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Alternatives to Laboratory Animals
2026, Vol. 54(4) 226–235
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Emerging bioethical conflicts: One Health and animal experimentation

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Abstract

One Health initiatives are modern paradigms for research and health care practices in various fields. Concrete definitions of the One Health framework, however, remain heterogeneous, leading to conceptual problems and uncertainties in the application of the framework. This article discusses several approaches to the One Health concept, and their associated consequences, with special focus on animal experimentation. The first issue addressed is how One Health should be defined, as well as what (and who) should be considered within a One Health approach. In order to shed further light on this, we explore the history of animals in biomedical science, highlighting historical milestones in the use of animal models, as well as the development and current state of ethical considerations in the field of animal experimentation. The second issue comes with the inclusion of animal experimentation *per se* as part of the One Health concept. Therefore, particular attention is paid to bioethical principles and the resulting problems that can arise when applying them to the One Health concept. Arguments such as the idea of inequality between humans and non-human animals, and the premise that all actions are done for the benefit of humans, are raised and then used to explore the question of whether the One Health concept is compatible with existing bioethical principles. Based on the bioethical principles of protecting the environment, the biodiversity and biosphere, this paper seeks an inclusive perspective of the One Health concept. Successful solutions will be based on this concept, which embraces all living beings. The authors conclude that a multispecies ethics approach could help create a more ethical ecosystem that is aligned with the wellbeing of all life on a shared planet.

Keywords

3Rs principles, animal experimentation, bioethics, ethics, One Health, Three Rs

Introduction

The 'One Health' concept, which posits a fundamental interconnectedness between the health of humans, animals and ecosystems, represents a critical shift in global health strategy. This integrated approach acknowledges that the threats to human health — from infectious diseases to antimicrobial resistance — are inextricably linked to the wellbeing of animal populations and the stability of the environment.

Biomedical research can be related to animal health and environmental protection, but it is mainly related to human health. Basic biomedical research, translational research, the development of medical devices, surgical techniques and drugs, and toxicological and safety studies are all linked to human health and quality of life. Despite the above-mentioned benefits, there is a strong ethical debate — not only within society but also within the scientific community

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— in relation to the use of animals for research and other scientific purposes. A central bioethical framework for evaluating the proper care and use of animals for research purposes is based on the principles of the Three Rs[1] (i.e. *replacement*, *reduction* and *refinement*). Before using animals in their experiments, researchers must fully investigate whether it is possible to replace such animal use with non-animal methods. Whenever this is not achievable, they must use the minimum number of animals whilst ensuring the quality of the results. Finally, they have to follow the best experimental protocols available, to avoid unnecessary suffering and pain for the animals used, and to optimise their welfare. While the Three Rs principles have not yet been implemented worldwide,[2] in Europe, a second bioethical framework is considered important for the evaluation of animal experimentation — namely, the legally required harm–benefit analysis which assesses the harm inflicted on the animals in relation to the legally legitimate benefits expected to result from the research. The objective of the Three Rs principles is to minimise harm, whereas the goal of the harm–benefit analysis is to assess whether the scientific aims of the experiment are sufficiently important to justify the harm inflicted on the animals. The harm–benefit analysis provides, in principle, stronger protection for animals than the Three Rs principles alone. However, in practice, the human-centric structure of the law means that the interests of animals remain comparatively weak.

An analogous development can be observed within the One Health framework. While the One Health philosophy conceptually and literally places animal and environmental health on the same level as human health, its operational reality often defaults to a human-centred, or anthropocentric, approach. A detailed examination of the One Health paradigm reveals a profound, and often unaddressed, paradox, particularly in relation to the use of animals in biomedical research (see section *Current criticism of the One Health concept: Is it too anthropocentric?*).

The purpose of this article is therefore to investigate whether, in the context of One Health, these bioethical principles governing the use of animals for research purposes relating to humans, animals and the environment, are ensured. Special attention will be given to the moral status of non-human animals within One Health, and the recent criticism that One Health is too human-centred. To address this controversy, we propose an interdisciplinary perspective that embraces biomedicine, philosophy and law under One Health ethics.

