This is not an easy task since the underlying economic and political structures are complex. Nevertheless, it starts with understanding that in One Health strategies to combat zoonotic diseases precaution as preparedness should always be accompanied with precaution as prevention.

## 6.6 Concluding remarks

This thesis was aimed at formulating a number of starting points for an ethic of One Health. During this process, I focussed on zoonotic disease control. Further research is needed to improve and develop an ethical framework for One Health. This also applies to other fields where the One Health concept is used, such as comparative and translational medicine. Besides the involvement of social sciences, the knowledge of ecologists, earth sciences and engineering is much needed in this respect. One of the topics this research should focus on is to specify what resilience entails for specific socio-ecological systems where humans, animals and ecosystems interact, like animal husbandry. The concept of resilience needs to be contextually defined further and criteria and indicators must be developed to measure and influence progress.

More empirical research could help to better understand how One Health strategies in zoonotic disease control, but also in other areas of application, work out in practice. Because of their close relation with clients and patients, both veterinarians and human medicine practioners have first-hand experience with moral dilemmas resulting from One Health strategies. The outcome of such research could contribute further to mitigate moral dilemmas and make zoonotic disease control more socially acceptable for health professionals. In this context, it is advised to extend this research also to animal welfare organizations and the general public.

Finally, I want to emphasize that more scientific research and political action is urgently needed to address the drivers of zoonotic diseases: climate change, land use, animal husbandry, globalization, urbanization etc. Let us hope that COVID-19 has finally opened our eyes and taught us that change is necessary to keep our planet habitable for humans, animals and nature alike.

# References

American Veterinary Medical Association. 2008. "One Health : A New Professional Imperative." www.avma.org. 2008. https://www.avma.org/KB/Resources/Reference/Pages/One-Health94.aspx.

Andersen, K.G., A. Rambaut, W.I. Lipkin, E.C. Holmes, and R.F. Garry. 2020. "The Proximal Origin of SARS-CoV-2." *Nature Medicine* 26 (4): 450–52. https://doi.org/10.1038/s41591-020-0820-9.

Anomaly, J. 2015. "What's Wrong With Factory Farming?" *Public Health Ethics* 8 (3): 246–54. https://doi.org/10.1093/phe/phu001.

Asselt, M. van, E.D. Ekkel, B. Kemp, and E. N. Stassen. 2019. "The Trade-Off Between Chicken Welfare and Public Health Risks in Poultry Husbandry: Significance of Moral Convictions." *Journal of Agricultural and Environmental Ethics* 32 (2): 293–319. https://doi.org/10.1007/s10806-019-09774-3.

Asselt, M. van, E.D. Ekkel, B. Kemp, and E.N. Stassen. 2016. "41. Role of Moral Values in the Trade-off between Animal Welfare and Food Safety Risks in Broiler Husbandry." In *Food Futures: Ethics, Science and Culture*, 273–78. University of Porto, Portugal: Wageningen Academic Publishers. https://doi.org/10.3920/978-90-8686-834-6_41.

Aylward, B., K.A. Hennessey, N. Zagaria, J.M. Olivé, and S. Cochi. 2000. "When Is a Disease Eradicable? 100 Years of Lessons Learned." *American Journal of Public Health* 90 (10): 1515-1520. https://doi.org/10.2105/AJPH.90.10.1515

Bailey, R. 2001. "Deciding about Your Health Care: The Ethicist as Policy-Maker." *Health Care Analysis* 9: 265–81. https://doi.org/10.1023/A:1012993514088.

Barrett, M.A., and S.A Osofsky. 2013. *One Health: Interdependence of People, Other Species and the Planet*. 4th ed. Jekel's Epidemiology, Biostatistics, Preventive Medicine and Public Health. Philadelphia, Pennsylvania: Saunders Elsevier.

Bate, R. 2003. *How Precaution Kills: The Demise of DDT and the Resurgence of Malaria*. Politicizing Science: The Alchemy of Policymaking. Hoover Institution Press. https://www.hoover.org/sites/default/files/uploads/documents/0817939326_261.pdf

Beauchamp, T.L., and J.F. Childress. 2013. *Principles of Biomedical Ethics*. New York : Oxford University Press.

Belt, H. van den. 2003. "Debating the Precautionary Principle: 'Guilty until Proven Innocent' or 'Innocent until Proven Guilty'?: Figure 1." *Plant Physiology* 132 (3): 1122–26. https://doi.org/10.1104/pp.103.023531.

Benedictus, A., H. Hogeveen, and B.R. Berends. 2009. "The Price of the Precautionary Principle: Cost-Effectiveness of BSE Intervention Strategies in the Netherlands." *Preventive Veterinary Medicine* 89 (3–4): 212–22. https://doi.org/10.1016/j.prevetmed.2009.03.001.

Bhamra, R., S. Dani and K. Burnard. 2011. "Resilience: The Concept, a Literature Review and Future Directions." *International Journal of Production Research* 49 (18): 5375–93. https://doi.org/10.1080/00207543.2011.563826.

Blood, D.C., and VP Studdert. 1999. *Saunders Comprehensive Veterinary Dictionary*. London: WB Saunders.

Bolt, L.L.E., M.F. Verweij, and J.J.M. Van Delden. 2003. *Ethics in Pratice*. 4th ed. Assen: Koninklijke Van Gorcum b.v.

Boni, M.F. 2020. "Evolutionary Origins of the SARS-CoV-2 Sarbecovirus Lineage Responsible for the COVID-19 Pandemic." *Nature Microbiology* 5: 1408-1417. https://doi.org/10.1038/s41564-020-0771-4

Boorse, C. 1977. "Health as a Theoretical Concept." *Philosophy of Science* 44 (4): 542–73. https://doi.org/10.1086/288768.

Bovenkerk, B., and M.F. Verweij. 2016. "Between Individualistic Animal Ethics and Holistic Environmental Ethics, Burring the Boundaries." In *Animal Ethics in the Age of Humans*, 369–85. The International Library of Environmental, Agricultural and Food Ethics 23. Springer International Publishing.

Bovenkerk, B., and F.L.B. Meijboom. 2012. "The Moral Status of Fish. The Importance and Limitations of a Fundamental Discussion for Practical Ethical Questions in Fish Farming." *Journal of Agricultural and Environmental Ethics* 25 (6): 843–60. https://doi.org/10.1007/s10806-011-9365-8.

Brand, F.S., and Kurt Jax. 2007. "Focusing the Meaning(s) of Resilience: Resilience as a Descriptive Concept and a Boundary Object." *Ecology and Society* 12 (1): art23. https://doi.org/10.5751/ES-02029-120123.

British Veterinary Association. 2018. "BVA Position on Veterinary Scanning Surveillance (Animal Health and Disease Monitoring)." https://www.bva.co.uk/uploadedFiles/Content/News_campaigns_and_policy/Policy/Animal_disease_surveillance/BVA%20position%20on%20veterinary%20scanning%20surveillance.pdf.

Broens, E.M., E.A.M. Graat, P.J. Van Der Wolf, A.W. Van De Giessen, and M.C.M. De Jong. 2011. "Prevalence and Risk Factor Analysis of Livestock Associated MRSA-Positive Pig Herds in The Netherlands." *Preventive Veterinary Medicine* 102 (1): 41–49. https://doi.org/10.1016/j.prevetmed.2011.06.005.

Brookes, V.J., M. Hernández-Jover, P.F. Black, and M.P. Ward. 2015. "Preparedness for Emerging Infectious Diseases: Pathways from Anticipation to Action." *Epidemiology and Infection* 143 (10): 2043–58. https://doi.org/10.1017/S095026881400315X.

Bruschke, C.J.M., H.I.J. Roest, and R.A. Coutinho. 2016. "Q Fever: The Dutch Policy." *Journal of Risk Research* 19 (8): 1022–35. https://doi.org/10.1080/13669877.2015.1042498.

Burki, T. 2020. "The Origin of SARS-CoV-2." *The Lancet Infectious Diseases* 20 (9): 1018–19. https://doi.org/10.1016/S1473-3099(20)30641-1.

British Veterinary Association. 2016. "Animal Welfare Policy Position." https://www.bva.co.uk/News-campaigns-and-policy/Policy/Ethics-and-welfare/Animal-welfare/.

Capps, B., M.M. Bailey, D. Bickford, R. Coker, Z. Lederman, A. Lover, T. Lysaght, and P. Tambyah. 2015. "Introducing One Health to the Ethical Debate About Zoonotic Diseases in Southeast Asia". *Bioethics*. 29(8): 588-96. https://doi.org/10.1111/bioe.12145

Caring Vets. 2017. "Come in opposition veterinarians. This is not animal welfare." Newspaper. NRC. https://www.nrc.nl/nieuws/2017/06/26/kom-in-verzet-dierenarts-dit-is-geen-dierenwelzijn-11289973-a1564575.

Carr, D. 1999. "Professional Education and Professional Ethics Right to Die or Duty to Live?" *Journal of Applied Philosophy* 16 (1): 33–46. https://doi.org/10.1111/1468-5930.00106.

Cassidy, A. 2016. *One Medicine? Advocating (Inter)Disciplinarity at the Interfaces of Animal Health, Human Health, and the Environment*. Vol. chapter 10. In: Frickel S, Albert M, Prainsack B, Editors. Investigating Interdisciplinary Collaboration: Theory and Practice across Disciplines. New Brunswick (NJ): Rutgers University Press. https://www.ncbi.nlm.nih.gov/books/NBK395883/.

Central Bureau of Statistics, PBL Netherlands Environmental Assessment Agency, and Wageningen University & Research. 2016. "Development of Livestock on Farms in the Netherlands, 1980-2015. Pdf." https://www.clo.nl/indicatoren/nl2124-ontwikkeling-veestapel-op-landbouwbedrijven-.

Chien, Y.J. 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): 213–26. https://doi.org/10.1111/j.1467-9566.2012.01534.x.

Cohen, N.E., F.W.A. Brom, and E.N. Stassen. 2012. "Moral Convictions and Culling Animals: A Survey in the Netherlands." *Anthrozoos: A Multidisciplinary Journal of The Interactions of People & Animals* 25 (3): 353–67. https://doi.org/10.2752/175303712X13403555186334.

Cook R.A., W.B. Karesh, and S.A. Osofsky. 2004. "One World One Health." http://www.oneworldonehealth.org/.

Costanza, R. 2012. "Ecosystem Health and Ecological Engineering." *Ecological Engineering* 45 (August): 24–29. https://doi.org/10.1016/j.ecoleng.2012.03.023.

Council on Animal Affairs. 2016a. "Antibiotic Policy in Animal Husbandry." The Hague, The Netherlands. https://english.rda.nl/publications/publications/2016/03/01/antibiotic-policy-in-animal-husbandry-effects-and-perspectives.

