COHESA
Capacitating One Health in Eastern and Southern Africa

Mainstreaming One Health approaches and principles into research in Ethiopia: Guidelines, frameworks and ethical procedures

Birhanu, Hadush[1], Argaw Ambalu[2,3], Balako, Gumi[2], Yordanos, Tadesse[2], Siobhan, Mor[3,5], Florence, Mutua[4], Shauna Richards[4], Mirgissa Kaba[2]

[1] College of Veterinary Sciences., Mekelle University, Ethiopia
[2] Addis Ababa University
[3] Ethiopian Environmental Health Professionals Association
[1] International Livestock Research Institute
[5] University of Liverpool

July 2024

ILRI INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE CGIAR ISAAA AfriCenter cirad OACPS R&I

Citation: Birhanu H., Ambelu, A., Gumi, B., Tadesse, Y., Siobhan Mor, S., Mutua, F., Richard, S. and Kaba, M. 2024. Mainstreaming One Health Approaches and Principles into Research in Ethiopia: Guidelines, Framework and Ethical Procedures. Addis Ababa, Ethiopia.

Cover photo: Members of the Technical Working Group participate in the development of guidelines under the COHESA initiative (Photo Credit: COHESA/Fistum Limeneh)

Contents

Figures

Tables

Acknowledgement and disclaimer

Financial and technical support for the development of this document was provided by 'Capacitating One Health in Eastern and Southern Africa' (COHESA) project, which is co-funded by the Organisation of African, Caribbean and Pacific States (OACPS) Research and Innovation Program, which is funded by the European Union.

The contents of this publication are the sole responsibility of the authors and do not necessarily reflect the view of the European Union.

Preamble

One Health is a collaborative, multisectoral and transdisciplinary approach that recognizes the interdependence of humans, animals, plants and their shared environment, with the goal of enhancing health outcomes at the local and global levels. The Capacitating One Health in Eastern and Southern Africa (COHESA) project aims to empower research and academic institutions to nurture the next generation of One Health researchers by creating tailored tools adaptable to local contexts. In Ethiopia, this includes development of One Health research guidelines to provide a structured framework for conducting research, emphasizing the integration of different disciplines to tackle health challenges at the intersection of the human, animal and ecological realms.

The need for these guidelines arose from discussions among national One Health stakeholders on integration of One Health into education and research. Following the discussion, a technical working group was established to guide the integration process. With guidance and technical contributions from the COHESA project lead in Ethiopia (Addis Ababa University), the sub-team engaged other research experts and individuals within institutions to draft guidelines that facilitate consideration of One Health principles in research undertakings.

This document, which was reviewed at different levels, presents three interrelated pieces: a) the basics of One Health research etiquette, b) a framework for One Health research criteria and c) One Health research ethics. These serve as a crucial entry point for strengthening locally led One Health research in Ethiopia. The documents serves as a foundational resource for integrating One Health research into academic and research institutions across Ethiopia and can be adopted by relevant ministries, One Health institutions, national and international projects, as well as academic and research entities within the country. The document is intended to guide researchers and research authorities including Institutional Review Boards (IRBs) to align research endeavors with One Health paradigms for comprehensive understanding of problems and seeking of holistic solutions.

Although initially tailored for Ethiopia, this tool can be adapted for use in other countries where the COHESA project operates and beyond, promoting the global advancement of One Health principles.