The One Health framework

Based on the interdisciplinary One Health High-Level Expert Panel (OHHLEP), established by the Food and Agriculture Organisation of the United Nations (FAO), the World Organisation for Animal Health (WOAH, formerly OIE), the United Nations Environment Programme (UNEP) and the World Health Organisation (WHO) in May 2021, One Health is defined as an integrated, unifying approach that aims to sustainably balance and optimise the health of people, animals and ecosystems (see Figure 1). It recognises that the health of humans, domestic and wild animals, plants

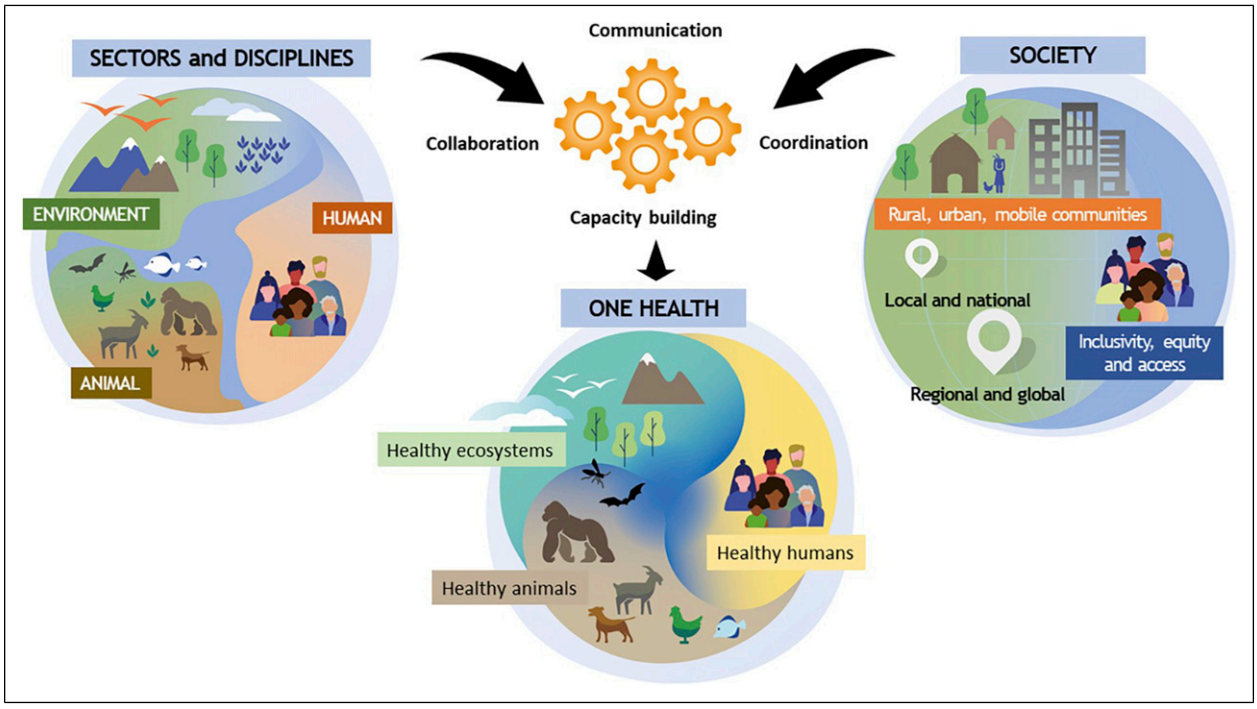


Figure 1. An illustration of the WHO's One Health concept. The WHO's One Health definition,[3] showing the different sectors and disciplines, their interaction and the major goal of One Health.

and the wider environment (including ecosystems) are closely linked and interdependent.[3] A central tenet of this approach is the recognition that the health of humans, domestic animals, wild animals, plants and their shared environment, are fundamentally intertwined and interdependent. This interconnectedness has become increasingly critical in recent years, due to several key global trends.