Council of Animal Affairs. 2016b. "One Health a Policy Assessment Framework." The Hague, The Netherlands: https://english.rda.nl/publications/publications/2016/02/08/one-health.

Council on Animal Affairs. 2018. "The State of the Animal." The Hague, The Netherlands. http://edepot.wur.nl/470938.

Daniels, N. 2020. "Reflective Equilibrium." The Stanford Encyclopedia of Philosophy (Summer 2020 Edition), Edward N. Zalta (ed.). https://plato.stanford.edu/archives/sum2020/entries/reflective-equilibrium/.

Davies, P. 2017. "Balancing Responsibilities When Prescribing Antimicrobials for Farm Animals." *Veterinary Record* 180 (15): 374–75. https://doi.org/10.1136/vr.j1708.

Davis, M.F., S.C. Rankin, J.M. Schurer, S. Cole, L. Conti, P. Rabinowitz, G. Gray, et al. 2017. "Checklist for One Health Epidemiological Reporting of Evidence (COHERE)." *One Health* 4 (December): 14–21. https://doi.org/10.1016/j.onehlt.2017.07.001.

De Boer, I.J.M., and E. De Olde. 2020. "Re-Rooting the Dutch Food System: From More to Better." Wageningen University & Research. https://www.wur.nl/en/show-longread/Re-rooting-the-Dutch-food-system-from-more-to-better.htm.

Degeling, C., J. Johnson, I. Kerridge, A. Wilson, M. Ward, C. Stewart, and G. Gilbert. 2015. "Implementing a One Health Approach to Emerging Infectious Disease: Reflections on the Socio-Political, Ethical and Legal Dimensions." *BMC Public Health* 15 (1): 1307. https://doi.org/10.1186/s12889-015-2617-1.

Degeling, C., Z. Lederman, and M. Rock. 2016. "Culling and the Common Good: Re-Evaluating Harms and Benefits under the One Health Paradigm." *Public Health Ethics* 9 (3): 244–54. https://doi.org/10.1093/phe/phw019.

Degeling, C., J. Johnson, M. Ward, A. Wilson, and G. Gilbert. 2017. "A Delphi Survey and Analysis of Expert Perspectives on One Health in Australia." *EcoHealth* 14 (4): 783–92. https://doi.org/10.1007/s10393-017-1264-7.

Degeling, C., G.L. Gilbert, P. Tambyah, J. Johnson, and T. Lysaght. 2019. "One Health and Zoonotic Uncertainty in Singapore and Australia: Examining Different Regimes of Precaution in Outbreak Decision-Making." *Public Health Ethics*, December, phz017. https://doi.org/10.1093/phe/phz017.

Dierks, J. 2015. "Taking Genes Seriously - An Interest-Based Approach to Environmental Ethics and Biodiversity Conservation." Ernst-Moritz-Arndt-Universität Greifswald. https://nbn-resolving.org/urn:nbn:de:gbv:9-002286-2.

Döring, T.F., A. Vieweger, M. Pautasso, M. Vaarst, M.R. Finckh, and M.S. Wolfe. 2015. "Resilience as a Universal Criterion of Health." *Journal of the Science of Food and Agriculture* 95 (3): 455–65. https://doi.org/10.1002/jsfa.6539.

European Commission. 2000. "Communication of the Commission: About the Precautionary Principle." https://eur-lex.europa.eu/legal-content/NL/TXT/PDF/?uri=CELEX:52000DC0001&-from=NL.

European Commission. 2020. "Coronavirus: Commission Unveils EU Vaccines Strategy.". https://ec.europa.eu/commission/presscorner/detail/en/ip_20_1103.

European Food Safety Authority and European Centre for Disease Prevention and Control. 2017. "The European Union Summary Report on Antimicrobial Resistance in Zoonotic and Indicator Bacteria from Humans, Animals and Food in 2015." *EFSA Journal* 15 (2). https://doi.org/10.2903/j.efsa.2017.4694.

Evans, B.R., and F.A. Leighton. 2014. "A History of One Health." *Revue Scientifique Et Technique (International Office of Epizootics)* 33 (2): 413–20. http://dx.doi.org/10.20506/rst.33.2.2298.

Fan, Y, K. Zhao, Z.L. Shi, and P. Zhou. 2019. "Bat Coronaviruses in China." *Viruses* 11 (3): 210. https://doi.org/10.3390/v11030210.

Food and Agricultural Organization of the United Nations. 2012. "Thoughts of FAO on One Health." http://www.fao.org/ag/againfo/home/en/news_archive/2010_one-health.html.

Food and Agricultural Organization of the United Nations. 2016. "Sustainable Agricultural Development for Food Security and Nutrition: What Roles for Livestock?" http://www.fao.org/3/a-i5795e.pdf.

Food and Agricultural Organization of the United Nations. 2020. *Exposure of Humans or Animals to SARS-CoV-2 from Wild, Livestock, Companion and Aquatic Animals*. FAO. https://doi.org/10.4060/ca9959en.

Food and Agricultural Organization of the United Nations- Office International des Epizooties -World Health Organization. 2010. "The FAO-OIE-WHO Collaboration Sharing Responsibilities and Coordinating Global Activities to Address Health Risks at the Animal-Human-Ecosystems Interfaces." http://www.who.int/influenza/resources/documents/tripartite_concept_note_hanoi_042011_en.pdf.

Federation of Veterinarians in Europe. 2009. "European Veterinary Code of Conduct." https://www.fve.org/cms/wp-content/uploads/bro_fve_2009_final-1.pdf.

Federation of Veterinarians in Europe. 2016. "Relationship between Animal Welfare and the Use of Antibiotics in Food Animals." http://www.fve.org/uploads/publications/docs/063_fve_aww_position_on_resistance_and_animal_welfare_final2.pdf.

Fitzgerald, J.R. 2012. "Livestock-Associated Staphylococcus Aureus: Origin, Evolution and Public Health Threat." *Trends in Microbiology* 20 (4): 192–98. https://doi.org/10.1016/j.tim.2012.01.006.

Flynn, J. 2020. "Theory and Bioethics". https://plato.stanford.edu/archives/win2020/entries/theory-bioethics/#AttrHighTheo.

Folke, C., S. Carpenter, B. Walker, M. Scheffer, T. Elmqvist, L. Gunderson, and C.S. Holling. 2004. "Regime Shifts, Resilience, and Biodiversity in Ecosystem Management." *Annual Review of Ecology, Evolution, and Systematics* 35 (1): 557–81. https://doi.org/10.1146/annurev.ecolsys.35.021103.105711.

Food and Veterinary Office. 2016. "Final Report Prudent Use of Antimicrobials in the Netherlands." DG(SANTE) 2016-8889-MR. http://ec.europa.eu/food/audits-analysis/audit_reports/details.cfm?rep_id=3753.

Food and Veterinary Office. 2017. "Final report of a fact-finding mission carried out in the Netherlands from 13 September 2016 to 20 September 2016 in order to gather information on the prudent use of antimicrobials in animals". http://ec.europa.eu/food/audits-analysis/country_profiles/details.cfm?co_id=NL.

Ge, L., N.P.R. Anten, I.D.E. van Dixhoorn, P.H. Feindt, K. Kramer, R. Leemans, M.P.M. Meuwissen, H. Spoolder, and W. Sukkel. 2016. "Why We Need Resilience Thinking to Meet Societal Challenges in Bio-Based Production Systems." *Current Opinion in Environmental Sustainability* 23 (December): 17–27. https://doi.org/10.1016/j.cosust.2016.11.009.

Gibbs, E.P.J. 2014. "The Evolution of One Health: A Decade of Progress and Challenges for the Future." *Veterinary Record* 174 (4): 85–91. https://doi.org/10.1136/vr.g143.

Grave, K., J. Torren-Edo, and D. Mackay. 2010. "Comparison of the Sales of Veterinary Antibacterial Agents between 10 European Countries." *Journal of Antimicrobial Chemotherapy* 65 (9): 2037–40. https://doi.org/10.1093/jac/dkq247.

Greenhalgh, T., M.B. Schmid, T. Czypionka, D. Bassler, and L. Gruer. 2020. "Face Masks for the Public during the Covid-19 Crisis." *BMJ*, April, m1435. https://doi.org/10.1136/bmj.m1435.

Grøntvedt, C.A., P. Elstrøm, M. Stegger, R.L. Skov, and P. Skytt Andersen. 2016. "Methicillin-Resistant Staphylococcus Aureus CC398 in Humans and Pigs in Norway: A 'One Health' Perspective on Introduction and Transmission." *Clinical Infectious Diseases* 11 (63): 1431–1438. https://doi.org/10.1093/cid/ciw552

Gruen, L. 2014. "The Moral Status of Animals." In *The Stanford Encyclopedia of Philosophy*, edited by Edward N. Zalta. Metaphysics Research Lab, Stanford University. https://plato.stanford.edu/archives/fall2014/entries/moral-animal/.

Gunnarsson, S. 2006. "The Conceptualisation of Health and Disease in Veterinary Medicine." *Acta Veterinaria Scandinavica* 48 (1): 20. https://doi.org/10.1186/1751-0147-48-20.

Gupta Strategists. 2020. "COVID-Goes-Cuckoo." https://gupta-strategists.nl/storage/files/200521-COVID-goes-Cuckoo.pdf.

Haalboom, A.F. 2017. *Negotiating Zoonoses: Dealings with Infectious Diseases Shared By Humans and Livestock in The Netherlands (1898-2001)*. University Utrecht. https://dspace.library.uu.nl/handle/1874/354208.

Hansson, S.O. 2003. "Ethical Criteria of Risk Acceptance." *Erkenntnis* 59 (3): 291–309. https://doi.org/10.1023/A:1026005915919.

Hartog, T. den, and H. van Soest. 2020. "Het coronavirus is overal, ook als Rutte zijn begroting verdedigt." Het Parool. September 18, 2020. https://www.parool.nl/gs-b5edc214.

Häsler, B., W. Gilbert, B.A. Jones, D.U. Pfeiffer, J. Rushton, and M.J. Otte. 2012. "The Economic Value of One Health in Relation to the Mitigation of Zoonotic Disease Risks." In *One Health: The Human-Animal-Environment Interfaces in Emerging Infectious Diseases*, edited by John S. Mackenzie, Martyn Jeggo, Peter Daszak, and Juergen A. Richt, 365:127–51. Berlin, Heidelberg: Springer Berlin Heidelberg. http://link.springer.com/10.1007/82_2012_239.

