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Comparing One Health and Ecohealth with Other Integrated Approaches to Health

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Chapter Overview

Elevator pitch

One Health and Ecohealth have diverse origins and with this, varied ways of relating to other similar integrated approaches to health. This chapter is dedicated to the many integrated approaches closely related to One Health and Ecohealth, while also recognizing the contribution and origination of integrated approaches from Indigenous cultures across the world. By understanding how these similar concepts revolve around and relate to One Health or Ecohealth, we hope to help the reader orient themselves and maximize opportunities to address health imbalances in all facets of our world: humans, animals, plants and our ecological settings. The effects of synergy between various integrated approaches have the potential to be greater than the sum of different, non-articulated interventions.

Book objectives the chapter relates to

- ☒ 1. Understand what One Health and Ecohealth mean
- ☒ 2. Think in a One Health and Ecohealth way
- ☐ 3. Apply One Health and Ecohealth in their professional and personal life
- ☐ 4. Know how to share One Health and Ecohealth knowledge
- ☐ 5. Integrate One Health and Ecohealth knowledge actively
- ☐ 6. Acquire or enhance core One Health competencies

One Health competencies covered

- ☐ 1. Effective communication
- ☒ 2. Collaborative and resilient working
- ☒ 3. Systems understanding
- ☐ 4. Transdisciplinarity
- ☐ 5. Social, cultural and gender equity and inclusiveness
- ☒ 6. Collective learning and reflective practice

- ☒ 7. One Health concepts
- ☒ 8. Theoretical and methodological pluralism
- ☐ 9. Harnessing uncertainty, paradox and limited knowledge

Learning outcomes

1. Describe the context in which different integrated approaches to health originated.
2. Analyse the differences and the synergies between these concepts and One Health or Ecohealth.
3. Evaluate calls for convergence in scholarship and joined action.

Summary

This chapter is an overview of several of the various integrated approaches to health, namely One Health, Ecohealth, Planetary Health, Conservation Medicine, Environmental Health, One Welfare, Comparative Medicine and One Ocean Health. A description is provided of the historical roots of each of these science-based approaches, while considering the convergence and divergence of each to the others. This chapter also highlights the importance of contributions from Indigenous Peoples and traditional knowledge that have influenced these more recent concepts. In this chapter you will learn about many of the different ways we approach health and comparatively dive into the discussion on differences and similarities to each of the approaches. You will then have the opportunity to consider arguments for or against calls for convergence. Complementary to Chapter 1, there is a more expansive timeline provided throughout the text highlighting various important dates, people and events in each of the respective histories. Throughout this chapter we aim for you to become more familiar with the use of a systems-thinking approach across a transdisciplinary and cross-sectoral playing field, by comparing the many integrated health approaches. We highlight the importance of effective communication, cooperation amongst all sectors through the collective learning process and reflective practice that are fundamental to One Health and Ecohealth.

2.1 The Many Integrated Approaches to Health

A number of **integrated approaches to health** have been developed, each originating from different epistemological (the perspective through which **knowledge** and its acquisition are understood) or academic traditions. These integrated approaches conceptualize the connectedness of the **environment**, human, plant (photosynthetic organisms) and animal health. While the multitude of approaches can lead to confusion among practitioners and academics, these approaches also represent the rich history of efforts within and across scientific **disciplines** to address the complex interactions between the health of humans, animals, plants and their environment (FAO *et al.*, 2022).

The ever-evolving scope of **One Health** and **Eco-health** poses a challenge in providing a single, clear definition of the concept. In this chapter, we focus on natural science-based integrated approaches to health as we discuss the concepts listed later in the chapter (see Table 2.1). While we recognize the importance of fields such as social sciences, economics and political ecology (which are crucial to some of the integrated approaches to health), these are not discussed in their own right in this chapter, as we focused on highlighting the need for holistic contributions to solve complex health issues. The same applies to concepts such as International Health, Geographical Health or Global Health, which are not included because of their focus on human health. We also did not include more methodologically oriented approaches like disease ecology.

We do recognize, however, the contribution of Indigenous, traditional and cultural influences to the understanding of the interconnectedness of life on Earth and to the integrated approaches to health (Box 2.1). For example, from an Australian Aboriginal perspective, 'One Health is highly [...] applicable within indigenous communities as it adopts a holistic approach and is in line with indigenous cultural beliefs [...] of health' (Riley *et al.*, 2021). An Indigenous approach often utilizes a 'whole-society' lens, involves community engagement, is inclusive, utilizes partnerships, and acknowledges the importance of cultural knowledge (Riley *et al.*, 2021). While we have chosen to focus on conventional academic approaches, we encourage the exploration into some of the Indigenous

Box 2.1. Significance of Traditional Healthcare

Traditional healthcare, while viewed with scepticism through a Western medicine lens, is commonly preferred over Western medicine in many parts of the world. In recognition by the international community of the rights of Indigenous Peoples' cultural beliefs in 2007, 143 member states adopted the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP), which is an internationally agreed upon set of principles acknowledging the human right to culturally determined traditional medicines, thereby allowing people to maintain their health practices (United Nations, 2008).

resources for more information on cultural approaches to health, such as the traditional knowledge of and practices by the Suquamish people and Māori (see: <https://suquamish.nsn.us/>; [https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(22\)01596-3/fulltext](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(22)01596-3/fulltext), respectively).

What follows is a non-exhaustive review of integrated approaches to health with an exploration through their synergies as well as the differences compared to One Health and Ecohealth. For orientation purposes, we present a timeline of the history of integrated approaches to health in this chapter (in the margins of some pages in this chapter with points in the text). Prior to our discussion of conventional academic approaches, we felt it important to discuss briefly the contributions of Indigenous or traditional cultures, highlighting regional examples of Indigenous, traditional connections to the land, animals, plants, Spirit and Mother Earth. While this does not cover the full breadth or depth of these concepts and cultures, we hope to provide these examples in a respectful and meaningful way to show that these belief systems hold the very essence of our more recent understanding of integrated approaches to health.

Finally, this chapter concludes with a discussion around calls for convergence between some of the approaches listed, given their inherent synergies and partially overlapping agendas. While we cover the history of integrated approaches closely related to One Health and Ecohealth, a more thorough description of the history of One Health and Ecohealth itself can be found in Chapter 1.

2.2 Contributions of Traditional and Indigenous Knowledge to Integrated Approaches to Health



The discussion of concepts around integrated approaches to health would not be complete without the recognition of the significance of Indigenous and traditional belief systems that hold the very essence of the more classic One Health approach. A commonly understood tenet of many ancient, **Indigenous and traditional belief systems** is that the health of the environment is inherently linked and inseparable from the physical and spiritual health of humans, animals and plants (QingWen *et al.*, 2010; Kimmerer, 2015; Pettan-Brewer *et al.*, 2021; Riley *et al.*, 2021; Pettan-Brewer *et al.*, 2024).



Task: Consider the key concept, ‘A commonly understood tenet of many ancient, Indigenous and traditional belief systems is that the health of the environment is inherently linked and inseparable from the physical and spiritual health of humans, animals and plants’. As you read through this chapter, consider how this idea is related to, or differs from, the various approaches to health discussed. Additionally, consider how the traditional Indigenous knowledge has provided a foundation to the integrated approaches to health.

Example answer: Indigenous communities often use a holistic approach to health, including the spiritual dimension of each individual and community with Nature. These practices are the basis for modern integrated approaches, contrasting with the reductionist interventions performed in Western medical specialization.