While the institutionalisation of One Health is a recent phenomenon, the philosophical underpinnings of this concept have existed for centuries. The ancient Jain philosophical idea of *Parasparopagraho Jivanam*, which expresses the interdependence of all life, mirrors the core principles of One Health.[4] Similarly, the term 'One Medicine' was coined in 1964 by veterinarian Calvin Schwabe (1927–2006), to highlight the similarities between human and animal medicine, and stress the importance of collaboration between physicians and veterinarians to solve global health problems.[5] The fact that the core idea of interdependence has been recognised for centuries — yet formal, cross-sectoral policy frameworks are only now being fully developed — points to a significant gap between philosophical recognition and operational reality. This gap is central to our understanding of why the ethical challenges associated with animal research persist, and why they remain so contentious. To bridge this divide, the core idea of interdependence must be fully integrated into policy and practice, not merely acknowledged as a guiding principle.

The One Health approach is championed by a growing number of international and national institutions (see Table 1). The most prominent of these is the Quadripartite Alliance — a partnership among four key international agencies: the FAO, the WHO, the WOAH (formerly OIE) and the UNEP. This alliance, formed in March 2022, signed a memorandum of understanding to strengthen cooperation, and published a One Health Joint Plan of Action to collectively better "prevent, predict, detect, and respond to health threats" (OH JPA, 2022–2026).[14] Other organisations, such as the Pan American Health Organisation (PAHO) and the Centers for Disease Control and Prevention (CDC),[15] have also integrated the One Health approach into their regulatory and operational frameworks to strengthen health security and address issues at the human–animal–environment interface.[16] Moreover, the Australian Centre for Disease Control, the Southeast Asia One Health University Network (SEAOHUN), the Africa Centres for Disease Control and Prevention, and the One Health South African Commission can be exemplified to indicate the global interest in this concept.

The role of animals in biomedical science

The contemporary landscape: Regulatory mandates and research reliance

With regard to the legal status of animal experimentation, three approaches to the use of animals can be distinguished:

(i) Despite efforts in line with the Three Rs principles to implement alternatives and reduce the number of animal experiments, the use of animals in biomedical research remains a critical and legally mandated component of the drug discovery and development process. This reliance is not just a matter of scientific tradition, but is deeply embedded in legal frameworks that were established in response to past public health tragedies. The 1937 sulphanilamide incident, in which a pharmaceutical company marketed an antimicrobial drug that had been prepared using a poisonous solvent, led to public outcry and the passing of the 1938 Federal Food, Drug and Cosmetic Act in the USA. This act legally required the safety testing of new drugs on animals before they could be marketed.[17]

Generally, the prevailing scientific justification for this continued reliance is that animal models provide a crucial, and currently irreplaceable, method for studying biological processes in a complex, whole-organ system. Proponents of animal research argue that animals are biologically and genetically similar to humans, sharing a significant percentage of DNA, and are susceptible to many of the same health problems, including cancer, heart disease and diabetes. Furthermore, their shorter life cycles allow researchers to study diseases of ageing and other long-term processes across multiple generations, which would be impractical in human studies. The scientific necessity and utility mean that, for now, there are currently no alternatives acceptable to regulatory authorities that fully replace animal research. This creates a state of regulatory lock-in where, even as non-animal alternatives advance, the legal mandate for animal data continues to govern the pace of change.[18]

(ii) In addition to experiments that are legally mandated, there is a second group of animal experiments that are largely undertaken as part of basic or applied biomedical research. These experiments must be evaluated, according to legal rules and ethical principles (such as the Three Rs principles and harm–benefit analysis), to determine whether the scientific necessity for undertaking them can be legally and ethically justified by the perceived benefits of doing so.

(iii) A third group of experiments is fundamentally prohibited in the EU and UK by law.[19] These include animal experimentation for cosmetic testing or tobacco testing. The use of great apes is also strictly limited to specific conditions.

The classification of a specific animal experiment into one of these three groups depends on the relevant national and international legal frameworks.

Table 1. An overview of the major global organisations involved in the One Health collaborative effort, highlighting their respective roles and areas of expertise.