Havelaar, A.H., F. van Rosse, C. Bucura, M.A. Toetenel, J.A. Haagsma, D. Kurowicka, J.A.P. Heesterbeek, et al. 2010. "Prioritizing Emerging Zoonoses in The Netherlands." Edited by Adam J. Ratner. *PLoS ONE* 5 (11): e13965. https://doi.org/10.1371/journal.pone.0013965.

Haverkamp, B., B. Bovenkerk, and M.F Verweij. 2018. "A Practice-Oriented Review of Health Concepts." *The Journal of Medicine and Philosophy: A Forum for Bioethics and Philosophy of Medicine* 43 (4): 381–401. https://doi.org/10.1093/jmp/jhy011.

Hensel, M.E., M. Negron, and A.M. Arenas-Gamboa. 2018. "Brucellosis in Dogs and Public Health Risk." *Emerging Infectious Diseases* 24 (8): 1401–6. https://doi.org/10.3201/eid2408.171171.

Herten, J. van, and F.L.B. Meijboom. 2018. "43. Veterinary Responsibilities within the One Health Framework." In *Professionals in Food Chains*, 281–86. Vienna, Austria: Wageningen Academic Publishers. https://doi.org/10.3920/978-90-8686-869-8_43.

Herten, J. van, B. Bovenkerk, and M.F. Verweij. 2019. "One Health as a Moral Dilemma: Towards a Socially Responsible Zoonotic Disease Control." *Zoonoses and Public Health* 66 (1): 26–34. https://doi.org/10.1111/zph.12536.

Herten, J. van, S. Buikstra, B. Bovenkerk, and E.N. Stassen. 2020. "Ethical Decision-Making in Zoonotic Disease Control: How Do One Health Strategies Function in the Netherlands?" *Journal of Agricultural and Environmental Ethics*, March. https://doi.org/10.1007/s10806-020-09828-x.

Herzog, H.A. 2007. "Gender Differences in Human–Animal Interactions: A Review." *Anthrozoös* 20 (1): 7–21. https://doi.org/10.2752/089279307780216687.

Heymann, D.L, J. Jay, and R. Kock. 2017. "The One Health Path to Infectious Disease Prevention and Resilience." *Transactions of The Royal Society of Tropical Medicine and Hygiene* 111 (6): 233–34. https://doi.org/10.1093/trstmh/trx052.

Hinchliffe, S., and K.J. Ward. 2014. "Geographies of Folded Life: How Immunity Reframes Biosecurity." *Geoforum* 53 (May): 136–44. https://doi.org/10.1016/j.geoforum.2014.03.002.

Hinchliffe, S. 2015. "More than One World, More than One Health: Re-Configuring Interspecies Health." *Social Science & Medicine*, 129 (March): 28–35. https://doi.org/10.1016/j.socscimed.2014.07.007.

Hisschemöller, M., and R. Hoppe. 1995. "Coping with Intractable Controversies: The Case for Problem Structuring in Policy Design and Analysis." *Knowledge and Policy* 8 (4): 40–60. https://doi.org/10.1007/BF02832229.

Höjgård, S., O. Aspevall, B. Bengtsson, S.Haeggman, M. Lindberg, K. Mieziewska, S. Nilsson, H. Ericsson Unnerstad, D. Viske, and H. Wahlström. 2015. "Preventing Introduction of Livestock Associated MRSA in a Pig Population: Benefits, Costs, and Knowledge Gaps from the Swedish Perspective." *PloS One* 10 (4): e0122875. https://doi.org/10.1371/journal.pone.0122875

Holling, C S. 1973. "Resilience and Stability of Ecological Systems." *Annual Review of Ecology and Systematics* 4 (1): 1–23. https://doi.org/10.1146/annurev.es.04.110173.000245.

Huber, M., J. A. Knottnerus, L. Green, H. v. d. Horst, A. R. Jadad, D. Kromhout, B. Leonard, et al. 2011. "How Should We Define Health?" *BMJ* 343 (jul26 2): d4163–d4163. https://doi.org/10.1136/bmj.d4163.

Ifejika Speranza, C., T. Wüthrich, S. Rüegg, J. Zinsstag, H. Keune, S. Boillat, L. Blake, S. Thieme, C. Degeling, and S. Rist. 2018. "Evaluating the Contributions of One Health Initiatives to Social Sustainability." In *Integrated Approaches to Health. A Handbook for the Evaluation of One Health*, edited by Simon R. Rüegg, Barbara Häsler, and Jakob Zinsstag, 86-125. Wageningen: Wageningen Academic Publishers. https://doi.org/10.7892/boris.121131.

Johnson, J., K. Howard, A. Wilson, M. Ward, G.L. Gilbert, and C. Degeling. 2019. "Public Preferences for One Health Approaches to Emerging Infectious Diseases: A Discrete Choice Experiment." *Social Science & Medicine* 228 (May): 164–71. https://doi.org/10.1016/j.socscimed.2019.03.013.

Johnson, L.E. 1992. "Toward the Moral Considerability of Species and Ecosystems." *Environmental Ethics* 14 (2): 145–57. https://doi.org/10.5840/enviroethics199214231.

Jones, K.E. 2001. "BSE, Risk and the Communication of Uncertainty: A Review of Lord Phillips' Report from the BSE Inquiry (UK)." *Canadian Journal of Sociology / Cahiers Canadiens de Sociologie* 26 (4): 655. https://doi.org/10.2307/3341496.

Jones, K.E., N.G. Patel, M.A. Levy, A. Storeygard, D. Balk, J.L. Gittleman, and P. Daszak. 2008. "Global Trends in Emerging Infectious Diseases." *Nature* 451 (7181): 990–93. https://doi.org/10.1038/nature06536.

Kahn, L., B. Kaplan, and T. Monath. 2012. "One Health Initiative-One World One Medicine One Health: About the One Health Initiative." http://www.onehealthinitiative.com/about.php.

Keesing, F., L.K. Belden, P. Daszak, A. Dobson, C.D. Harvell, R.D. Holt, P. Hudson, et al. 2010. "Impacts of Biodiversity on the Emergence and Transmission of Infectious Diseases." *Nature* 468 (7324): 647–52. https://doi.org/10.1038/nature09575.

Kekes, J. 1993. *The Morality of Pluralism*. New Jersey: Princeton University Press.

Kelly, T.R., W.B. Karesh, C. Kreuder Johnson, K.V.K. Gilardi, S.J. Anthony, T. Goldstein, S.H. Olson, C. Machalaba, and J.A.K. Mazet. 2017. "One Health Proof of Concept: Bringing a Transdisciplinary Approach to Surveillance for Zoonotic Viruses at the Human-Wild Animal Interface." *Preventive Veterinary Medicine* 137 (February): 112–18. https://doi.org/10.1016/j.prevetmed.2016.11.023.

Kimman, T., M. Hoek, and M.C.M. de Jong. 2013. "Assessing and Controlling Health Risks from Animal Husbandry." *NJAS - Wageningen Journal of Life Sciences* 66 (November): 7–14. https://doi.org/10.1016/j.njas.2013.05.003.

Kingsley, P., and E. M. Taylor. 2017. "One Health: Competing Perspectives in an Emerging Field." *Parasitology* 144 (1): 7–14. https://doi.org/10.1017/S0031182015001845.

Knight, S., K. Bard, A. Vrij, and D. Brandon. 2010. "Human Rights, Animal Wrongs? Exploring Attitudes toward Animal Use and Possibilities for Change." *Society & Animals* 18 (3): 251–72. https://doi.org/10.1163/156853010X510771.

Koolmees, P.A. 2012. *Tussen Mens Dier En Samenleving, Korte Geschiedenis van de Koninklijke Nederlandse Maatschappij Voor Diergeneeskunde (1862-2012)*. Houten.

Kramer, K., H.L. Zaaijer, and M.F. Verweij. 2017. "The Precautionary Principle and the Tolerability of Blood Transfusion Risks." *The American Journal of Bioethics* 17 (3): 32–43. https://doi.org/10.1080/15265161.2016.1276643.

Lakoff, A. 2007. "Preparing for the Next Emergency." *Public Culture* 19 (2): 247–71. https://doi.org/10.1215/08992363-2006-035.

Leboeuf, A. 2011. "Making Sense of One Health." *Cooperating at the Human-Animal-Ecosystem Health*. http://onehealthinitiative.com/publications/IFRI_ifrihereport7alineleboeuf.pdf.

Lederman, Z. 2016. "One Health and Culling as a Public Health Measure." *Public Health Ethics* 9 (1): 5–23. https://doi.org/10.1093/phe/phw002.

Lee, K., and Z.L. Brumme. 2013. "Operationalizing the One Health Approach: The Global Governance Challenges." *Health Policy and Planning* 28 (7): 778–85. https://doi.org/10.1093/heapol/czs127.

Leopold, A., and C.W. Schwartz. 1949. *A Sand County Almanac, and Sketches Here and There*. New York: Oxford University Press.

Lerner, H., and C. Berg. 2015. "The Concept of Health in One Health and Some Practical Implications for Research and Education: What Is One Health?" *Infection Ecology & Epidemiology* 5 (1): 25300. https://doi.org/10.3402/iee.v5.25300.

Lu, Y., R. Wang, Y. Zhang, H. Su, P. Wang, A. Jenkins, R.C. Ferrier, M. Bailey, and G. Squire. 2015. "Ecosystem Health towards Sustainability." *Ecosystem Health and Sustainability* 1 (1): art2. https://doi.org/10.1890/EHS14-0013.1.

Lysaght, T., T.I. Lee, S. Watson, Z. Lederman, M. Bailey, and P. Tambyah. 2016. "Zika in Singapore: Insights from One Health and Social Medicine." *Singapore Medical Journal* 57 (10): 528–29. https://doi.org/10.11622/smedj.2016161.

Lysaght, T., B. Capps, M. Bailey, D. Bickford, R. Coker, Z. Lederman, S. Watson, and P. Tambyah. 2017. "Justice Is the Missing Link in One Health: Results of a Mixed Methods Study in an Urban City State." Edited by Sanjay B. Jadhao. *PLOS ONE* 12 (1): e0170967. https://doi.org/10.1371/journal.pone.0170967.

May, S.A. 2018. "Protecting Society: The Value of the Professional Regulatory Model." In *Professionals in Food Chains*, 25–29. Vienna, Austria: Wageningen Academic Publishers. https://doi.org/10.3920/978-90-8686-869-8_1.

McShane, K. 2014. "Individualist Biocentrism vs. Holism Revisited." *Les Ateliers de l'éthique* 9 (2): 130–48. https://doi.org/10.7202/1026682ar.