There are many examples repeated across time and place that showcase the importance of the interconnectedness of the land, the environment, plants, animals and the people that share these values and resources. While **Indigenous Peoples** make up only 6% of the world’s population, they live within and protect areas that hold up to 80% of the world’s **biodiversity** according to the World Bank (Worldbank.org, 2022). More

information on the importance of Indigenous Peoples’ stewardship can be found in Chapter 7.

2.2.1 North America

Native American, First Nations, Inuit and Métis cultural beliefs are as varied as the tribes themselves. There are over 600 Tribal Nations in Canada and the USA (Government of Canada, 2023), each with their own Creation stories. We share, with gratitude, some of the stories with consideration of the connectedness to the holistic principal concepts of One Health and Ecohealth and to exemplify how they have been applied well before these terms became popularized. Robin Wall Kimmerer shares the traditional Potawatomi creation story in her book *Braiding Sweetgrass* (Kimmerer, 2015). She describes how Skywoman fell to the water-covered Earth and the animals worked together for her survival, including the geese who flew up to catch her. Turtle who offered his back for her to rest. Muskrat who gave his life diving deep into the water to collect a handful of mud from which the land grew. Skywoman shared the seeds and fruits of many plants from the Tree of Life, thereby feeding and nourishing all of the creatures. Kimmerer impresses that the beauty of this story is what was created from the collaboration of the animals and Skywoman’s gratitude toward them.



Animals play an important role in many Tribal Nations; great respect is held for all living things, including animals. The Tlingit (phonetically ‘klin-kit’) People of Alaska carry a beautiful story as to the origin of the aurora borealis. The Tlingit people believe that each life we live on the Earth holds a lesson for our Spirit to learn from and that we continue to have many lives to learn the necessary lessons. The final lesson on Earth, the last lesson in a living body, is experienced in the body of a sacred animal. At the close of this final transition on Earth, the Animal Spirit is released to the heavens; the aurora borealis is the display of the Animal Spirits playing in the sky (Watermolen, 2022).

2.2.2 South America

Animals and plants have also influenced human history in an adaptive and interdependent human–animal relationship in South America (Vergara,

2018). Although the use of animals in conventional medicine has been comparatively recent, a **meta-analysis** (a statistical technique used in research to combine and analyse **data** from multiple independent studies on a particular topic) of historical and archaeological evidence indicated that animals have been used in traditional medicine in South America since ancient times, similar to other Indigenous cultures (Montenegro and Stephens, 2006). This was considered a 'faunal drugstore'. Animals, mostly wild species, were seen as healing instruments and considered sacred in native rituals and ceremonies (Alves and Souto, 2011). Plants have also been used for both human and animal care in South America (Alves *et al.*, 2010), demonstrating the environmental health **impact** on One Health. In contrast, animals have historically threatened human health prior to European arrivals, such as the Yanomami indigenous communities of Northern Brazil, which have been faced with high burdens of **zoonotic disease** from soil-, water- and food-borne zoonoses, including larvae of the native sand flea, which causes severe disability of hands and feet (Ehrenberg and Ault, 2005).

2.2.3 Asia

Classic Eastern belief systems hold animals in high prestige, including the belief in the cyclical embodiment of all living beings or reincarnation. Many incorporate a doctrine of nonviolence, which is extended to animals. Buddhism holds that killing animals is karmically equivalent to killing humans, therefore animal welfare is placed in high importance to everyday life. The Islamic religion teaches that unnecessary use or careless entertainment from animals is to disobey Allah's will (Szucs *et al.*, 2012). As of the time of writing, in parts of Asia, specifically India, it remains controversial to euthanize animals, making disease management and population control challenging, particularly with zoonotic diseases such as rabies and leishmaniasis (Srinivasan *et al.*, 2020).



Learning question: Consider the example above. What is your own country's approach to disease management or population control regarding animals (domestic, production or wild animals)?

Example answer: In Brazil, domestic animals are vaccinated against rabies as part of a national plan of vigilance and control. According to the World Health Organization (WHO), Food and Agriculture Organization of the United Nations (FAO) and World Organisation for Animal Health (WOAH):

Mass dog vaccination is a proven, cost-effective way to save human lives by stopping transmission of rabies at its source. (...) dogs are responsible for 99% of human cases. (...) real-world experience shows that sustained vaccination coverage of 70% of dog populations is sufficient to stop transmission of the disease between dogs, and from dogs to humans.

WHO *et al.* (2018)

Through the One Health approach, vaccinating feral dogs can contribute to the decrease of rabies in wildlife.

2.2.4 Africa

African Traditional Religion (ATR) and African Traditional Medicine (ATM) are the traditional beliefs, convictions and heritage handed down from generation to generation by African people. It is the 'cumulative knowledge and practices among Africans used in the diagnosis, prevention and elimination of physical, mental or social imbalance and the restoration of health and weakness' (Ajima and Ubana, 2018). Medicines, in many traditional therapies and specifically African traditional medicines, refer to healing agents such as plants, but also ritual or spiritual practices and objects (Ajima and Ubana, 2018). African traditional belief systems posit that we as humans should strive to maintain a harmonious relationship with all forces in the entire world, which is seen as a flowing, connected unit where all entities contribute to the relationship including spirits, plants, animals, the elements, humans and the dead (Ajima and Ubana, 2018).



Task: Identify the One Health core competencies discussed in the Introduction Chapter and throughout the text that are exemplified by Indigenous and traditional teachings / knowledge.

Example answer: Indigenous communities use practical skills of systems understanding based on their values and attitudes, applying collective learning and reflective practice.