Organisation	Role in the One Health framework	Core areas of expertise
Africa Centres for Disease Control and Prevention[6]	Supports public health initiatives of member states and strengthens the capacity of their public health institutions to detect, prevent, control and respond quickly and effectively to disease threats.	Human health, disease control and immunisation.
Australian Centre for Disease Control[7]	Protects Australia from public health threats through disease surveillance, expert analysis and trusted information. Improves the health of all Australians.	Human health, animal health and environmental health.
Food and Agriculture Organisation (FAO)[8]	Focuses on food security and sustainable agricultural systems by improving animal production and veterinary services. Works to address antimicrobial resistance and food safety.	Food security, animal production, veterinary services and antimicrobial resistance.
South African One Health Programme[9]	Educates and creates networks to improve health outcomes and the wellbeing of humans, animals and plants, and to promote environmental resilience through a collaborative, global One Health approach.	Public health, environmental and plant health.
Southeast Asia One Health University Network (SEAOHUN)[10]	Promotes and facilitates collaborative activities and projects among the countries with an emphasis on improving One Health workforce capacity with cross-sectoral competencies to effectively prevent, detect and respond to all hazards and emerging threats.	Public health and infectious diseases.
UN Environment Programme (UNEP)[11]	Addresses the environmental determinants of health, including climate change, pollution and threats to ecosystems.	Environmental contamination, climate change, biodiversity protection and ecosystem health.
World Health Organisation (WHO)[12]	Leads the global health response, focusing on human public health, disease surveillance and epidemic intelligence.	Public health, disease control, antimicrobial resistance, food safety and global health security.
World Organisation for Animal Health (WOAH)[13]	Protects and advances the health and welfare of all animals. Builds global surveillance systems for disease threats and conducts research to advance animal health.	Animal health and welfare, zoonotic disease surveillance and food safety of animal origin.

The spectrum of use: From rodents to primates and beyond

The animals used in research are not a monolithic group. According to the most recent EU statistics, the majority of biomedical research (between 95% and 99%) is conducted on mice, fish and rats.[20] Mice and rats are favoured due to their genetic and biological similarities to humans, as well as their rapid reproduction and small size, which make them ideal for genetic engineering and large-scale studies.[21] The genetic engineering of numerous mouse genotypes has generated mutant models that mimic key aspects of human diseases.[22,23]

While rodents dominate, other species, such as cattle, sheep, pigs, dogs, cats and horses, are used for specific research purposes. Rabbits, for instance, are valuable in studies of vision, orthopaedics and cardiology, while the use of guinea pigs has contributed notably to immunology, vaccine and infectious disease research.[21] Larger animal models, such as pigs or sheep, provide unique opportunities for research that requires more complex physiological systems.[24,25] Dogs are used in cardiology and endocrinology studies, as well as for the development of surgical techniques, and swine are used as models in cardiovascular research and for xenotransplantation.[21] Non-human primates, although accounting for less than 1% of all animals used in research, remain critical for studies of vision, neurosciences, infectious diseases and vaccine safety testing. Other species, including zebrafish, amphibians (*Xenopus*) and various birds, are also utilised to study development, genetics and disease processes.[26] This spectrum of use underscores the diversity of animal models, and the specific biological and systemic insights that they are believed to provide.

One Health and the role(s) of animal experimentation

According to the WHO, the One Health approach "recognizes that the health of humans is closely linked and interdependent with the health of domestic and wild animals, as well as plants and the wider environment (including ecosystems), aiming for a sustainable balance, and

uses an integrated multisectoral and transdisciplinary approach to pandemic prevention preparedness and response, which contributes to sustainable development in an equitable manner".[27] This concept recognises the interconnection between human health, animal health, and the health of our shared environment. It emphasises the need for collaborative, multi-sectoral and transdisciplinary efforts at local, regional, national and global levels, to address challenges such as zoonotic diseases, antimicrobial resistance, food safety and climate change.