Meekelenkamp, J., P. Schneeberger, M. Hermans, M. Janssen, and A. Robben. 2017. "Aanpassing van Isolatiemaatregelen Bij Livestock-Associated MRSA (LA-MRSA) Leidt Tot Betere Patiëntenzorg." *Infectieziektenbulletin RIVM* Jaargang 28 (1): 60–64.

Meijboom, F.L.B., and J. Nieuwland. 2017. "Health in plurality: about the ethical aspects of One Health and the need for ethical cooperation." Dutch Association for Bioethics. https://nvbioethiek.files.wordpress.com/2018/01/pre-advies-2017-meijboom-en-nieuwland.pdf.

Meijboom, F.L.B., and J. Nieuwland. 2018. "41. Manifold Health: The Need to Specify One Health and the Importance of Cooperation in (Bio)Ethics." In *Professionals in Food Chains*, 266–71. Vienna, Austria: Wageningen Academic Publishers. https://doi.org/10.3920/978-90-8686-869-8_41.

Meijboom, F.L.B. 2018. "More Than Just a Vet? Professional Integrity as an Answer to the Ethical Challenges Facing Veterinarians in Animal Food Production." *Food Ethics* 1 (3): 209–20. https://doi.org/10.1007/s41055-017-0019-z.

Mepham, B., M. Kaiser, E. Thorstensen, S. Tomkins, and K. Millar. 2006. *The Ethical Matrix Manual*. The Hague, The Netherlands: LEI. Wageningen University. https://library.wur.nl/WebQuery/wurpubs/426154

Mepham, B. 2015. "8. Morality, Morbidity and Mortality: An Ethical Analysis of Culling Nonhuman Animals." In *The End of Animal Life: A Start for Ethical Debate*, 115–36. Wageningen Academic Publishers. https://doi.org/10.3920/978-90-8686-808-7_8.

Miles, M.B., A.M. Huberman, and J. Saldaña. 2013. *Qualitative Data Analysis: A Methods Sourcebook*. Third edition. Thousand Oaks, Califorinia: SAGE Publications, Inc.

Minister of Health, Welfare and Sports. 2012. "Letter to the President of the First Chamber on animal welfare and zoonotic disease control," The Hague, January 2012. https://www.eerstekamer.nl/behandeling/20120124/verslag_van_een_schriftelijk_2/f=y.pdf

Ministry of Agriculture, Nature and Food Quality. 2011. "Animal Law." Law. 2011. https://wetten.overheid.nl/BWBR0030250/2019-01-01#Hoofdstuk4_Artikel4.2.

Ministry of Agriculture, Nature and Food Quality. 2019. "Policy documents zoonotic and animal diseases." https://www.rijksoverheid.nl/onderwerpen/dierziekten/bestrijding-dierziekten/beleidsdraaiboeken-dierziekten.

Ministry of Agriculture, Nature and Food Quality, and Ministry of Health, Welfare and Sport. 2016. "Letter to the Parliament on Forthcoming Policy on Antimicrobial Use in Livestock." July 8, 2016. https://www.rijksoverheid.nl/documenten/kamerstukken/2016/07/08/kamerbrief-over-vervolgbeleid-antibiotica-in-de-veehouderij.

Molewijk, B. 2004. "Integrated Empirical Ethics: In Search for Clarifying Identities." *Medicine, Health Care and Philosophy* 7 (1): 85–87. https://doi.org/10.1023/B:MHEP.0000021851.43585.26.

Morens, D.M., and A.S. Fauci. 2020. "Emerging Pandemic Diseases: How We Got to COVID-19." *Cell* 182 (5): 1077–92. https://doi.org/10.1016/j.cell.2020.08.021.

Morse, S.S., J.A.K. Mazet, M. Woolhouse, C.R. Parrish, D. Carroll, W.B. Karesh, C. Zambrana-Torrelio, W.I. Lipkin, and P. Daszak. 2012. "Prediction and Prevention of the next Pandemic Zoonosis." *The* Lancet 380 (9857): 1956–65. https://doi.org/10.1016/S0140-6736(12)61684-5

Mullan, S., and D. Main. 2001. "Principles of Ethical Decision-Making in Veterinary Practice." *In Practice* 23 (7): 394–401. https://doi.org/10.1136/inpract.23.7.394.

Nalon, E. 2017. "Veterinarians Speak out against Systematic Abuse of Farm Animals." June 27, 2017. https://www.linkedin.com/pulse/veterinarians-speak-up-against-systematic-abuse-farm-animals-nalon.

National Institute for Public Health and the Environment. 2017. "Livestock farming and the health of local residents." http://rivm.openrepository.com/rivm/handle/10029/620868#.

National Institute for Public Health and the Environment. 2019a. "Over One Health | One Health." One Health. 2019. https://onehealth.nl/over-one-health.

National Institute for Public Health and the Environment. 2019b. "Q Fever." 2019. https://www.rivm.nl/q-koorts.

National Institute for Public Health and the Environment 2019c. "Signalling and Risk Assessment of Emerging Zoonoses." https://www.rivm.nl/sites/default/files/2019-02/Folder%20signalling%20zoonoses.PDF.

Natterson-Horowitz, B., and K. Bowers. 2012. *Zoobiquity: What Animals Can Teach Us about Health and the Science of Healing*. Toronto: Doubleday Canada.

Netherlands Veterinary Medicines Institute. 2017. "Usage of antibiotics in agricultural livestock in the Netherlands in 2016, Trends and benchmarking of livestock farms and veterinarians". https://www.autoriteitdiergeneesmiddelen.nl/en/publications/general-reports

Netherlands Veterinary Medicine Institute. 2018. "Usage of Antibiotics in Agricultural Livestock in the Netherlands in 2017, Trends and Benchmarking of Livestock Farms and Veterinarians." http://www.autoriteitdiergeneesmiddelen.nl/Userfiles/AB%20gebruik%202017/engels-def-rapportage-2017.pdf.

Nielsen. 2016. "Meat Consumption and Vegetarianism in Europe." Statista. 2016. https://www.statista.com/topics/3345/meat-consumption-and-vegetarianism-in-europe/.

Nieuwland, J., and F.L.B. Meijboom. 2015. "One Health as a Normative Concept: Implications for Food Safety at the Wildlife Interface." In *Know Your Food*, edited by Diana Elena Dumitras, Ionel Mugurel Jitea, and Stef Aerts, 1st ed., 132–37. The Netherlands: Wageningen Academic Publishers. http://www.wageningenacademic.com/doi/10.3920/978-90-8686-813-1_19.

Nolt, J. 2006. "The Move from 'Good' to 'Ought' in Environmental Ethics." *Environmental Ethics* 28 (4): 355-375. https://doi.org/10.5840/enviroethics20062843.

Nordenfelt, L. 1993. *Quality of Life, Health and Happiness*. Repr. Aldershot: Avebury. United Kingdom.

Nordenfelt, L. 2006. *Animal and Human Health and Welfare: A Comparative Philosophical Analysis*. CABI Publishing, Wallingford, United Kingdom. 190 pp. ISBN 1-8459-3059-2

Organization for Economic Co-operation and Development and Food and Agricultural Organization of the United Nations. 2018. "OECD-FAO Agricultural-Outlook-2018-2027." http://www.agri-outlook.org/commodities/Agricultural-Outlook-2018-Meat.pdf.

Ohl, F., and F.J. van der Staay. 2012. "Animal Welfare: At the Interface between Science and Society." *The Veterinary Journal* 192 (1): 13–19. https://doi.org/10.1016/j.tvjl.2011.05.019.

Office International des Epizooties. 2021. "New International Expert Panel to Address the Emergence and Spread of Zoonotic Diseases." *OIE - World Organization for Animal Health* (blog). https://www.oie.int/en/new-international-expert-panel-to-address-the-emergence-and-spread-of-zoonotic-diseases/.

Okello, A.L., K. Bardosh, J. Smith, and S.C. Welburn. 2014. "One Health: Past Successes and Future Challenges in Three African Contexts." Edited by Jakob Zinsstag. *PLoS Neglected Tropical Diseases* 8 (5): e2884. https://doi.org/10.1371/journal.pntd.0002884.

O'Neill, J. 2016. "Tackling Drug-Resistant Infections Globally; Final Report and Recommendations. The Review of Antimicrobial Resistance." London. https://amr-review.org/

Oosterveer, P. 2002. "Reinventing Risk Politics: Reflexive Modernity and the European BSE Crisis." *Journal of Environmental Policy & Planning* 4 (3): 215–29. https://doi.org/10.1002/jepp.111.

Oreshkova, N, R.J. Molenaar, S. Vreman, F. Harders, B. Oude Munnink, R.W. Hakze-van der Honing, N. Gerhards, et al. 2020. "SARS-CoV-2 Infection in Farmed Minks, the Netherlands, April and May 2020." *Eurosurveillance* 25 (23). https://doi.org/10.2807/1560-7917.ES.2020.25.23.2001005.

Palmer, C. 2010. *Animal Ethics in Context*. Columbia University Press.

Peters, B.G., and J. Pierre. 2014. "Food Policy as a Wicked Problem: Contending with Multiple Demands and Actors." *World Food Policy* 1 (1): 4–11. https://doi.org/10.18278/wfp.1.1.1.

Pinillos, R. García, M. C. Appleby, X. Manteca, F. Scott-Park, C. Smith, and A. Velarde. 2016. "One Welfare – a Platform for Improving Human and Animal Welfare." *Veterinary Record* 179 (16): 412–13. https://doi.org/10.1136/vr.i5470.

Raffensberger, C, and J.A. Tickner. 1999. *Protecting Public Health and the Environment: Implementing the Precautionary Principle*. Island Press.

Ratschen, E., E. Shoesmith, L. Shahab, K. Silva, D. Kale, P. Toner, C. Reeve, and D.S. Mills. 2020. "Human-Animal Relationships and Interactions during the Covid-19 Lockdown Phase in the UK: Investigating Links with Mental Health and Loneliness." Edited by Stefano Triberti. *PLOS ONE* 15 (9): e0239397. https://doi.org/10.1371/journal.pone.0239397.

Rauw, W.M., E. Kanis, E.N. Noordhuizen-Stassen, and F.J. Grommers. 1998. "Undesirable Side Effects of Selection for High Production Efficiency in Farm Animals: A Review." *Livestock Production Science* 56 (1): 15–33. https://doi.org/10.1016/S0301-6226(98)00147-X.

Rawls, J. 1999. *A Theory of Justice*. Revised edition. Oxford University Press.

Regan, T. 1983. *The Case for Animal Rights*. University of California Press.

Resnik, D.B. 2004. "The Precautionary Principle and Medical Decision Making." *The Journal of Medicine and Philosophy* 29 (3): 281–299. https://doi.org/10.1080/03605310490500509.