1 One Health research guideline

1.1 Introduction

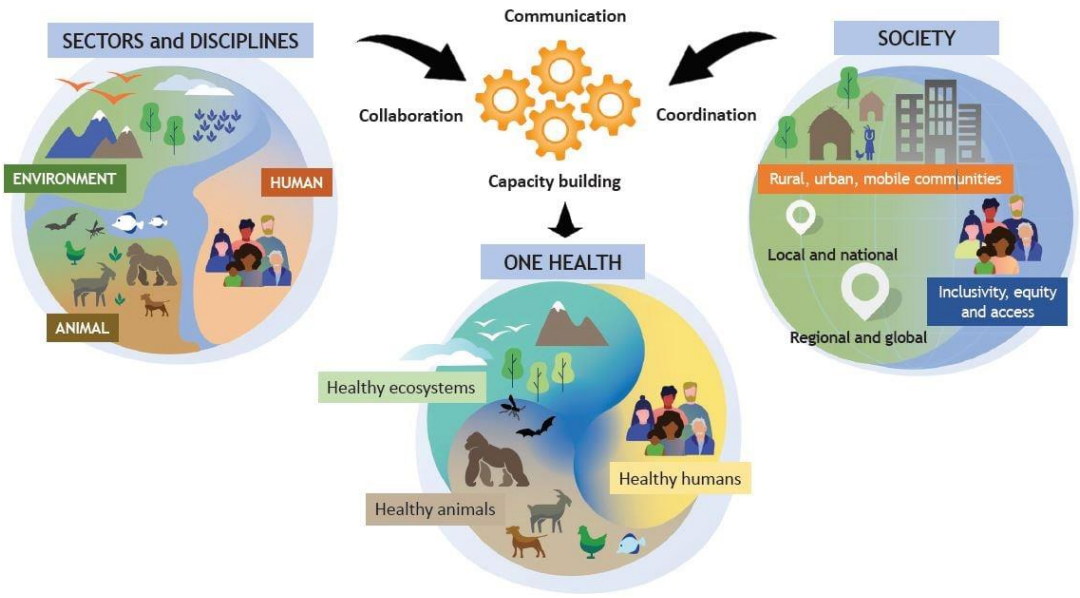
One Health is a collaborative, multisectoral and transdisciplinary approach recognizing the interconnectedness of people, animals, plants and their shared environment as shown in Figure 1 (Mettenleiter et al. 2023). One Health aims to optimize health outcomes across local, regional, national and global levels. In recent years, the significance of the One Health approach has intensified following the recognition that approximately 60% of human diseases are shared with animals and three quarters of emerging human infections are zoonotic (Karesh et al., 2012).

Factors such as population growth, climate change and urbanization have reshaped interactions between people, animals, plants and the environment. The expansion of human populations into new geographic areas, closer interaction between wild and domestic animals, climate change and the rise of drug-resistant microbes, underscore the necessity of the One Health approach (Hernando-Amado et al., 2019). One Health can also help tackle the rapid spread of diseases across borders and continents that has been facilitated by the increased movement of people, animals and animal products through international travel and trade. By embracing the One Health approach, better health outcomes for humans and animals can be achieved while safeguarding the environment. One Health research is a key aspect of this approach.

Worldwide, One Health research has generally been dominated by investigations into zoonoses; limited thematic and disciplinary attention has been given to environmental themes and social science insights (Humboldt-Dachroeden et al. 2020). Although food safety and antimicrobial resistance (AMR)-related research within the One Health frame has advanced in many countries, these themes remain the areas of focus in Ethiopia despite the growing relevance of environmental and social sciences aspects in One Health. Research undertakings in Ethiopia and elsewhere promote and perhaps maintain silos in the disciplines of human and veterinary medicine and environmental science. These guidelines aim to provide approaches that can strengthen disciplinary and sectoral collaboration and knowledge sharing for not only more comprehensive understanding of the problem but also for designing and implementing One Health research solutions What is One Health?

The One Health High-Level Expert Panel (OHHLEP) defines One Health as 'an integrated, unifying approach that aims to sustainably balance and optimize the health of people, animals and ecosystems.' It recognizes that the health of humans, domestic and wild animals, plants and the wider environment (including ecosystems) are closely linked and interdependent. The approach mobilizes multiple sectors, disciplines and communities at varying levels of society to work together to foster well-being and tackle threats to health and ecosystems while addressing the collective need for clean water, energy and air, safe and nutritious.

Figure 1: Definition of One Health



Sourced from The One Health High-Level Expert Panel (OHHLEP).