2.3 Emergence of the Different Integrated Approaches to Health

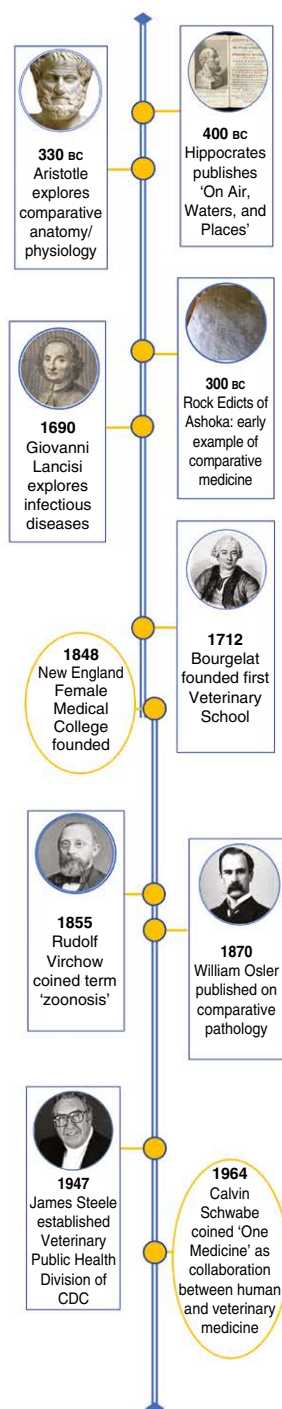
2.3.1 Environmental Health

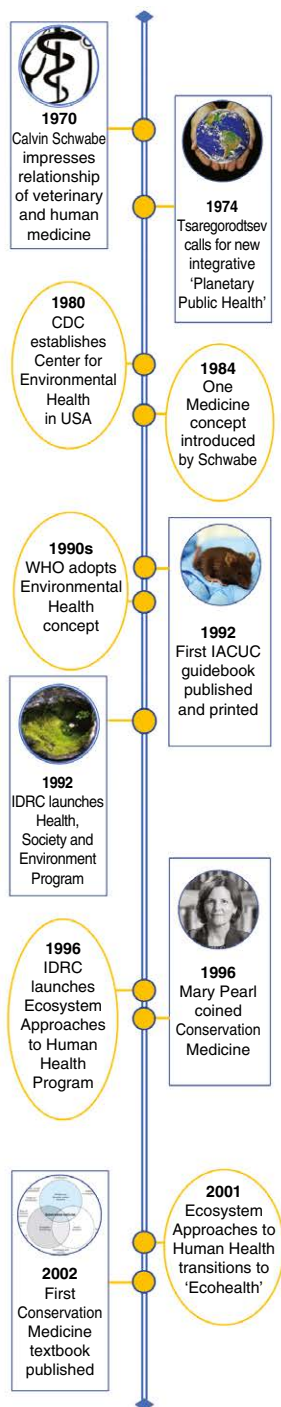
The origin of the concept or science of **Environmental Health** is less defined than many of the other concepts around One Health. The ambiguity arises, in part, as there was not a single entity that popularized the concept throughout history; the understanding of the role of the environment in health and disease was a gradual, evolving process (Gochfeld and Goldstein, 1999). The concept was formalized across Europe in the early 1800s with the discovery of the causal relationship of poor living conditions and dirty water to disease in humans. Similarly in the USA, Environmental Health Science arose from a branch of Sanitary Science in the late 1800s and was adapted by various universities across the USA to a variety of studies (University of Michigan, 2021).

The US Center for Disease Control (CDC) established the Center for Environmental Health in the 1980s and the concept of Environmental Health was eventually adopted and popularized by the World Health Organization (WHO) in the early 1990s. The study of Environmental Health has held an anthropocentric public health policy focus and has become an umbrella term for many related sciences including environmental toxicology, ecotoxicology, industrial hygiene, occupational health studies, etc. Environmental Health studies work to identify and evaluate environmental sources of hazardous agents and explore ways to limit exposures to such toxic environmental agents in water, soil, food and air that may affect human health (NEHA, 2013).

2.3.2 One Medicine Leading to One Health

The **One Medicine** concept has significant overlap with One Health as the originating concepts arose and evolved throughout history, at times in parallel and at others tangentially. Contemporarily, One Medicine was conceptualized in part by the recognition that animals share similar physiology to humans, while sharing the same environment. There are various references across pre-industrial history noting the link between human and animal health (Woods, 2017; King, 2021). The Industrial Revolution in Europe brought with it a number of scientific and medical advances, many guided by animal dissection, anatomical exploration and animal experimentation.





The German physician and pathologist Rudolf Virchow (1821–1902) is credited with the origination of the One Medicine concept in the 1800s with the recognition and investigation of transmissible disease between animals and humans, thereby familiarizing the term 'zoonosis' (Gyles, 2016) in the Global West. The concept was supported in 1870 with William Osler's publication on Comparative Pathology (Gyles, 2016). Continuing to recognize the importance of the study of animal health and disease transmission in relation to human health, James Steele was successful in the establishment of the Veterinary Public Health Division of the CDC in 1947 (Gyles, 2016). It was not until Calvin Schwabe at UC Davis popularized the term One Medicine, however, and spearheaded the integrative collaboration between veterinarians and human medical doctors in the 1960s that the term became part of common vernacular in the field (Gyles, 2016). Dr Schwabe revolutionized the One Medicine field, highlighting how veterinary medicine is directly related to human health and establishing the first Department of Veterinary Epidemiology in the USA at UC Davis (Zinsstag *et al.*, 2011). Interestingly, much of Schwabe's influence on the Global West understanding of One Health came from his time spent in Africa working with native Dinka pastoralist people (Zinsstag *et al.*, 2011). The terms and ideas around One Medicine have gradually evolved since origination, progressing and continuing toward a more comprehensive and holistic approach that commonly sits within the concept of One Health.



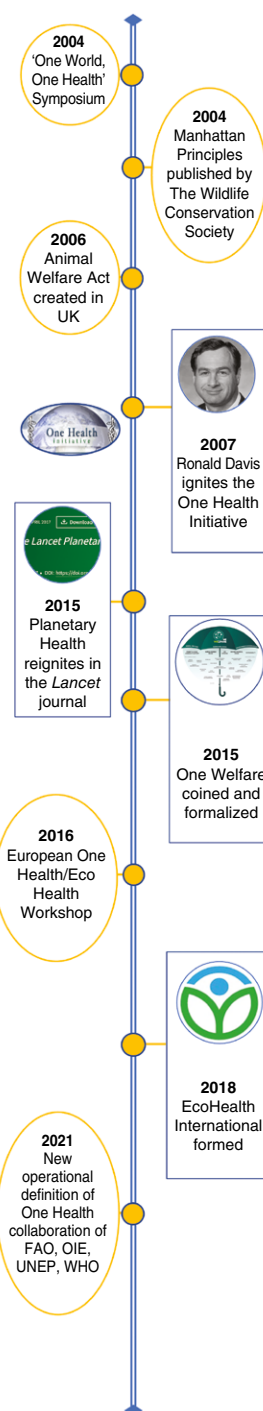
These leaders in One Health exemplify the core competencies of One Health through their spearheading of ideas incorporating collective learning and reflective practice, understanding of the inherent interconnectedness between humans, plants, animals and **ecosystems**, transcendence of disciplinary and sectoral confines engaging diverse groups through a collaborative, systems-thinking approach with effective communication (Laing *et al.*, 2023). In 2004 following outbreaks of Ebola Hemorrhagic Fever, SARS, Mpox and West Nile Virus, the 'One World, One Health' conference was held with a focus on the emergence and resurgence of infectious disease, pollution, habitat degradation, biodiversity loss and global **climate** change. Here, the 12 Manhattan Principles were envisioned as recommendations to establish a comprehensive approach to preventing infectious diseases and maintaining ecosystem integrity (Cook *et al.*, 2004).

Of note, many oncological advances in human chemotherapeutics and radiation methodologies were gained in part due to the collaboration and overlap between veterinary and human medicine (see Section 2.3.4 on Comparative Medicine below).

2.3.3 Conservation Medicine

Conservation Medicine first emerged as a concept in the 1990s in response to the growing health concerns associated with environmental degradation and biodiversity loss (Pokras *et al.*, 1999; Tabor, 2002; Daszak *et al.*, 2004; Jakob-Hoff and Warren, 2012). The term was first used in 1994 and has been attributed to Mary Pearl. The first textbook (*Conservation Medicine: Ecological Health in Practice*) was published in 2002 (Aguirre, 2002) as an output from a multidisciplinary conference in 1999 in Florida, USA. A Symposium on Conservation Medicine was launched in June 2000 at the annual meeting of the Society for Conservation Biology. The Center for Conservation Medicine was established as a collaboration between Tufts University School of Veterinary Medicine and the Wildlife Trust, later designated Ecohealth Alliance, while the Harvard Medical School Center for Health and Global Environment expanded to become the Consortium for Conservation Medicine in 2000. At the time, conservation practitioners recognized that the health of all species was an important factor limiting the success of conservation and development programs. Conservation Biology had been widely adopted by ecologists and conservation practitioners since the 1970s to develop strategies to address declines in wildlife species and the loss of biodiversity. Conservation Biology was heavily influenced by Rachel Carson's *Silent Spring* in 1962, a transformative call to attention towards the interconnected relationship of humans and the natural environment, including animals and plants (Carson, 1962, republished 2022). However, the scope of Conservation Biology was considered too narrow to address some of the complex health challenges related to conservation, which required a more integrated and holistic approach, focusing on the health sciences (Tabor *et al.*, 2001).