Rhouma, M., J.M. Fairbrother, F. Beaudry, and A. Letellier. 2017. "Post Weaning Diarrhea in Pigs: Risk Factors and Non-Colistin-Based Control Strategies." *Acta Veterinaria Scandinavica* 59 (1). https://doi.org/10.1186/s13028-017-0299-7.

Rist, C.L., C. Logan, C.S. Arriola, and C. Rubin. 2014. "Prioritizing Zoonoses: A Proposed One Health Tool for Collaborative Decision-Making." Edited by Tara C. Smith. *PLoS ONE* 9 (10): e109986. https://doi.org/10.1371/journal.pone.0109986.

Rock, M.J., and Chris Degeling. 2015. "Public Health Ethics and More-than-Human Solidarity." *Social Science & Medicine* 129 (March): 61–67. https://doi.org/10.1016/j.socscimed.2014.05.050.

Roest, H.I.J., J.J.H.C. Tilburg, W. Van Der Hoek, P. Vellema, F.G. Van Zijderveld, C.H.W. Klaassen, and D. Raoult. 2011. "The Q Fever Epidemic in The Netherlands: History, Onset, Response and Reflection." *Epidemiology and Infection* 139 (01): 1–12. https://doi.org/10.1017/S0950268810002268.

Rollin, B.E. 2002. "The Use and Abuse of Aesculapian Authority in Veterinary Medicine" 220 (8): 1144-1149 https://doi.org/10.2460/javma.2002.220.1144

Rollin, B.E. 2006. *An Introduction to Veterinary Medical Ethics: Theory and Cases*. 2nd edition. Ames, IA, USA: Iowa State University Press.

Rolston, H. 1988. *Environmental Ethics: Duties to and Values in the Natural World.* Philadelphia: Temple University Press.

Rosella, L.C., K. Wilson, N.S. Crowcroft, A. Chu, R. Upshur, D. Willison, S.L. Deeks, et al. 2013. "Pandemic H1N1 in Canada and the Use of Evidence in Developing Public Health Policies – A Policy Analysis." *Social Science & Medicine* 83 (April): 1–9. https://doi.org/10.1016/j.socscimed.2013.02.009.

Rüegg, S.R., B.J. McMahon, B. Häsler, R. Esposito, L, Rosenbaum Nielsen, C. Ifejika Speranza, T. Ehlinger, et al. 2017. "A Blueprint to Evaluate One Health." *Frontiers in Public Health* 5 (February). https://doi.org/10.3389/fpubh.2017.00020.

Schwabe, C.V. 1964. *Veterinary Medicine and Human Health*. University of California: Williams & Wilkins.

Science and Environmental Health Network. 1998. "Precautionary Principle, Understanding Science in Regulation." SEHN. 1998. http://sehn.org/precautionary-principle/.

Seinfeld, H., P. Gerber, T. Wassenaar, V. Gastel, M. Rosales, and C. De Haan. 2006. *Livestock's Long Shadow*. FAO. http://www.fao.org/docrep/010/a0701e/a0701e00.HTM.

Sen, A. 2009. *The Idea of Justice*. Cambridge, Massachusetts: Harvard University Press.

Sheldon, T. 2016. "Saving Antibiotics for When They Are Really Needed: The Dutch Example." *BMJ*, August, i4192. https://doi.org/10.1136/bmj.i4192.

Simmons, A.J. 2010. "Ideal and Nonideal Theory." *Philosophy & Public Affairs* 38.1: 5–36. https://doi.org/10.1111/j.1088-4963.2009.01172.x.

Singer, P. 1975. *Animal Liberation: A New Ethics for Our Treatment of Animals*. 9th ed. Harper Collins. New York

Singer, P., and K. Dawn. 2004. "When Slaughter Makes Sense." https://www.dawnwatch.com/oped-february8-2004.htm.

Speksnijder, D.C., D.A.C. Jaarsma, T.J.M. Verheij, and J.A. Wagenaar. 2015. "Attitudes and Perceptions of Dutch Veterinarians on Their Role in the Reduction of Antimicrobial Use in Farm Animals." *Preventive Veterinary Medicine* 121 (3–4): 365–73. https://doi.org/10.1016/j.prevetmed.2015.08.014.

Spickler, A.R. 2018. "Brucellosis: Brucella Canis," 10. https://www.cfsph.iastate.edu/Factsheets/pdfs/brucellosis_canis.pdf

Spielthenner, G. 2017. "The Is-Ought Problem in Practical Ethics." *HEC Forum* 29 (4): 277–92. https://doi.org/10.1007/s10730-016-9318-8.

Spike, J.P. 2018. "Principles for Public Health Ethics." *Ethics, Medicine and Public Health* 4 (January): 13–20. https://doi.org/10.1016/j.jemep.2017.12.003.

Star, S.L, and J.R. 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. https://doi.org/10.1177/030631289019003001

Stephen, C., and W. Karesh. 2014. "Introduction: Is One Health Delivering Results?" *Revue Scientifique Et Technique (International Office of Epizootics)* 33 (2): 375–79. https://doi.org/10.20506/rst.33.2.2301

Stephen, C. 2014. "Toward a Modernized Definition of Wildlife Health." *Journal of Wildlife Diseases* 50 (3): 427–30. https://doi.org/10.7589/2013-11-305.

Tang, K.L., N.P. Caffrey, D.B. Nóbrega, S.C. Cork, P.E. Ronksley, H.W. Barkema, A.J. Polachek, et al. 2017. "Restricting the Use of Antibiotics in Food-Producing Animals and Its Associations with Antibiotic Resistance in Food-Producing Animals and Human Beings: A Systematic Review and Meta-Analysis." *The Lancet Planetary Health* 1 (8): 316–327. https://doi.org/10.1016/S2542-5196(17)30141-9.

Taylor, L.H., S.M. Latham, and M.E. Woolhouse. 2001. "Risk Factors for Human Disease Emergence" *Philos Trans R Soc Lond B Biol Sc*i. 356 (1411):983-989. https://doi.org/10.1098/rstb.2001.0888

Termeulen, R. 2005. "The Ethical Basis of the Precautionary Principle in Health Care Decision Making." *Toxicology and Applied Pharmacology* 207 (2): 663–67. https://doi.org/10.1016/j.taap.2004.11.032.

Tickner, J.A. 2002. "The Precautionary Principle and Public Health Trade-Offs: Case Study of West Nile Virus." *The ANNALS of the American Academy of Political and Social Science* Volume: 584 (1): 67–79. https://doi.org/10.1177/000271620258400105.

United Nations. 1992. "Rio UN Conference on Evironment and Development Declaration." http://www.un.org/documents/ga/conf151/aconf15126-1annex1.htm.

United Nations Environment Programme. 2020. "Preventing the next Pandemic: Zoonotic Diseases and How to Break the Chain of Transmission." https://www.unenvironment.org/resources/report/preventing-future-zoonotic-disease-outbreaks-protecting-environment-animals-and.

Valentini, L. 2012. "Ideal vs. Non-Ideal Theory: A Conceptual Map: Ideal vs Non-Ideal Theory." *Philosophy Compass* 7 (9): 654–664. https://doi.org/10.1111/j.1747-9991.2012.00500.x.

Van Dijk et al. 2010. "Van verheffing tot verwerping. Q-koortsbeleid 2005-2010." The Hague. http://library.wur.nl/WebQuery/edepot/156237.

Van Thiel, G.J.M.W., and J.J.M. Van Delden. 2010. "Reflective Equilibrium as a Normative Empirical Model." *Ethical Perspectives*, no. 2: 183–202. https://doi.org/10.2143/EP.17.2.2049263.

Vanclay, F. 2003. *Conceptual and Methodological Advances in Social Impact Assessment. In: Becker, H.A. and Vanclay, F. (Eds.) The International Handbook of Social Impact Assessment: Conceptual and Methodological Advances.* Elgar, Cheltenham, United Kingdom.

VandeVeer, D. 1979. "Interspecific Justice." *Inquiry : An Interdisciplinary Journal of Philosophy* 22 (1–4): 55–79. https://doi.org/10.1080/00201747908601866.

Verweij, M.F., and B. Bovenkerk. 2016. "Ethical Promises and Pitfalls of OneHealth." *Public Health Ethics* 9 (1): 1–4. https://doi.org/10.1093/phe/phw003.

Vlaanderen, F., M. Uiterwijk, T. Cuperus, I. Keur, M. de Rosa, H. Rozendaal, M. Koene, et al. 2019. "State of Zoonotic Diseases 2018." Report. Rijksinstituut voor Volksgezondheid en Milieu RIVM. https://rivm.openrepository.com/handle/10029/623615.

Waegemaekers, C.H.F.M., and J.H.T.C. van den Kerkhof. 2013. "The New Zoonotic Infectious Disease Control Structures in The Netherlands Ensure a Quick Response to a Possible Health Risk: Hans van Den Kerkhof." *European Journal of Public Health* 23 (suppl_1). https://doi.org/10.1093/eurpub/ckt123.013.

Warren, M.A. 2000. *Moral Status, Obligations to Persons and Other Living Things*. Oxford University Press.

Webster, J. 1987. *Understanding the Dairy Cow*. London: Wiley-Blackwell.

Weinstock, D. 1998. "Moral Pluralism," Routledge Encyclopedia of Philosophy. https://doi.org/10.4324/9780415249126-L058-1.

World Health Organization. 1946. *World Health Organization*. http://dl4a.org/uploads/pdf/constitution-en.pdf.

World Health Organization, Office International des Epizooties, and Food and Agricultural Organization of the United Nations. 2010. "The FAO-OIE-WHO Collaboration: Sharing Responsibilities and Coordinating Global Activities to Address Health Risks at the Animal-Human-Ecosystems Interfaces." https://www.who.int/foodsafety/zoonoses/final_concept_note_Hanoi.pdf?ua=1.

Wildlife Conservation Society. 2004. "Manhattan Principles on 'One World, One Health.'" http://www.wcs-ahead.org/manhattan_principles.html.

Wilson, K., and Katherine Atkinson. 2017. "Toward Neo-Precaution: A New Approach to Applying the Precautionary Principle to Public Health." *The American Journal of Bioethics* 17 (3): 44–46. https://doi.org/10.1080/15265161.2016.1274792.

Wingspread. 1998. "Winspread Declaration on the Preactionary Principle."

Wolf, Susan. 1992. "Two Levels of Pluralism." *Ethics* 102 (4): 785–98.

World Health Organization. 2017. "WHO Guidelines on Use of Medically Important Antimicrobials in Food-Producing Animals." https://apps.who.int/iris/bitstream/handle/10665/258970/9789241550130-eng.pdf;jsessionid=BB593A9387A91DA1A7326C5DCD7D2D4A?sequence=1.