Animal experimentation plays a critical role in the One Health approach, as it may help to bridge the understanding of health dynamics across humans, animals and ecosystems. Animal experimentation bridges the One Health triad by enabling controlled studies of disease transmission, immune responses and environmental interactions, across humans, animals and ecosystems. For example, it helps elucidate zoonotic pathogen spill-over from wildlife, informing integrated prevention strategies. This animal-based research is considered by many to be essential for studying diseases, developing medical treatments, and ensuring the wellbeing of both humans and animals, while protecting environmental health.[28]

Proponents of animal-based science highlight historical examples of its role in developing lifesaving treatments, vaccines and medical technologies that continue to improve human health. In contrast, critics question the scientific validity and epistemic value of the animal model itself; they emphasise the poor scientific validity and limited reproducibility of biomedical research,[29] as well as methodological and epistemological challenges such as conflicts between internal and external validity[30] or the bias resulting from selective reporting, including the non-publication of negative or inconclusive results. Moreover, it has been shown that most animal-based studies are neither published in leading journals nor cited subsequently, suggesting that many such studies have had little to no scientific impact.[31] How the rationale behind the selective emphasis on positive rather than negative results should be understood and subsequently addressed, is a matter of ongoing debate within the philosophy of science.[32]

While alternatives are being developed, animal models will remain essential in some areas until fully reliable replacements are available. Also, advanced alternatives — such as organs-on-chips (i.e. advanced *in vitro* models), *in silico* methods and stem cell technologies — are constantly emerging, with the potential to complement and replace some animal-based methods and models. Recent progress in advanced *in vitro* models, particularly those incorporating biomimetic cell culture techniques, are transforming preclinical research by offering more physiologically relevant alternatives to traditional animal models.[33] These systems aim to closely replicate the structure, function and microenvironment of human tissues, thereby improving the accuracy of experimental outcomes. The most advanced of them are the organ-on-chip systems, which use microfluidics and 3D cell cultures to simulate the mechanical and biochemical behaviours of real organs (such as the heart, brain, liver, etc.), and can offer highly controlled and human-relevant environments for testing drug efficacy and toxicity.[34] *In silico* methods, including computer modelling and AI-driven simulations, provide powerful tools for predicting biological responses, streamlining early-stage drug discovery and reducing the need for preliminary animal testing.[35] Meanwhile, stem cell technologies, particularly the use of induced pluripotent stem cells (iPSCs), enables the creation of patient-specific cell lines for disease modelling and personalised medicine.[36] These approaches not only aim to complement existing animal models, but also to address ethical concerns and improve translational relevance to human biology. While animal studies still play a crucial role, these innovative alternatives are paving the way for more ethical, efficient and precise scientific research.[37]

Bioethical conflicts regarding animal experiments and their interconnection with the One Health concept

The relevant principles of bioethics

The controversial issue of using animals as living beings in biomedical research requires an ethical perspective and insight, in order to help resolve the ensuing conflicts through consideration of bioethical principles. In addition to its initial focus on ethical issues relevant to clinical care, bioethics is also concerned with the moral, legal, political and social issues raised by medicine, biomedical research and life sciences technologies.[38] Furthermore, bioethics has recently been called to engage value issues concerning all species on earth and encompassing the health of the planet, by placing particular emphasis on One Health.[39]

In addition to the principles of bioethics put forward by Beauchamp and Childress in 2019[40] — namely, beneficence, non-maleficence, justice and autonomy (Figure 2) — UNESCO's 2005 *Universal Declaration on Bioethics and Human Rights*[41] also includes the bioethical principles of justice and fairness, social responsibility and health, sharing of benefits, protecting future generations, and protection of the environment, the biosphere and biodiversity. Such bioethical principles can guide discussions on the reasoning behind the use of animals in experiments.[42] Disregarding these bioethical principles will result in the failure to give due respect to animal welfare.