The emergence of Conservation Medicine was influenced by conservation biology, veterinary science and human medicine (Meffe, 1999). Joint meetings and conferences were held between conservation biologists and veterinary, medical and public health fields, framing biodiversity conservation firmly within the context of global health (e.g. the AHEAD meetings



sponsored by the Wildlife Conservation Society and Cornell University since 2004). An important belief underpinning the newly emergent field was that conservation of biodiversity, and of functional healthy ecosystems, was necessary for the health of human and animal populations. It has many similarities in this regard to Ecohealth and has been described as the pursuit of ecological health, or ecological health in practice (Aguirre, 2002). It forms part of an intellectual trend beyond the species-specific approach to focus instead on ecosystems.

The approach has developed substantially since its origins. In its most holistic form, its scope may be as broad as that of One Health, including both the natural sciences and the social sciences. Similar to One Health, it focuses on the interactions between humans, animals and the ecosystems that they inhabit (Tabor, 2002; Deem, 2015); however, it has primarily been promoted by the veterinary profession and those working in the field of wildlife health. For example, it has been popular amongst zoo veterinarians and has been promoted by the American Association of Zoo Veterinarians. Inclusion of the term ‘medicine’ within the name has had the unfortunate effect of reinforcing the misguided belief that this field should be the domain of veterinarians, rather than a truly holistic and integrated approach to health.

This limited scope is not reflected in the most commonly cited definitions. Reflecting the more holistic view of Conservation Medicine, Aguirre (2002) states that ‘conservation medicine examines the interactions between pathogens and disease and their linkages with the synergies that occur between species and ecosystems’. Deem (2015) considers it to be ‘a transdisciplinary approach to study the relationships among the health states of humans, animals, and ecosystems to ensure the conservation of all, including *Homo sapiens*’. Defined this way, there is little difference from One Health apart from the emphasis on ensuring the conservation of all. Conservation Medicine therefore fosters an interdisciplinary, or ideally a transdisciplinary, approach and has a similar philosophy and epistemological basis to One Health. Indeed, it may be described as the application of One Health to the conservation of biodiversity.

2.3.4 Comparative Medicine



The discipline of **Comparative Medicine** is an interdisciplinary and translational approach to biomedical research benefiting animal

and human medicine, commonly correlating with animal models of disease (Macy and Horvath, 2017). In other words, it relates to and leverages biological similarities and differences among species, including humans, to gain a better understanding of the mechanism of human and animal disease for treatment, drug discovery and vaccine production. It has also been defined as a study of similarities and unique differences between human and veterinary medicine, including the critical role veterinarians play in understanding animal diseases as spontaneous and natural models for human diseases. It, thus, improves human health, including neglected and emerging zoonotic diseases (zooanthroponosis, or reverse zoonosis, refers to diseases transmitted from humans to non-human animals; anthroponosis refers to diseases transmitted from animals to humans). For example, the COVID-19 pandemic has highlighted the utmost importance of veterinarians in One Health, Global Health and Population Health for the prevention and control of pandemics (as in the latest paper by Bernstein *et al.*, 2022). Comparative Medicine has been instrumental in moving forward the concept of One Health and promoting some of the most important medical advances in the 21st century. In addition, the Institutional Animal Care and Use Committees (IACUC) have played major roles in facilitating and ensuring humane animal welfare and reproducible laboratory results in studies involving research animals. The 19th-century German physician Rudolf Ludwig Carl Virchow, widely known as the ‘Father of Modern Pathology’ and the founder of the science of veterinary pathology, wrote: ‘Between animal and human and medicine, there is no dividing line – nor should there be. The object is different, but the experience obtained constitutes the basis of all medicine.’

The recognition of highly identical biological mechanisms shared among the animal kingdom (humans included) was the basis for the continuity of this crossover discipline and forwarded translation studies ever since. Sadly, the comparative efforts maintained an anthropocentric vision with results mainly benefiting humans. More recently, translation research has been applied with a special attention on naturally occurring diseases in animals that are almost completely identical to human diseases. This allows an acceleration of knowledge gaining that would be much harder to obtain via inducing

these conditions in a lab setting, fully representing the common vision of shared problems and shared solutions (Macy and Horvath, 2017). This comparative trend to use ‘naturally occurring/spontaneous’ animal models has gained traction only fairly recently (2010 onwards) with the legal settings in place to attend ‘Replacement, Reduction and Refinement – the Three Rs’ (Tannenbaum and Bennett, 2015).

Historically, Comparative Medicine can be traced back to 1927 when Sir Bradley presented the arguments for the parallel practices of human and veterinary medicine. A renewed interest began in the 1960s with Gordon Theilens’ groundbreaking research in veterinary oncology and viral oncology advancing oncological treatments and opening new doors in other fields of health sciences by unravelling mechanisms and providing solutions based on translational medicine research. Interestingly, Comparative Medicine recognizes and serves as the basis for the study of similarities and differences, which was also used as a favourable argument for animal experimentation. In an attempt to promote a more ethical use of animals, Russel and Burch edited what is known as the 3Rs (Replacement, Reduction, Refinement) guiding principles, while also promoting efforts to find alternatives to animal use for education purposes and testing (Cozigou *et al.*, 2015). This acknowledgement that animals are sentient beings laid the groundwork for other approaches that include **welfare** as an intricate part of the health status, see section 2.3.7.

2.3.5 Ecohealth

The foundation for the Ecohealth concept was laid in the early 1990s using the term ‘Ecosystem health’ (Mageau *et al.*, 1995; Rapport *et al.*, 1998), which was also the name of a journal that was issued from 1997 to 2001 and then discontinued (Rapport *et al.*, 1999). In 1992, the International Development Research Centre (IDRC) in Canada launched its Health, Society and Environment Program, which explored how environmental factors influence health. In 1996, the IDRC created the Ecosystem Approaches to Human Health Program, and later in 2003 coined the term ‘Ecohealth’. Shortly after, the IDRC hosted the International Forum on Ecosystem Approaches to Human Health in Montreal, Quebec, Canada, and in 2004 the new *EcoHealth* journal was launched. This journal was associated with the International Association for Ecology and Health (IAEH). The IAEH was formed in 2006 and hosted a series of biennial conferences, such as in

the USA in 2006, Mexico in 2008, the UK in 2010, China in 2012, Canada in 2014, Australia in 2016, Colombia in 2018 and South Africa in 2022. The IAEH parted from the journal in 2016 and *EcoHealth* was henceforth managed by the Ecohealth Alliance (<https://www.Ecohealthalliance.org>). In 2016, a joint International One Health Congress and Biennial Conference on the International Association on Ecology and Health took place in Australia. In 2018, the IAEH transformed into Ecohealth International. In 2019, the Network for Ecohealth and One Health (NEOH) became Ecohealth International’s European Chapter.

In 2008, the Canadian Community of Practice in Ecosystem Approaches to Health (CoPEH Canada) was created, including the formation of workshops and an Ecohealth field school. The IDRC later supported the development of an Ecohealth field-building Leadership Initiative in South-east Asia designed to strengthen the field through training, evidence-building and linking researchers. In 2012, Dominique Charron published the six overarching guiding principles (systems thinking, transdisciplinary research, participation, sustainability, gender and social equity, and finally, knowledge-to-action) for Ecohealth (Charron, 2012). Later that year, the Kunming Position Statement was released, identifying Ecohealth contributions to the Millennium Development Goals. In 2017, the Tackling Infections to Benefit Africa (TIBA) Initiative was funded to work in transdisciplinary ways to reduce the threat of infectious diseases in Africa through health policy and system interventions.