World Health Organization. 2018. "Annual Review of Diseases Prioritized under the Research and Development." https://www.who.int/emergencies/diseases/2018prioritization-report.pdf?ua=1.

World Health Organization. 2020. "Zoonoses." Factsheet Zoonoses. https://www.who.int/news-room/fact-sheets/detail/zoonoses.

World Health Organization. 2021. "WHO-Convened Global Study of Origins of SARS-CoV-2: China Part." https://www.who.int/health-topics/coronavirus/origins-of-the-virus.

World Veterinary Association. 2017. "WVA Declaration of Incheon." https://www.worldvet.org/uploads/news/docs/wva_declaration_of_incheon_final.pdf

Wright, N., F.L.B. Meijboom, and P. Sandøe. 2010. "Thoughts on the Ethics of Preventing and Controlling Epizootic Diseases." *The Veterinary Journal* 186 (2): 127–28. https://doi.org/10.1016/j.tvjl.2009.12.028.

Yanow, D., and P. Schwartz-Shea. 2014. *Interpretation and Method: Empirical Research Methods and the Interpretive Turn*. 2nd ed. Armonk, N.Y: M.E. Sharp, Inc.

York, D.G., J. Adelman, J.E. Anderson Jr, S.F. Anderson, J. Annis, N.A. Bahcall, J.A. Bakken, et al. 2012. "World Bank_the Economics of One Health_2012." *The Astronomical Journal* 120 (3): 1579. https://documents1.worldbank.org/curated/en/612341468147856529/pdf/691450ESW0whit0D0ESW120PPPvol120web.pdf

Zinsstag, J., J.S. Mackenzie, M. Jeggo, D.L. Heymann, J.A. Patz, and P. Daszak. 2012. "Mainstreaming One Health." *EcoHealth* 9 (2): 107–10. https://doi.org/10.1007/s10393-012-0772-8.

Zinsstag, J., E. Schelling, D. Waltner-Toews, M. Whittaker, and M. Tanner, eds. 2015. *One Health: The Theory and Practice of Integrated Health Approaches*. Wallingford: CABI. https://doi.org/10.1079/9781780643410.0000.

# Summary

The COVID-19 pandemic once again confirmed that zoonotic diseases are a serious threat to humanity. These infectious diseases, which are transmitted from animals to humans, have the power to cause a global health crisis. Besides all the physical suffering, such a health crisis is also disruptive to our social lives and our economy, inter alia due to disease control measures. Zoonotic diseases are probably as old as humanity itself. However, over time the risk on zoonotic disease outbreaks has increased. Since the beginning of this century we have experienced outbreaks of SARS (2002), H1N1 influenza (2009), MERS (2012), Ebola (2014), Zika (2015) and now COVID-19 (2019). Some of the main drivers for the (re)emergence of these diseases are global population growth, urbanization, worldwide transport, increased demand for animal protein, unsustainable agriculture, and climate change.

In *chapter 1*, the introduction of my thesis, I explain that this development has fueled a renewed interest in the relation between human, animal and environmental health. The awareness that human health is inextricably connected with the health of animals and ecosystems, led to the understanding that interdisciplinary cooperation is indispensable to combat (re)emerging zoonotic diseases. Around 2008, this way of thinking was framed in the concept of One Health, which can be defined as the integrative effort of multiple disciplines working locally, nationally, and globally to attain optimal health for people, animals, and the environment. At present, the One Health approach is the worldwide standard to combat zoonotic diseases. In an ideal world such a strategy should lead to a better health for humans, animals and our environment.

However, in practice it is not self-evident that a One Health approach in zoonotic disease control is actually in the interest of animals or the environment. As we have seen during the Q-fever outbreak in the Netherlands (2007-2012) zoonotic disease control can lead to ethical questions. Not only because conflicts of interest can arise between human centered values like public health and economy. If we really understand One Health as a call to promote the health of humans as well as the health of animals and the environment, the current practice of zoonotic disease control is often morally problematic. From a holistic One Health perspective it is, for example, difficult to accept economically driven non-vaccination policies, that lead to culling of healthy animals. The same goes for long term confinement of free range poultry, whose housing systems are often not suitable for this purpose, to prevent avian influenza outbreaks. Or antimicrobial reduction policies that lead to higher disease incidence and mortality in animals. These ethical considerations formed the start of this thesis.

The aim of my research is to clarify the ethical assumptions of a One Health approach in zoonotic disease control, to explore how these can be coherently understood and ethically justified and to indicate what this implies for policymaking. This has led to my overall research question: how should a One Health approach in zoonotic disease control be conceived and justified from an ethical perspective?

To answer this question I have divided my research in a number of sub-questions. I address those questions in the subsequent chapters that constitute this dissertation. I hope the outcome of my research contributes to the development of an ethic of One Health and will lead to a more socially acceptable zoonotic disease control. My project is related to the interdisciplinary Wageningen UR strategic research theme 'Global One Health'.

In *chapter 2*, I examine what a One Health approach in zoonotic disease control exactly entails. From my conceptual analysis I conclude that there is no straightforward answer to this question. There is no universal interpretation of the One Health concept nor of a One Health approach in zoonotic disease control. Despite the lack of a clear definition, a shared agenda, or institutional governance One Health has proven to be a successful idea. One Health thinking has produced several successes in zoonotic disease control, surveillance and research, like worldwide vaccination campaigns against rabies. Furthermore, due to its ambiguity, the One Health concept functions as a boundary object: by leaving room for interpretation to fit different purposes it facilitates cooperation. In many cases this results in the promotion of health of humans, animals and the environment.

However, there are also situations in which this mutual benefit of a One Health approach is not that evident. For instance, when healthy animals are culled to protect public health. Although such a strategy could well be part of a One Health approach, it is hard to understand how this contributes to the health of these animals. Consequently, these practices often lead to public debate. In cases of conflict between different values, the lack of a universal definition of the One Health concept contributes to this complexity. Although boundary objects have many positive aspects, in the context of One Health and zoonotic disease control, it seems to conceal underlying normative differences. To address moral dilemmas related to a One Health approach in zoonotic disease control, it is important to develop an ethical framework. Such an ethic of One Health starts with acknowledging the moral status of animals and the indirect moral obligations we have towards ecosystems. Furthermore, it is necessary that we find an appropriate definition of health, which encompasses all three components of One Health: humans, animals and ecosystems.

I demonstrate that animal ethics provides us with compelling reasons why we should attribute moral status to animals, this implies that their interests should be taken into account while drafting zoonotic disease control policies. In case of ecosystems, I suggest that because of their fundamental value for life on earth, we should strive that these policies support healthy ecosystems. Furthermore, I argue that we need a health concept that can be used for all elements within the One Health framework. In my view, the concept of 'resilience' is a fruitful option in this respect. Resilience is applicable to humans, animals and ecosystems. Moreover, it encourages us to invest in a more preventive rather than reactive approach to zoonotic diseases. In case of unavoidable moral dilemmas, it can be useful to apply VanDeVeer's principle of two factor egalitarianism. This implies that peripheral human interests are not accepted as a sufficient reason to take zoonotic disease control measures that seriously harm basic interests of animals. Moreover, these measures should not negatively affect long term resilience of animals and ecosystems.

In *chapter 3*, I present the results of an empirical study on normative presuppositions of health professionals involved in zoonotic disease control policies in the Netherlands. This study reveals that in theory these professionals adhere to a holistic view of the One Health concept, however, in practice an anthropocentric approach was dominant. The study identified public health as a trumping moral value, which reveals an inherent field of tension with the core of One Health thinking. Furthermore, I argue that the lack of ethical expertise in control systems for zoonotic diseases can lead to misconception of ethical principles, like the precautionary principle which is frequently evoked to justify disease control measures.

To implement One Health strategies in zoonotic disease control, many countries set up early warning systems, in which human and veterinary health professionals cooperate. These systems, like the Dutch Zoonoses Structure, can be very successful in detecting emerging disease threats. However, these systems are not well equipped to handle moral dilemmas that can arise in zoonotic disease control, like the culling of healthy animals. My research has indicated that not all values that are important in zoonotic disease control are sufficiently considered, like honesty, trust and transparency. Involvement of ethicists in the process of drafting zoonotic disease control policies could support the handling of moral dilemmas. Moreover, to build societal support for zoonotic disease control measures the ethical decision-making process should be more transparent.

In *chapter 4*, I discuss the use of the precautionary principle in zoonotic disease control. The use of this principle is not without ethical implications. Especially within a One Health strategy, that requires us to balance public health benefits against the health interests of animals and the environment, unrestricted use of the precautionary principle can lead to moral dilemmas. It causes conflicts between human-, animal- and environmental values that lead to difficult trade-offs. As I have showed in this thesis, mostly at the cost of animals. Therefore, application of the precautionary principle must be restricted; it can only be applied if there is a clear risk of harm, there has to be a certain amount of scientific evidence for a cause- and effect relation and the proposed precautionary measures should be effective, consistent, proportional and not counterproductive. An assessment of the effect of precautionary measures should be integrated in the standard decision-models of public health authorities. Moreover, to ensure societal support these considerations and the trade-offs they contain should be transparent and open for dialogue, with the involved stakeholders as well as with the general public. Ethicists could play a role in this dialogue by clarifying the relevant ethical aspects.

Furthermore, I distinguish two possible conceptions of the precautionary principle. First, it is noticeable that because of the unpredictable nature of zoonotic diseases, public health authorities in general focus on the idea of precaution as preparedness. This reactive response leads to difficult trade-offs between human and animal health. I therefore argue that this policy should always be accompanied by a second policy, that I refer to as precaution as prevention. Although zoonotic diseases are part of our natural world, we have to acknowledge that their origin and global impact are often a consequence of our disturbed relation with animals and the environment. Addressing the underlying drivers

of zoonotic disease is therefore a necessary condition to justify disease control measures that harm animals and ecosystems on the basis of the precautionary principle.

In *chapter 5*, I elaborate the responsibilities of veterinarians within the One Health framework. In their daily work veterinarians frequently experience the interaction between human, animal and environmental health. Therefore, the One Health concept has always been broadly promoted within veterinary medicine. Veterinarians are professionally responsible for the health and welfare of the animals under their care. Moreover, society expects veterinarians to safeguard food safety and public health. However, societal expectations are sometimes overdemanding and lead to moral dilemmas. For instance, how should veterinarians deal with situations in which measures to protect public health negatively affect animal health? This creates a conflict of professional responsibilities. Especially because the underlying causes for zoonotic disease outbreaks often originate at a system level. This is something that cannot easily be changed by individual veterinarians. I argue that a holistic perspective on One Health offers veterinarians a way out of the dichotomy between public and animal health, that is at the basis of many moral dilemmas in zoonotic disease control. Therefore I introduce the 'encapsulated health' argument: the best way to safeguard human health is to ensure the health of animals and the environment. This has consequences for the responsibility of the veterinary profession. I argue that in order to serve public health, the central responsibility of veterinarians is to take care of animal health and welfare. Veterinary organizations should express this view and appeal to society to make animal health the central value of any animal husbandry system.