The bioethicist Benjamin Capps considers One Health to be an egalitarian biomedical approach, a social movement, and an interdisciplinary effort to improve the wellbeing of humans, animals and the environment. One Health includes the following areas: management of zoonoses, environmental toxicants, health and disease at the human–animal–environment

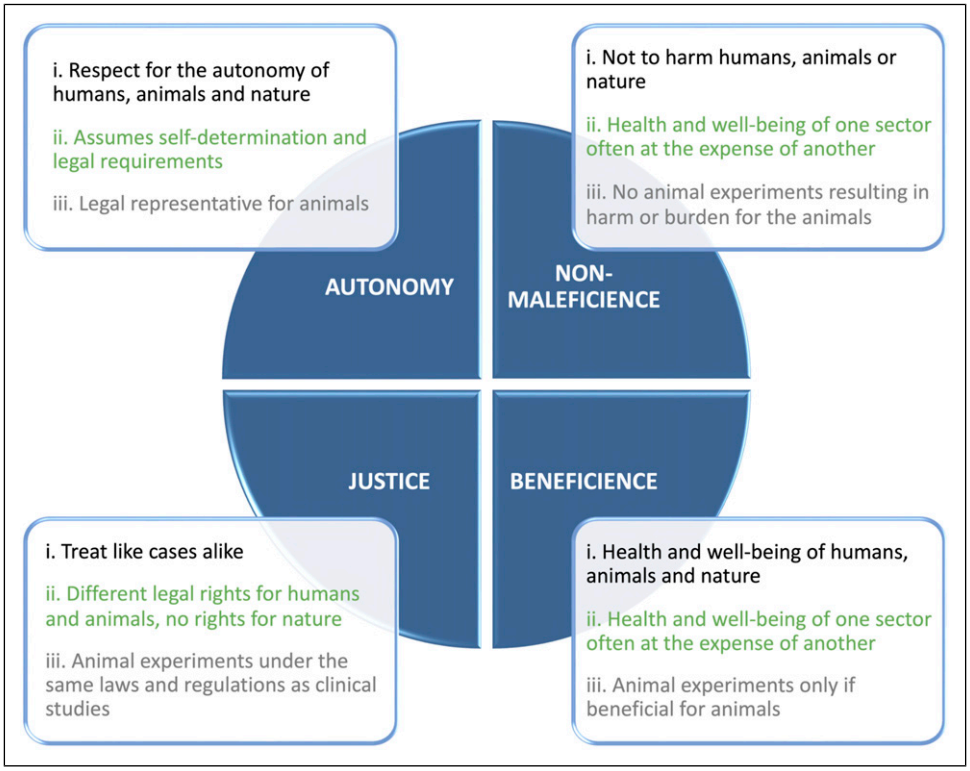


Figure 2. The translation of bioethical principles proposed within a human-relevant context, to the concept of One Health. The diagram shows: (i) translation of the four bioethical principles proposed by Beauchamp and Childress in a human-relevant context,[32] to the concept of One Health (in black); (ii) the consequences of this translation (in green); and (iii) its impact on animal experimentation (in grey).

interface (such as the effects of climate change on human and animal health), comparative medicine, food safety and security, and animal-assisted therapy.[43]

In contrast, according to Lindenmayer et al.,[44] One Health firstly recognises the interdependence of health and wellbeing among people, animals and nature; secondly, it incorporates physiological, mental, emotional and social wellbeing (regardless of the species), as well as the physical systems and ecological integrity of nature; thirdly, it strives to achieve optimal health simultaneously for humans, other animals and nature, and accommodates trade-offs that may not privilege only humans; and lastly, it acknowledges scientific uncertainty and our limited understanding of a complex and constantly changing world.[44]

Lederman et al.[45] builds the link between One Health and bioethics. They draw attention to the fact that One Health is on the agenda of many governments and international health organisations. It has been recognised by a diverse range of scholars — for example, natural scientists, social scientists, ecologists, public health experts and ethicists — as an interdisciplinary effort to improve the lives of humans, animals and the environment in public health, clinical medicine and bioethics.[45]

Additionally, Capps interprets One Health as a theory of equality that connects culture to nature, and as a separate, but coextensive, approach to that of public health.[46] He relies on the assumption that "optimal health" is a matter for human beings, despite other plausible interests at the environmental nexus.[46] Capps[46] and Johnson et al.[47] argue that One Health ethics also allude to interconnections or interdependencies between species, and shared interests in the places in which they live. Capps qualifies One Health ethics as a more inclusive concept of justice that combines the interests of non-human animals and the environment with those of human health.[46] Thus, the relevant bioethical principles of protecting the environment, biodiversity and biosphere help us to comprehend the interconnected and interdependent features of the One Health concept, and to justify the significance of the human–animal–nature interaction.