Common themes in Ecohealth and One Health include a systems approach to health and holistic understanding of the linkages between human and animal health. Ecohealth emphasizes the intertwined connections between health and sustainable development, which have recently also gained momentum in One Health. The One Health movement has achieved a considerable footprint in the areas of zoonotic disease control and emergence, including very recently during the COVID-19 pandemic (WHO, 2021). A key assumption of Ecohealth is that humans can only survive in healthy, diverse ecosystems. Ecohealth with its focus on Ecosystems is situated at an ‘intermediate level’ of complexity compared to One Health on one side and **Planet-ary Health** on the other side.

2.3.6 Planetary Health

The concept of Planetary Health was popularized in 2014 and 2015 to a wider audience after being published in the *Lancet* (Horton *et al.*, 2014; Whitmee *et al.*, 2015). It is closely linked to prior global concerted efforts assessing the status of global environmental / climate change like the Brundtland Commission ('Our Common Future', 1987, United Nations; <https://sustainabledevelopment.un.org/content/documents/5987our-common-future.pdf>), the Millennium Ecosystem Assessment (<https://www.millenniumassessment.org/en/index.html>) and the reports of the International Panel on Climate Change (IPCC) (<https://www.ipcc.ch/>). The term 'Planetary Health' was introduced previously, as early as the 1970s–1980s (Prescott and Logan, 2019). Currently, the movement mostly follows an anthropocentric approach, but also includes the more abstract concepts of 'Planetary Boundaries', which put the focus on the maintenance of key biophysical functions necessary for human health and growth (Rockstroem *et al.*, 2009).

For Planetary Health, human **health** and **wellbeing** depends on the wellbeing of the Earth, attending to its living and non-living systems, for long-term sustainability and balance (Lerner and Berg, 2017; Hill-Cawthorne, 2019). Contrastingly, Rabinowitz *et al.* (2018) defend that One Health embraces both Ecohealth and Planetary Health concepts. For many researchers and practitioners, the dividing line between One Health and Ecohealth is that One Health does not include a health definition on the systems level, even if the importance of the systems approach to health is stressed for scientific inquiry and practice.



The proponents of the Planetary Health movement state that while a global improvement in human health was achieved over the last century, the natural systems of the Earth have deteriorated, which will have implications for human health in the future. Planetary Health now is being supported by the Lancet Planetary Health Commission and the Rockefeller Foundation. The secretariat of the Planetary Health Alliance is located at Harvard University, USA (<https://www.planetary-healthalliance.org/>). Ferretto *et al.* (2022) discuss the operationalization of Planetary Boundaries taking into account Doughnut economics (see Chapter 13 for more information on different schools of economic

thought), and point out that global-level policies require local-scale implementations in order to have meaningful impact and preserve the social components of each country/region.

2.3.7 One Welfare

Animal rights and animal welfare are commonly overlapping. In sum, sentient animals have similar moral rights and worth as humans, and should be allowed to live free from human exploitation while welfare is based on the relationship between humans and animals, relying on the five freedoms, namely: freedom from hunger and thirst, discomfort, pain, injury or disease, freedom to express normal behaviour, and freedom from fear and distress. Laws were published almost 200 years ago in the United Kingdom, with animal welfare legislators passing the Act to Prevent the Cruel and Improper Treatment of Cattle in 1822 based on the acknowledgement that animals are sentient beings (not commodities), making the UK the first nation to regulate animal rights and welfare. Soon, this prompted the first animal welfare charity named the Society for the Prevention of Cruelty to Animals (SPCA), which later had royal patronage (1837) and since 1840 has been called the RSPCA. Still in the UK, Pease's Act of 1835 extended the prohibition of cruelty towards dogs and other domestic animals, and other activities envisioned as cruel to animals, while appealing for better standards and handling in slaughterhouses. The Protection of Animals Act, the first animal protection law, was approved in 1911, leading on to the more recent Animal Welfare Act (2006).

Many countries do not recognize animals as sentient beings, so offer no protection for their welfare, while other countries are making great strides to support empathic and respectful animal handling. According to the World Organisation for Animal Health (WOAH), animal welfare is 'the physical and mental state of an animal in relation to the conditions in which it lives and dies'. Still, WOAH emphasizes animal welfare practices in Asia, the Far East and Oceania, by the regional animal welfare strategy (<https://rr-asia.woah.org/en/projects/animal-welfare/>, accessed 13 March 2024). WOAH also identified two major tools to overcome welfare issues as being education and training in animal welfare through active professional awareness and community engagement. All animal–human interactions should assess animal welfare, considering necessities

(nutrition, environment and possibility to behave as in a natural setting) along with the physical and mental health status, according to the 5 Domains Model. In line with this call for action, several international organizations, e.g. Veterinarians Without Borders International and Brooke Organization (Action for Working Horses and Donkeys), and others, advocate for animal welfare, voicing concerns for laboratory animal conditions and improving standards for trade and transport conditions for animals (Tarazona *et al.*, 2019; UN Conventions on Animal Health Protection, <https://www.globalanimallaw.org/gal/projects/uncahp.html>).

More recently, in 2015, a group of veterinarians came together and coined the **One Welfare** concept defending the ‘interconnection between animal welfare, human wellbeing and their physical and social environment’ (Pinillos *et al.*, 2016; Bourque, 2017). This initiative promotes the awareness of the consequences of human activities with animals (direct and indirect use), which have profound impacts on the environment, law making, commerce and finance development, and ultimately conditioning humans’ and animals’ health. For this, the One Welfare framework champions a One Health approach with the appeal for multisectoral-approach collaborations to attain health for all and to help prevent zoonotic disease emergence, while defending equity stewardship and compassionate professional practices both for animal welfare and human wellbeing (Fawcett *et al.*, 2018; Pinillos, 2021). Overall, One Welfare based its conceptual approach on the One Health vision and practices along with other initiatives that contribute to One Health evolution (Radeski *et al.*, 2018).

Notably, the initial protective laws for the respect of animal welfare also helped set the tone for later protection laws for children (1880) and women in the UK, and throughout the world. These achievements can be related to the definition for human health, ‘A state of complete physical, mental and social well-being and not merely the absence of disease or infirmity’, inscribed in the Constitution of WHO in 1948. Health in an integrated approach means basically the same for humans, animals and the environment they inhabit.

2.3.8 One Water, Oceans Health and One Health

Oceans cover more than 70% of our planet and represent over 95% of the biosphere. Hence there is an

urgent need to develop the underlying One Health concept and approaches of global sustainability, based on an understanding of the fundamental interactions between oceans and health. This requires a new research and education paradigm that embraces aquatic ecosystems’ complexity, which integrates the physical, biological and social sciences, and uses an integrated natural systems approach (<https://www.cabidigitallibrary.org/journal/cabioh/special-issues/beyond-one-ocean-health>; <https://oceanandsociety.org/en/projects/b1oh-beyond-one-ocean-health>).

Marine and coastal habitats cover a diverse spectrum (...) such as coral reefs, mangrove forests, seagrass beds and estuaries, (...) open ocean, hydrothermal vents, seamounts and soft sediments on the ocean floor. (CBD)

One Ocean, One Health has been previously described and published in the first edition of *EcoHealth* (Wilcox and Aguirre, 2004). The authors discuss the paradigm, applying the concept of health to ecosystems,

Box 2.2.