In chapter 6, I present the main findings of my research and some discussion points that follow from these results. After that, I come to my conclusions and recommendations for policy making. In this chapter I also address the value of ideal ethical theory in relation to the moral dilemmas that arise in a non-ideal world. I argue that we have to acknowledge that in zoonotic disease control we sometimes have to take drastic measures to safeguard public health, like the culling of healthy animals. At first sight, this is contrary to the ideal of One Health. However, if we are forced to take such radical measures, this can only be justified when at the same time precautionary measures are taken to prevent future zoonotic disease outbreaks by tackling the underlying problems. Before we decide to implement certain disease control measures, an ethic of One Health requires that we first balance all possible interventions, and choose those interventions that have the least impact on the health of animal and ecosystem health, while they are still effective enough to stop the disease. Unfortunately, at the moment economic considerations still dominate animal disease policies in the European Union. For this reason, not all opportunities to prevent mass culling are sufficiently exploited, like the use of preventive vaccination. It must be noticed too, that to date efforts to prevent zoonotic disease outbreaks by addressing their underlying drivers are not robust enough. This is morally problematic and makes it difficult to justify current zoonotic disease control policies. My research indicates that the contemporary conception and application of One Health is necessary but insufficient to address moral dilemmas related to emerging zoonotic diseases that will continue to arise sooner or later. A holistic interpretation of the One Health concept confronts us with underlying value conflicts but will ultimately promote human health more than the current anthropocentric conception.

# Samenvatting

De COVID-19 pandemie heeft nog maar weer eens duidelijk gemaakt dat zoönosen een ernstige bedreiging voor de mensheid vormen. Dit soort infectieziekten, die van dieren op mensen worden overgedragen, hebben de kracht om een wereldwijde gezondheidscrises te veroorzaken. Buiten al het fysieke lijden is zo'n gezondheidscrisis ook ontwrichtend voor ons sociale leven en onze economie, onder andere door de maatregelen om de ziekte te bestrijden.

Zoönosen zijn waarschijnlijk net zo oud als de mensheid zelf. Maar in de loop van de tijd is het risico op uitbraken wel toegenomen. Sinds het begin van deze eeuw hebben we epidemieën gezien van SARS (2002), H1N1 influenza (2009), MERS (2012), ebola (2014), zika (2015) en nu dan van COVID-19. Een aantal van de belangrijkste drijvende krachten achter (terugkerende) uitbraken van dit soort infectieziekten zijn: een toenemende wereldbevolking, de verstedelijking, het wereldwijd transport, de toenemende vraag naar dierlijk eiwit, niet-duurzame landbouw en klimaatverandering.

In *hoofdstuk 1*, de inleiding van mijn proefschrift, leg ik uit dat deze ontwikkeling heeft geleid tot een hernieuwde interesse in de relatie tussen de gezondheid van mens, dier en milieu. Het besef dat de gezondheid van mensen onlosmakelijk verbonden is met de gezondheid van dieren en ecosystemen, maakt duidelijk dat interdisciplinaire samenwerking onmisbaar is om (opnieuw) opkomende zoönosen te bestrijden. Rond 2008 werd deze manier van denken vertaald naar het concept van One Health, dat gedefinieerd kan worden als een geïntegreerde inspanning van verschillende disciplines om op lokaal, nationaal en globaal niveau samen te werken aan een optimale gezondheid voor mens, dier en milieu. Tegenwoordig is een zogenaamde One Health-aanpak de wereldwijde standaard voor de bestrijding van zoönotische ziekten. In een ideale wereld zou een dergelijke strategie moeten leiden tot een betere gezondheid van mensen, dieren en ons milieu.

In de praktijk blijkt echter dat het niet vanzelfsprekend is dat een One Health-aanpak bij het bestrijden van zoönosen ook daadwerkelijk in het belang is van dieren en ecosystemen. Zoals we hebben gezien tijdens de Q-koorts uitbraak in Nederland (2007-2012) kan zoönosebestrijding ethische vragen oproepen. Niet alleen omdat er belangenconflicten kunnen ontstaan tussen mensgerichte waarden, zoals tussen volksgezondheid en economie. Als we One Health opvatten als een oproep om zowel de gezondheid van mensen als die van dieren en ecosystemen te bevorderen, dan is de huidige praktijk van zoönosebestrijding vaak moreel problematisch. Vanuit een holistisch One Health perspectief is het bijvoorbeeld moeilijk te accepteren dat een economisch gedreven non-vaccinatiebeleid tot gevolg heeft dat gezonde dieren worden geruimd. Hetzelfde geldt voor het langdurig ophokken van vrije-uitloop kippen, in daarvoor ongeschikte stallen, als maatregel ter preventie van aviaire influenza. Een ander voorbeeld is beleid om het gebruik van antibiotica in de veehouderij te reduceren dat leidt tot hogere ziekte-

incidentie of sterfte bij dieren. Deze ethische overwegingen waren de aanleiding tot het schrijven van dit proefschrift.

Het doel van mijn onderzoek is om de bestaande ethische vooronderstellingen van een One Health-aanpak bij het bestrijden van zoönosen te verhelderen, te onderzoeken hoe deze coherent te begrijpen en ethisch te rechtvaardigen zijn en aan te geven wat dit betekent voor beleidsvorming. Dit heeft geleid tot de volgende onderzoeksvraag: hoe zou vanuit ethisch perspectief een One Health-aanpak bij het bestrijden van zoönosen geconstrueerd en gerechtvaardigd moeten worden?

Om deze vraag te beantwoorden heb ik mijn onderzoek verdeeld in een aantal subvragen. Ik behandel deze vragen in een aantal opeenvolgende hoofdstukken die samen deze dissertatie vormen. Ik hoop dat de uitkomst van mijn onderzoek bijdraagt aan de ontwikkeling van een ethiek van One Health en zal leiden tot een meer maatschappelijk geaccepteerde zoönosebestrijding. Mijn onderzoek is gerelateerd aan het interdisciplinaire onderzoeksthema "Globale One Health" van Wageningen University & Research.

In *hoofdstuk 2*, bespreek ik wat een One Health-aanpak bij het bestrijden van zoönosen nu precies inhoudt. Op basis van een conceptuele analyse concludeer ik dat er op deze vraag geen eenduidig antwoord is. Er bestaat geen universele interpretatie van het One Health-concept, noch van een One Health-aanpak in zoönosebestrijding. Ondanks het gebrek aan een heldere definitie, een gedeelde agenda, of institutionele bestuurlijke aansturing, is One Health een vruchtbaar idee gebleken. One Health-denken heeft verschillende successen opgeleverd bij het bestrijden, monitoren en onderzoeken van zoönosen, zoals wereldwijde vaccinatiecampagnes tegen rabiës. Bovendien functioneert het One Health-concept als een 'boundary object': door ruimte te laten voor interpretatie faciliteert het samenwerking zodat verschillende doelen kunnen worden gediend. In veel gevallen resulteert dit inderdaad in de bevordering van de gezondheid van mensen, dieren en het milieu.

Er zijn echter ook situaties waarin dit wederzijdse voordeel van een One Health-aanpak niet zo duidelijk is, bijvoorbeeld als gezonde dieren worden geruimd om de volksgezondheid te beschermen. Hoewel een dergelijke strategie wel degelijk onderdeel van een One Health-aanpak zou kunnen uitmaken, is het moeilijk te begrijpen hoe dit zou bijdragen aan de gezondheid van de dieren in kwestie. Daarom leiden dit soort praktijken vaak tot een publiek debat. Bij conflicten tussen verschillende waarden, draagt het gebrek aan een universele definitie bij aan deze complexiteit. Hoewel zo'n 'boundary object' vele positieve aspecten heeft, lijkt het in de context van One Health en zoönosebestrijding dus eerder onderliggende normatieve verschillen te verhullen. Om de morele dilemma's die een rol spelen bij een One Health-aanpak in de zoönosebestrijding het hoofd te bieden, is het belangrijk om een ethisch kader te ontwikkelen. Een dergelijke ethiek van One Health begint met de erkenning van de morele status van dieren en de indirecte morele verplichtingen die we als mensen hebben ten opzichte van ecosystemen. Bovendien is het essentieel om een geschikte definitie van gezondheid te vinden die de drie onderdelen van One Health (mensen, dieren en milieu) kan verbinden.

Ik laat zien dat de dierethiek ons overtuigende argumenten geeft om dieren een morele status toe te kennen. Dat houdt in dat we hun belangen mee moeten wegen bij het vormgeven van zoönosebestrijding. Omdat ecosystemen van fundamentele waarde zijn voor al het leven op aarde, stel ik dat we er ook naar moeten streven dat dit beleid ondersteunend is aan de gezondheid van ecosystemen. Verder bepleit ik dat we een gezondheidsconcept nodig hebben dat gebruikt kan worden voor alle elementen binnen One Health. Mijns inziens is in dit kader het concept 'resilience' ofwel veerkracht een vruchtbare optie. Het idee van gezondheid als veerkracht is toepasbaar op mensen, dieren en ecosystemen. Bovendien moedigt het ons aan om te investeren in een meer preventieve dan reactieve benadering van zoönosen. Wanneer er bij zoönosebestrijding sprake is van onvermijdelijke morele dilemma's dan kan het behulpzaam zijn om het 'two factor egalitarianism' principe van VanDeVeer toe te passen. Dit houdt in dat perifere menselijke belangen niet afdoende zijn voor het nemen van zoönosebestrijdingsmaatregelen die de basale belangen van dieren ernstig schaden. Daarnaast moeten deze maatregelen op lange termijn geen negatieve invloed hebben op de 'resilience' van dieren en ecosystemen.

In *hoofdstuk 3* presenteer ik de resultaten van een empirische studie naar de normatieve vooronderstellingen van gezondheidsprofessionals die betrokken zijn bij de zoönosebestrijding in Nederland. De studie laat zien dat deze professionals in theorie weliswaar een holistische visie op het One Health-concept hebben, maar dat in de praktijk een antropocentrische aanpak dominant blijkt. Het onderzoek maakt duidelijk dat volksgezondheid als een overtroevende morele waarde wordt gezien. Dit wijst op een inherent spanningsveld dat de kern van het One Health-denken raakt. Verder geef ik aan dat het gebrek aan ethische expertise in controlesystemen voor zoönosen aanleiding kan zijn voor misvattingen over de betekenis van ethische principes. Dit is bijvoorbeeld het geval bij toepassing van het voorzorgsbeginsel, een principe dat vaak gebruikt wordt om bestrijdingsmaatregelen te rechtvaardigen.