The interconnection between bioethical principles and One Health

To consider the inclusive character of bioethics regarding the use of animals in experiments, and for connecting it to the One Health concept, it is worthwhile delving into several philosophical theories.

In his groundbreaking book, *Animal Liberation Now*,[48] Peter Singer explored research using animals from a consequentialist and utilitarian approach. A consequentialist approach would be in harmony with the One Health

concept, as it aims to be beneficial to people, animals and the environment whereas, in utilitarianism, only sentient animals are given moral consideration and the environment is taken into account only indirectly. Furthermore, Singer put forward the concept of an animal liberation movement, arguing that sentient animals should be considered from a moral perspective because of their ability to experience suffering.[48] This book also made the term 'speciesism' popular, which is a highly controversial approach today because it puts the beneficence of humans over all other living beings on earth. Singer also argued that animal rights are not the same as human rights, and that equal consideration does not lead to equal treatment. This means that the interests of humans and other animals in the relief of physical pain must be considered equally, but the interests between humans and other animals can vary. In the 2023 edition of his work, Singer called for a radical change in the way in which we treat animals.[49]

Pollo and Vitale[50] explore the issue from a virtue ethics and consequentialist point of view, adopting an anti-speciesism standpoint with regard to the ethics of animal experiments. They propose that the use of animals in research can be justified according to its importance in terms of benefit to science and advancement of civilisation. They emphasise the need for a harm–benefit analysis in basic, translational and regulatory research on a case-by-case scenario, minimising harm to the animals used.[50]

On the other hand, Camenzind[51] adopts a Kantian critique to animal experiments. He argues that the assumption that animals are simply on earth to serve humans is scientifically and ethically wrong: Neither the argument of reciprocity, nor the fact that humans are morally autonomous beings, support the claim that animals are "means and instruments" for human ends. On the contrary, because animals are part of the moral community, the prohibition of instrumentalisation applies to them too.[51]

From a bioethical perspective, to avoid or minimise the risk to animal subjects, research conducted on animals must conform not only to generally accepted scientific rules, but also to universally adopted bioethical principles.[52] The One Health concept represents a balanced middle ground, which revisits the Three Rs principles, that can form part of a bioethical approach to analysing the conflict between generating benefits to humans and avoiding harm to animals, with consideration also given to the need for scientific advancement.

With regard to rethinking the Three Rs principles, in order not to use animals redundantly, Lauwereyns[53] highlights the importance of 'open science' — for example, data sharing, the broad dissemination of methods, workflows and publications, and the establishment of outreach programmes. He advises adhering to 'Big Science', in the sense of producing fully-fledged and well-designed research projects that demonstrate the responsible conduct of research and the role of animal ethics committees. Giving greater ethical consideration to scientific activities involving animals and raising awareness within the scientific community of this consideration, will play a significant role in increasing awareness of the need to give due care and respect to laboratory animals.[53] This can be achieved by, for example, highlighting the role of ethics when drafting scientific publications and research proposals, and whilst participating in collegiate and societal discussions. While recognising the significance of the Three Rs principles in the context of animal experiments, Lauwereyns et al.[54] propose ways to embrace them in order to achieve better science, advance scientific knowledge and care for the animals used in the best way possible.

On the other hand, Lindenmayer et al.[44] claim that integrating ethical considerations and debate into every aspect of One Health will support a multispecies understanding of the term, and move us forward by building a common point of departure for dialogue, deliberation and decisions inherent in One Health. This recent discussion strives to relate ethics and One Health, and dwells on the bioethical principles for protection of the environment, the biosphere and biodiversity[41,55] that require due regard for the interconnection and interdependence of all living beings — thus assuring sustainability of life on earth.