For many decades, a well-known correlation between marine ecosystem distress caused by nutrient loading and potential contributions of anthropogenic global climate change is associated with the frequency and intensity of harmful algal blooms (HABs) and their associated toxicity for marine mammals and humans. Indeed, the horror movie *The Birds* by Alfred Hitchcock (1963) reflects a real event that happened in Monterey, California in 1963 and an example of domoic acid toxicity and algal blooming. *Pseudo-nitzschia* is a marine planktonic diatom genus that accounts for 4.4% of pennate diatoms found worldwide. Some species are capable of producing harmful blooms and toxicity that affects humans and animals. Many populations of marine animals, marine birds and sea turtles are exposed to pollutants from water and agricultural runoff, human sewage, including pathogens of terrestrial origin best described as pathogen pollution, antimicrobial-resistant (AMR) genes and microplastics. Thus, marine mammals and birds can serve as sentinel species for environmental and human health, reflecting their ecosystems.

addressing the links between oceans, wildlife, plants and human health. In addition, the authors discuss the economic and social value that provides the importance of subsistence, health and equity for more than 200 million people and animals.

A Beyond One Ocean Health Action (BIOH) Initiative based in Kiel, Germany is led by collaborative partnerships and supported by the Ocean Decade and a Special One Oceans Health Edition (<https://www.cabidigital-library.org/journal/cabioh/special-issues/beyond-one-ocean-health>) is available at CABI One Health Journal. Thus, the **Beyond One Ocean Health** perspective includes issues related to: health and disease in the ocean, ocean-mediated human disease, ocean-related prevention, healing including physical and spiritual wellbeing concepts, the morality and justice of interventions with environmental health **outcomes**, and understanding and living within planetary limits (<https://oceandecade.org/actions/beyond-one-ocean-health/>).

Finally, we must '**Go Blue**' and be concerned that the current biodiversity loss, ocean pollution

and anthropogenic threats will cause planetary health distress if we continue to ignore sustainability and health of the oceans.

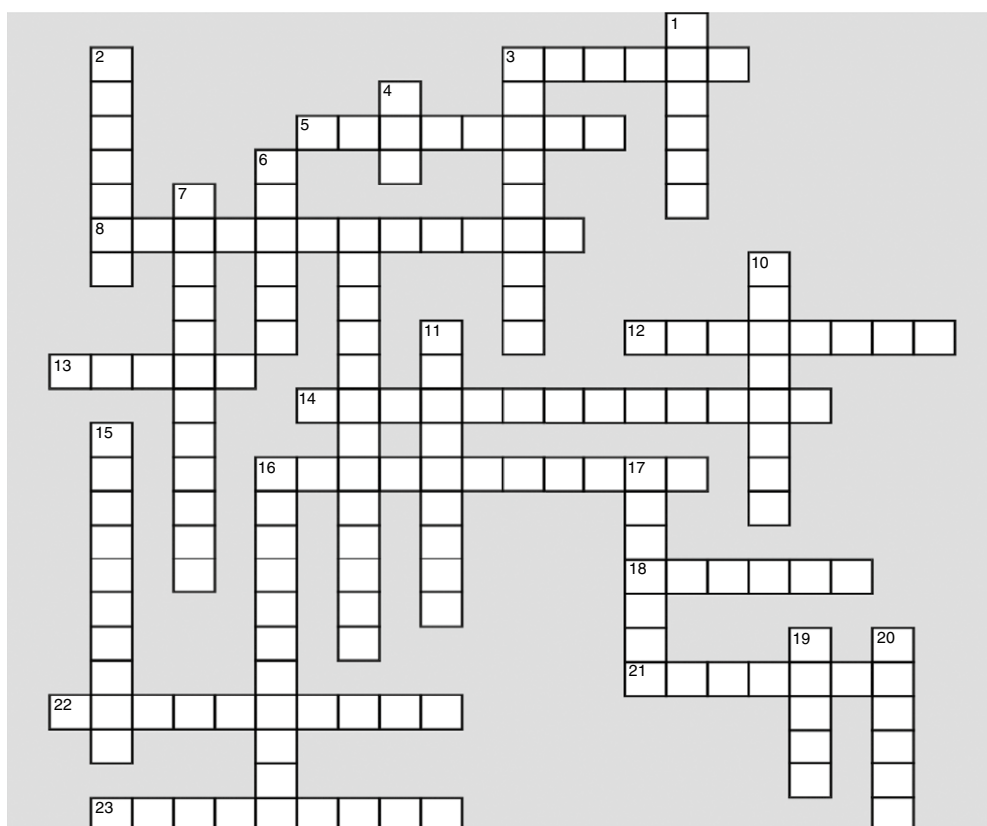


Crossword puzzle. Using your newly gained knowledge, see if you can solve the crossword puzzle below.



Learning question: Using the examples provided in Table 2.1, discuss the following questions:

- How unique is each approach? Is the suitability in different scenarios the answer to opt for one instead of another?
- What are the difficulties with these different approaches that are all similar, but yet quite different?
- What does it mean for working together in practice in the same setting?



	Across		Down
3	These 'medicines' are also ritual and spiritual objects in many African traditional therapies	1	Veterinarian and pioneer who worked to establish the Veterinary Public Health Division of the CDC in 1947
5	Environmental Health originally came about as the study of _____ sciences	2	A leader in the One Medicine movement who established the first department of veterinary epidemiology in the US
8	Conservation Medicine arose due to health concerns associated with environmental degradation and _____ loss	3	This health concept is often prioritized by physicians taking an anthropocentric approach to human and environmental health
12	In the 1700s Darwin discussed infectious diseases of humans and animals in his book called _____	4	_____ Medicine concept, shares similarities with One Health in that animals are physiologically similar to humans and share the same environment
13	Leading biologist (last name) who spear headed the Conservation Medicine movement	6	The Tlingit people of Alaska believe the aurora borealis is the display of the sacred _____ Spirits playing in the sky
14	One Health conceptualizes the _____ between animal, plant, environment and human health	7	_____ Medicine is a health concept that is influenced by conservation biology, veterinary science and human medicine, focusing on the interactions between humans, animals and their environment
16	This health concept, _____ Medicine, leverages biological similarities and differences among species in health and pathology, including an important focus on zoonotic diseases	9	This health concept discussion includes a focus on toxin exposure
18	Woman author (last name) who helped set the stage for the environmental movement in the US in the 1960s and 1970s	10	Researcher (last name), veterinarian and public health professional who focuses on zoonoses and is active in the One Health and Ecohealth fields
21	The initial protective laws for animal _____ helped set the tone for children and women protection laws later in history	11	These 12 'Principles' arose at the 'One World, One Health' Conference as recommendations to establish a more holistic approach to prevent infectious disease and maintain ecosystem integrity
22	Practically, _____ cultural beliefs preceded many of the same concepts currently embodied within the One Health paradigm	15	The third 'R' of the 3Rs, a principle referencing animal experimentation to find alternatives to animal testing, to find ways to limit the number of animals and adopt methods to alleviate stress
23	Systems-thinking approach that includes the principles of transdisciplinarity, participation, sustainability, equity and knowledge-to-action	16	A call for the synergism between the varied and integrated approaches to health around One Health
		17	Early notable physician who recognized and published on investigation of transmissible disease between animals and humans
		19	Acronym for the committee that ensures humane animal welfare and reproducible laboratory results in studies using research animals
		20	The One _____ concept is one that integrates unifying approaches to sustainably balance the health of humans, animals and ecosystems through multidisciplinary involvement

Table 2.1. Integrated approaches to health in the context of their academic origin.