Om One Health-strategieën in zoönosebestrijding te implementeren zetten veel landen zogenaamde 'early warning'-systemen op waarin humane en veterinaire gezondheidsprofessionals samenwerken. Deze systemen, zoals de Nederlandse zoönosestructuur, kunnen heel succesvol zijn in het opsporen van opkomende ziektedreigingen. Ze zijn echter niet goed toegerust om morele dillema's op te lossen die bij zoönosebestrijding kunnen ontstaan, denk bijvoorbeeld aan kwesties als het ruimen van gezonde dieren. Mijn onderzoek heeft bovendien uitgewezen dat niet alle waarden die bij zoönosebestrijding van belang zijn, waaronder eerlijkheid, vertrouwen en transparantie, voldoende worden meegewogen. Ethici zouden kunnen ondersteunen bij het oplossen van morele vraagstukken die zich voordoen tijdens de zoönosebestrijding. Bovendien zou het ethische besluitvormingsproces transparanter moeten zijn om maatschappelijke steun voor zoönosebestrijding op te bouwen.

In *hoofdstuk 4* bespreek ik het gebruik van het voorzorgsbeginsel in het kader van zoönosebestrijding. Het toepassen van dit principe is niet vrij van ethische implicaties. Met name bij een One Health-strategie, die van ons vraagt om volksgezondheidsvoordelen af te wegen tegen de belangen van dieren en milieu, kan onbeperkt gebruik van het voorzorgsbeginsel leiden tot morele dilemma's. Het zorgt voor conflicten tussen waarden

van mensen, dieren en milieu. Vaak met moeilijke afwegingen tot gevolg. Zoals ik in mijn proefschrift laat zien gaat dit meestal ten koste van dieren. Daarom moet vanuit het oogpunt van One Health het gebruik van het voorzorgsbeginsel beter ingekaderd worden. Het voorzorgsbeginsel kan alleen gebruikt worden wanneer er sprake is van een duidelijk risico op schade. Er moet ook een zekere mate van wetenschappelijk bewijs zijn voor een oorzaak-gevolg relatie. Tot slot moeten de voorgestelde voorzorgsmaatregelen effectief, consistent, proportioneel en niet contraproductief zijn. De beoordeling van het effect van bepaalde voorzorgsmaatregelen op mensen, dieren en ecosystemen zou een integraal onderdeel moeten zijn van de beslismodellen van volksgezondheidsautoriteiten. Om te zorgen voor maatschappelijk draagvlak zouden de beweegredenen en bijbehorende afweging bovendien transparant moeten zijn en open moeten staan voor dialoog met betrokken belanghebbenden en het algemene publiek. Ethici kunnen in deze dialoog een rol spelen door het verhelderen van relevante ethische aspecten.

Vervolgens maak ik onderscheid tussen twee mogelijke interpretaties van het voorzorgsbeginsel. Ten eerste is het opvallend dat vanwege het onvoorspelbare karakter van zoönosen, volksgezondheidsautoriteiten over het algemeen gericht zijn op het idee van 'voorzorg als paraatheid'. Deze reactieve respons zorgt soms voor moeilijke afwegingen tussen volks- en diergezondheid. Ik pleit er daarom voor dat deze aanpak altijd gepaard moet gaan met een tweede beleidsagenda, die ik 'voorzorg als preventie' noem. Hoewel zoönosen een onderdeel zijn van de natuurlijke wereld om ons heen, moeten we erkennen dat hun oorsprong en globale impact vaak het gevolg zijn van onze verstoorde relatie met dieren en het milieu. Daarom is het een noodzakelijke voorwaarde ook de onderliggende oorzaken van zoönosen aan te pakken als voor de rechtvaardiging van bepaalde bestrijdingsmaatregelen, die dieren en het milieu schaden, een beroep gedaan wordt op het voorzorgsbeginsel.

In *hoofdstuk 5* werk ik de verantwoordelijkheden uit die dierenartsen in het kader van One Health hebben. In hun dagelijks werk ervaren dierenartsen veelvuldig de (gevolgen van de) interactie tussen de gezondheid van mens, dier en milieu. Daarom is het One Health-concept ook altijd breed uitgedragen binnen de veterinaire beroepsgroep. Dierenartsen zijn professioneel verantwoordelijk voor de gezondheid en het welzijn van dieren die aan hun zorg zijn toevertrouwd. Bovendien verwacht de maatschappij van dierenartsen dat zij waken over voedselveiligheid en volksgezondheid. Deze maatschappelijke verwachtingen overvragen dierenartsen soms en leiden tot morele dilemma's. Hoe moeten dierenartsen, bijvoorbeeld, omgaan met situaties waarin maatregelen om de volksgezondheid te beschermen een negatief effect hebben op de gezondheid van dieren? Dit zorgt voor een conflict tussen professionele verantwoordelijkheden. Vooral ook omdat de onderliggende oorzaken voor zoönose-uitbraken vaak hun oorsprong hebben op systeemniveau. Dat is iets wat niet eenvoudig veranderd kan worden door individuele dierenartsen. Ik beargumenteer dat een holistisch perspectief op One Health dierenartsen een uitweg kan bieden uit de dichotomie tussen dier- en volksgezondheid die de basis vormt voor veel morele dilemma's in de zoönosebestrijding. Daarvoor introduceer ik het argument van de 'ingekapselde gezondheid': de beste manier om de gezondheid van mensen te verzekeren is door het borgen van de gezondheid van dieren en het milieu. Dit heeft gevolgen voor de verantwoordelijkheden van dierenartsen. In

het belang van volksgezondheid is hun centrale verantwoordelijkheid daarom: de zorg voor gezondheid en het welzijn van dieren. Dierenartsenorganisaties zouden deze visie moeten uitdragen en de maatschappij moeten oproepen om diergezondheid centraal te stellen in alle vormen van dierhouderij.

In *hoofdstuk 6* presenteer ik de belangrijkste bevindingen van mijn onderzoek en enkele discussiepunten die volgen uit deze resultaten. Daarna kom ik tot mijn conclusies en aanbevelingen voor beleid. In dit hoofdstuk ga ik ook in op de waarde van ideale ethische theorieën in relatie tot de morele dilemma's die ontstaan in onze niet ideale wereld. Ik stel dat we moeten erkennen dat bij we bij het bestrijden van zoönosen soms drastische maatregelen moeten nemen om de volksgezondheid te beschermen. Op het eerste gezicht is dat in strijd met het ideaal van One Health. Maar als we inderdaad gedwongen worden tot zulke radicale maatregelen als het ruimen van gezonde dieren, dan kan dat alleen gerechtvaardigd worden wanneer gelijktijdig voorzorgsmaatregelen genomen worden die gericht zijn op onderliggende oorzaken om zo toekomstige uitbraken te voorkomen. Voordat gezondheidsautoriteiten beslissen om bepaalde bestrijdingsmaatregelen toe te passen, vereist een ethiek van One Health dat men eerst alle mogelijke interventies afweegt en de maatregelen kiest die de minste impact hebben op de gezondheid van dieren en milieu. Uiteraard moeten deze maatregelen nog wel nog wel voldoende effectief zijn om ziekte af te stoppen. Helaas domineren economische afwegingen nog steeds in grote mate de dierziektebestrijding binnen de Europese Unie. Daardoor worden mogelijkheden om massale ruimingen te voorkomen, zoals de inzet van preventieve vaccinatie, niet altijd voldoende benut. Het moet eveneens gezegd worden dat tot op heden de inspanningen gericht op het voorkómen van zoönosen, via de aanpak van onderliggende oorzaken, onvoldoende robuust zijn. Dat is moreel problematisch en maakt het lastig om het huidige beleid ten aanzien van de bestrijding zoönosen te rechtvaardigen. Mijn onderzoek toont aan dat de hedendaagse toepassing van One Health noodzakelijk is voor het bestrijden van zoönosen, die vroeger of later zullen blijven opduiken. Tegelijkertijd is deze interpretatie onvoldoende om de morele dilemma's te adresseren die er onvermijdelijk mee gepaard gaan. Een holistische opvatting van het One Health-concept confronteert ons weliswaar met onderliggende waardenconflicten, maar zal uiteindelijk de gezondheid van mensen sterker bevorderen dan de huidige antropocentrische benadering.

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# WASS Completed Training and Supervision Plan

Joost van Herten

Wageningen School of Social Sciences (WASS)

Completed Training and Supervision Plan

| Name of the learning activity | Department/Institute | Year | ECTS* |
|---|---|---|---|
| **A) Project related competences** | | | |
| Writing PhD proposal | PHI, WUR | 2016 | 6 |
| OZSW study group Environmental Philosophy – Animal Ethics | OZSW | 2016-2020 | 4 |
| *'Animal politics: justice, power and the state'* | ISVW | 2016 | 1 |
| Ethical Theory & Applied Ethics | OZSW spring school 2017 | 2017 | 6 |
| *'Euthanasie bij zorgdieren in de veehouderij'* | NBVE-conference | 2018 | 1 |
| Dag van de Milieufilosofie | VVM | 2017 | 0,5 |
| *'Veterinary responsibilities within the One Health framework'* | EURSAFE Congres | 2018 | 1 |
| Philosophy of risk | OSZW | 2018 | 5 |
| 'Q-koorts te lijf' | Raboud University reflects | 2019 | 1 |
| Contribution EURSAFE newsletter | EURSAFE | 2021 | 0.3 |
| **B) General research related competences** | | | |
| WASS Introduction course | WASS | 2016 | 1 |
| The Essentials of Scientific Writing and Presenting | Wageningen in'to Languages | 2017 | 1,2 |
| Organisation yearly conference NVBe | NVBe | 2019 | 1 |
| Review paper Public Health Ethics | | 2019 | 1 |
| Review paper Journal of Agricultural and Environmental Ethics | | 2020 | 1 |
| Review Journal of Applied Animal Ethics Research | | 2020 | 1 |
| Review paper Public Health Ethics | | 2021 | 1 |
| Member jury NBVe jaarprijs 2021 | NVBE | 2021 | 0,2 |
| **C) Career related competences/personal development** | | | |
| Career assessment | WGS | 2020 | 0,3 |
| NVBe board member | NVBe | 2017-2021 | 1 |
| Total | | | 34.5 |

*One credit according to ECTS is on average equivalent to 28 hours of study load

**Colofon**

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