Therefore, the conventional Three Rs framework in animal research can be reconceptualised to balance the reduction of unnecessary harm with the promotion of benefits for all living beings, advancing an inclusive, pluralistic and responsible approach to research that supports the long-term sustainability of nature and is guided by the One Health and One Medicine approaches.

Current criticism of the One Health concept: Is it too anthropocentric?

Even though the WHO's One Health definition encompasses the health of humans, animals, plants and the broader environment (including ecosystems), and emphasises the interdependence of these stakeholders, it has been criticised for being anthropocentric, or overly anthropocentric. According to this critique, animals and the environment are considered primarily for instrumental or pragmatic/strategic reasons, rather than for their intrinsic value.[56]

The One Health Joint Plan of Action, while aiming to integrate human, animal and environmental health, remains heavily skewed toward human-centric outcomes.[57] For instance, its stated goals — ranging from the containment of zoonotic epidemics to addressing antimicrobial resistance — are predominantly framed around their impact on human populations. Moreover, animal health is often discussed not as a value itself, but rather in terms of its utility to human health. The WHO, a key player in this framework, has tolerated or supported practices such as intensive livestock farming and the global animal trade, where systemic violations of animals' bodily integrity, are routine. The

violation of bodily integrity means to physically interfere with, alter, or damage the body of an animal. In zoonotic outbreak control, the culling of animals is commonly preferred over treatment or ethical alternatives, further underscoring this instrumental view.[45]

The critique of the One Health approach as being anthropocentric raises several intriguing philosophical and scientific questions. Moreover, the broad anthropocentrism in One Health raises ethical concerns. For example, critics argue that One Health's anthropocentric focus undermines ethical considerations for animals and the environment. This focus risks perpetuating exploitative practices rather than fostering a truly balanced approach. Also, the use of animals in research and surveillance for human benefit is sometimes viewed as exploitative, particularly when it does not directly benefit the animals involved.[58] The anthropocentric critique of One Health highlights the need for greater balance in addressing the health of humans, animals and ecosystems.[59] While human health often takes precedence, a more eco-centric and inclusive approach can ensure that One Health fulfils its promise of optimising health across all domains, not just for humans. This shift will require the rethinking of priorities, governance and ethical frameworks, to reflect the interconnectedness of all life forms. This approach may present a key to being better equipped to solve global health problems in an ethically and scientifically sound and sustainable manner.[60]

Conclusions

The ethical conflict of using animals in biomedical research is not a simple, binary problem with an easy solution. It is a profound, systemic challenge that posits at the intersection of a legacy of scientific discovery, complex ethical frameworks, and an evolving understanding of the interconnectedness of all life. The One Health paradigm, with its call for an integrated and collaborative approach, offers the most robust framework for addressing these conflicts. Although a purely egalitarian One Health approach would mean that animal experimentation is morally wrong, it can guide the conversation beyond the traditional pro/con debate and toward an inclusive future where consideration of the Three Rs, together with a harm–benefit assessment, are not merely a compliance checkbox, but a dynamic, innovation-driven goal that leads to a more humane science that also satisfies the principles of bioethics (i.e. protecting the environment, the biosphere and biodiversity on earth). The authors propose that, by embracing a multispecies-focused ethical approach, promoting rigorous scientific standards and investing in non-animal alternatives, the global health community could potentially create a research ecosystem that is more ethical, more effective and more aligned with the wellbeing of all life on a shared planet, to protect human health, animal welfare and environmental sustainability.

Acknowledgements

This publication is based upon work from the Ethics Crossover Group within the COST Action IMPROVE ('3Rs Concepts to improve the quality of biomedical science'), CA21139, supported by COST (European Cooperation in Science and Technology).

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Ethical considerations

As this study does not include human participants, human material or animals, no ethics approval was required.

Informed consent

Informed consent was not required.

Funding

The authors received no financial support for the research, authorship, and/or publication of this article.

Declaration of conflicting interests

The authors declare no conflict of interest with respect to the research, authorship, and/or publication of this article.

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