Concept	Historical origin and notable dates	Stakeholders / target audience	Key concepts and tenets	Journals (J), conferences (C), societies (S)
Environmental health	Initiated from the Sanitary Sciences ^a 1800s	Ecologists, biologists, public health professionals, students of the natural sciences	Anthropocentric approach of how the environment affects human health	J: <i>Environmental Health Perspectives</i> ; <i>Healthy People 2030</i> ; <i>BMC Journal of Environmental Health</i> , <i>International Journal of Environmental Research and Public Health</i> C: WHO Annual Ministerial Conference on Environmental Health, Global Summit on Environmental Health S: US National Environmental Health Association (NEHA), National Institute of Environmental Health Sciences (NIEHS), International Federation of Environmental Health
One Medicine (precursor to traditional One Health)	Virchow and Osler (1800s) embraced One Medicine and coined the term zoonosis. Schwabe in 1964 revived the concept ^b and Zinsstag (2000s) implemented practices for pastoralists in developing countries ^c	Medical professionals (human and animal), microbiologists, geneticists, medical researchers	Collaboration between human and veterinary medical professionals	J: <i>Emerging Topics in Life Sciences</i> , <i>Journal of Veterinary Medical Education</i> , <i>Veterinary Medicine and Medical Journals</i> C: Zoobiquity Symposiums and Conferences, One Medicine Day Seminar S ^d : Zoobiquity (books) and Humanimal Trust (HUB)
One Health	Modern One Health History ^e . While the term 'One Health' arose in the early 2000s, the concept has been around for hundreds of years. The use of the term arose largely in response to infectious disease (SARS, MERS, Ebola) as a transition from One Medicine through the lens of the broader Ecosystem approach to health	Human, animal, plant and environmental health professionals, public health professionals, politicians/ governmental officials and communities, anthropologists, journalists	Collaboration between every sector to promote cross-sectoral and transdisciplinary changes to improve health of humans, animals and ecosystems. Central tenet revolves around the inter connectedness of all systems where an impact or alteration in one system affects all other systems. Incorporates components of food safety, antimicrobial resistance, and environmental contamination	J: <i>One Health</i> , <i>One Health Outlook</i> , <i>Infection Ecology and Epidemiology</i> , <i>Lancet</i> , <i>Frontiers</i> , <i>CABI</i> C: World One Health Congress, WVA/WMA Global Conference on One Health, yearly One Health Symposiums (international) S: One Health Commission; Network of Ecohealth and One Health (NEOH); One Health Initiative, Health in Harmony, International Alliance against Health Risks in Wildlife Trade; continental One Health networks; Nature4Health

Continued

Table 2.1. Continued.

Concept	Historical origin and notable dates	Stakeholders / target audience	Key concepts and tenets	Journals (J), conferences (C), societies (S)
Conservation Medicine	Emerged in the 1990s out of a recognition of the importance of health in conservation problems	Veterinarians and other wildlife health professionals, biologists	The central principle of Conservation Medicine is that the health of animals and humans is connected with the ecosystems in which they live. This fosters an interdisciplinary or transdisciplinary approach	J: No dedicated journal – however, <i>EcoHealth</i> has promoted itself as a Conservation Medicine journal C: Annual Wildlife Disease Association Conference S: No global society exists, although Ecohealth International focuses on common areas; regional societies exist including the Asian Society for Conservation Medicine Conferences and Societies ^f
Comparative Medicine	The legacy for this approach includes Hippocrates, Aristotle, Virchow, Steele and many more	Medical professionals (human and animal), biomedical, biosciences and translational researchers	‘Inclusive crossover discipline’. Understanding of shared / similar physiological and pathological processes (humans and other animals). Fundamentals for medical and translational research (anthropogenic)	J: <i>Comparative Medicine</i> ^a , <i>Clinical and Translational Medicine</i> , <i>Journal of Translational Medicine</i> , <i>Current Research in Translational Medicine</i> , SAGE journals, <i>European Journal of Medical Research</i> C: Combivet, AALAS, Zoo and Wildlife Health Conferences S: The Royal Society of Medicine (UK), Centre for Comparative Medicine (SE, ES), Einstein Center 3R (DE), The 3Rs Collaborative (US, UK)
Ecohealth	The underlying Ecosystems approach to health ^h was established in part by the French Canadian-based International Development Research Centre (IDRC) in the 1990s	Biologists, ecologists, conservationists	The central tenet of Ecohealth is the premise that human and animal health and wellbeing are dependent on that of the environment and cannot be sustained in a resource-depleted, contaminated and socially unstable planet. Ecohealth recognizes the importance of inclusivity, gender and social equity and contributions of holistic and Indigenous views	J: <i>Ecosystem Health</i> ; <i>EcoHealth</i> C: Ecohealth International Biennial Conference series S: Ecohealth International; Ecohealth Alliance; Network of Ecohealth and One Health (NEOH)

Continued

Table 2.1. Continued.

Concept	Historical origin and notable dates	Stakeholders / target audience	Key concepts and tenets	Journals (J), conferences (C), societies (S)
Planetary Health	Concept was first introduced in the 1970s–1980s. Repopularized and publicized in 2015 by the Lancet Commission and the Rockefeller Foundation	(Human) medical professionals	Anthropomorphized view of the impact of and interconnectedness of humans with the Earth at all levels	J: <i>Lancet Planetary Health</i> (Lancet Commission on Planetary Health); <i>Panorama</i> ⁱ C: Annual Planetary Health Conference S: Planetary Health Alliance
One Welfare	This approach emerged in 2015 to promote the links between animal welfare and human wellbeing	Animal welfare scientists and veterinarians / veterinary nurses	One Welfare serves to highlight the interconnections between animal welfare, human wellbeing and the environment. It fosters interdisciplinary collaboration to improve human and animal welfare internationally	J: <i>Animal Welfare</i> ^j C: Variety of conferences related to animal welfare, One Welfare World Conference; UFAW S: One Welfare ^k
Beyond One Ocean Health (B1OH)	The Ocean Decade integrates and recognizes the impacts of environmental change on the health of ecosystems and organisms, with an emphasis on the ocean domain	Oceanographers, economists, science and health professionals, modelling engineers, fisheries and oceanography, coastal and river communities	Oceans Health or Beyond One Ocean Health highlights transdisciplinary actions emphasizing aquatic ecosystems and all interconnected integrated systems and health through sustainable development. It links a healthy ocean with health and equity	J: <i>One Earth, Environmental Justice, EcoHealth, Planetary Health</i> and <i>One Health</i> C: The Ocean Decade Conferences, International Ocean Health Symposium on Emerging Marine Diseases, Regulating Functions and Governance S: Ocean Decade, ECOHA, Oceans Health Associations and Institutions

^a <https://sphweb.bumc.bu.edu/otlt/mph-modules/ph/publichealthhistory/publichealthhistory7.html>^b Schwabe (1964)^c Zinsstag et al. (2011)^d <https://www.zoobiquity.com/> and <https://www.humanimalhub.org.uk/>^e Pettan-Brewer et al. (2024)^f <http://www.ascm.info/> and <https://www.eazwv.org/events/EventDetails.aspx?id=1002188>^g <https://www.scimagojr.com/journalsearch.php?q=21383&tip=sid>^h <https://www.cbd.int/ecosystem/> and <https://www.unep.org/unepmap/what-we-do/ecosystem-approach>ⁱ <https://www.panoramaglobal.org/>^j <https://www.scijournal.org/impact-factor-of-anim-welfare.shtml>^k <https://www.onewelfareworld.org/>

- What does it mean for funding potential vs funding struggles?
- What does it mean for solving problems jointly?
- How can we make connections across these different approaches and communities?

Example answer: ‘What does it mean for funding potential vs funding struggles?’: Planetary Health has substantial funding since its origin because it is focused on human health (anthropocentric). In contrast, One Health initiatives have en-

countered unsustainable funding as the investment return is not so evident for human health (human–animal–plant–environment based), disregarding the long-term gains of this integrated approach.

Example answer: See the Venn diagram in Fig. 2.1. The pros and cons of each domain are shown through the One Health lens.



Learning question: Consider the various integrated health concepts and approaches above. What two stand out to you the most (perhaps the one you most agree with and the one you most disagree with)?

List the pros and cons for each, then create a visual representation of the relationships between considering how each would approach a multisectoral challenge such as increasing incidence of infectious disease in human health related to climate change (consider pandemics, disease transmission, natural disasters), public health and disaster preparedness, or human/animal migrations.

2.4 Future Perspectives and Calls for Convergence

The synergies and partially overlapping agendas between some of the integrated approaches for health have led to **calls for convergence**, for example, in the case of **Ecohealth and One Health**, which we will concentrate on from this point. In this case, the proponents of the convergence share a broad notion of One Health, which is sometimes distinguished from a more focused tradition in One Health (of which both are coexisting) (Stephens and Karesh, 2014; Harrison *et al.*, 2019; Laing *et al.*, 2023). Areas supporting this convergence have been identified as the research around zoonotic disease and emergence, as well as pandemic threats

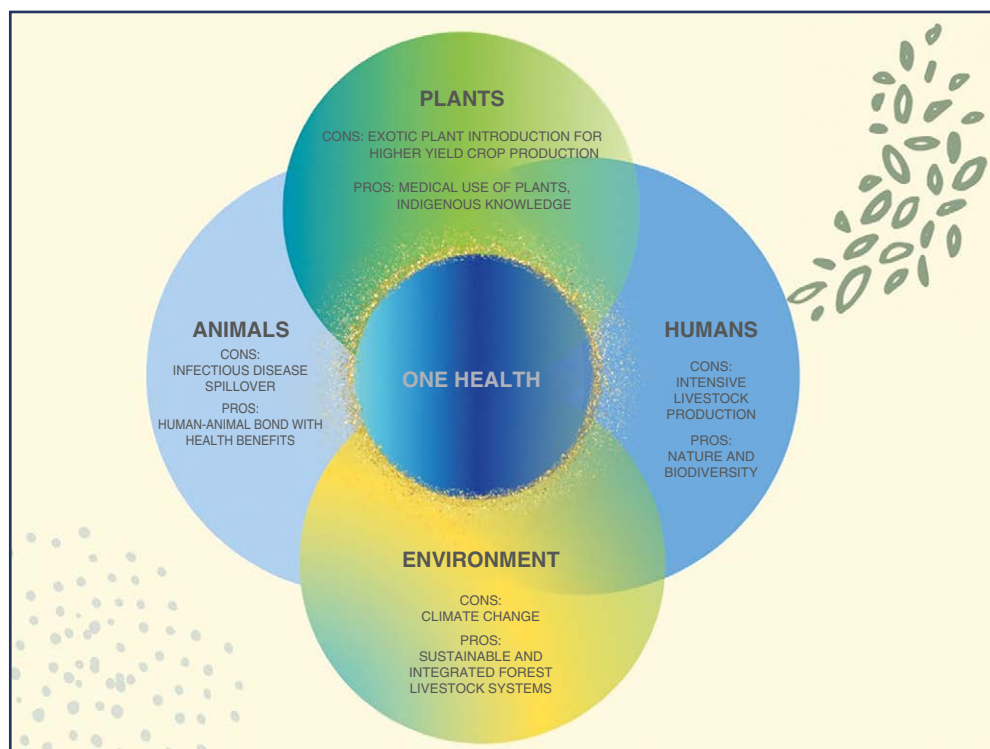


Fig. 2.1. Venn diagram showing the pros and cons relating to plants, animals, humans and environment viewed through the One Health lens.

(Zinsstag, 2012). According to Zinsstag *et al.* (2022), both approaches can benefit from each other's strengths and complementary perspectives. Practical synergies would include joint conferences, integrated health education, curricula development, shared training opportunities, research partnerships and transdisciplinary community involvement as efforts to boost transformative change (Zinsstag *et al.*, 2022).

However, the question is whether the different epistemological heritage as well as the academic disciplines standing behind one versus the other approach can easily be united or reconciled. Some of the epistemological differences between One Health and Ecohealth are related to **ontology** (understanding the categories and relationships that exist within a knowledge domain) and environmental ethics, referring to bearers of health, integrity and value. Thus, taking Ecohealth and One Health as examples, the differences between different integrated approaches to health are related to the background histories and epistemologies and might preclude a full convergence; nevertheless, convergence of practice might be achievable in many cases (Harrison *et al.*, 2019).

The future relies on strengthening the practical initiatives that have previously faced unforeseen challenges, forging non-competitive alliances, operating with transparent communication, trust and **inclusiveness**.

In order to achieve wellbeing for humans, animals and supporting ecosystems, integrated concepts need to be fostered by policy makers and put into practice by societies.



Task: Consider the integrated health approaches described above and the common problem of urban sprawl into natural places. Consider the impact on nature of the urban expansion, increased stress on the environment, encroachment of humans into animal spaces, disease transmission, reduced environmental resources and pollution and how this impacts climate change. Choose two of the above approaches and describe how each would address this problem, listing priorities, possible solutions and challenges faced for each. Finally, indicate the major differences (at least one or two) between these two approaches in addressing this dilemma.

Example answer:

- Extreme weather events related to climate change:

- Planetary Health lens – human deaths, human communities' displacement, increased risk of human diseases (anthropogenic vision)
- Ecohealth lens – Terrestrial environmental destruction, aquatic habitat disruption, animals, humans and plants die off

2.5 Conclusions

This chapter's learning points offer practical applications to better understand and implement integrated approaches to health, especially One Health and Ecohealth. The historical background, individual description of each health perspective and comparative analysis were presented to address complex health challenges at the interfaces of human–animal–plant–environment.

- Emphasize the importance of multisectoral collaboration involving various disciplines such as human health, veterinary medicine, agriculture, environmental sciences and social sciences attending the concepts evolution and key players.
- Encourage breaking down silos between different sectors to achieve a more integrated approach to health management, especially considering the traditional Indigenous knowledge and practices.
- Promote global awareness of health-related integrated approaches, especially among students, through initiatives like One Health Day (and promoting active interplay with associations, foundations, etc.).
- Highlight the need for identifying and prioritizing research gaps as, for example, in zoonoses, emerging infectious diseases, antimicrobial resistance and other multifaceted issues, by shared evidence and knowledge.
- Stress the significance of international collaboration, education and coordination using available technology for controlling outbreaks effectively, promoting a preparedness mindset towards a health continuum of ecosystems, plants, animals and humans.
- Advocate for policy integration across sectors to overcome challenges related to disease control and prevention programmes, from bottom-up and top-to-bottom strategies, and mostly involving community approach to decision making.

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