1.2 Importance of One Health

The One Health concept is vital because it addresses the complex and interrelated health challenges our world faces. With the increase in global travel, urbanization and environmental changes, zoonotic diseases and conditions such as antimicrobial resistance and food safety can quickly spread among humans, animals and ecosystems, leading to new and potentially devastating health threats. The One Health approach helps to prevent, detect and respond to these health threats more effectively by considering all the factors involved. This approach leads to better health for people, animals and the environment, mitigates the impact of diseases and contributes to sustainable development.

The One Health approach plays an important role in the following areas:

1. **Disease control**: Many infectious diseases can be transmitted between animals and humans (zoonoses), highlighting the need for holistic approaches to disease control that consider both animal and human health.
2. **Environmental conservation**: Human related activities, such as deforestation and pollution, can impact both animal and human health. By considering environmental factors, the One Health approach promotes sustainable practices that benefit all species.
3. **Antimicrobial resistance**: The misuse of antibiotics in both human medicine and animal agriculture contributes to the emergence of antimicrobial resistance. One Health initiatives address this global health threat by promoting responsible antibiotic use in humans, animals and the environment.
4. **Emerging infectious diseases**: Rapid urbanization, globalization and climate change contribute to the emergence of new infectious diseases. One Health approaches facilitate early detection, surveillance and response to such emerging threats.
5. **Climate change and health**: Climate change affects the spread of diseases and the health of ecosystems. Integrating climate science into the One Health approach allows for a better understanding of how changing weather patterns influence zoonotic disease

dynamics and environmental health, leading to more effective adaptation and mitigation strategies.

6. **Food safety**: Ensuring food safety involves managing risks from farm to table. One Health approaches recognize the interconnections between the health of soil, plants, animals and people, addressing factors like pesticide use, microbial contamination and food handling practices to prevent foodborne illnesses and promote public health.

2. The One Health research process

The One Health Research process follows the same planning process as a standard research protocol but necessitates consideration of disciplinary and non-disciplinary stakeholders to define problems and pathways jointly (Lebov et al. 2017). This process involves the following key considerations to ensure comprehensive and effective research outcomes:

1. **Collaboration and partnerships**: Identify potential collaborators and partners from diverse disciplines to enhance research.
2. **Defining the problem:** One Health recognizes that any problem has multiple facets. Each facet could be better understood with different perspectives and tools. Bringing different perspectives and tools together is believed to enable a more holistic understanding of the problem.
3. **Defining the research questions**: Clearly define research questions that benefit from multidisciplinary lenses (humans, animals and the environment) and sectors including the community.
4. **Conducting literature review**: a comprehensive review of literature helps to understand existing knowledge and gaps related to the One Health research topic.
5. **Determining the study design**: an appropriate study design should consider interactions between humans, animals and the environment and the likely need to collect data from each domain.
6. **Identifying and selecting study participants**: determine study participants and develop appropriate sampling methods considering accessibility, feasibility and ethical considerations when accessing human and animal populations.
7. **Data collection methods**: choose suitable data collection methods capturing data from multiple disciplines, populations and stakeholders involved in the One Health issue.
8. **Ethical considerations**: address ethical considerations concerning human subjects, animal welfare and impact on the environment.
9. **Data analysis**: plan for data analysis considering the interdisciplinary nature of the data generated from multiple sources.
10. **Interpretation and integration of findings**: interpret and integrate research findings, exploring implications for policy development, intervention strategies and future research directions.
11. **Dissemination and knowledge translation**: develop a plan to disseminate research findings to relevant stakeholders and communities.

2.1 One Health research etiquette

One Health research etiquette encompasses the framework and guidelines established by governments, institutions and organizations to promote and support research activities aligned with the One Health approach. It encourages interdisciplinary collaboration, fosters data sharing and directs research efforts towards addressing health challenges at the human-animal-environment interface. Engaging in One Health research requires adherence to specific etiquette and best practices to ensure effective collaboration, respect for diverse disciplines and ethical conduct (Bhatia, 2019). Critical aspects of One Health research etiquette are:

Respect and recognize disciplinary expertise

One Health research necessitates collaboration among professionals from diverse backgrounds, including human medicine, veterinary and environmental science, epidemiology and social sciences. Respect and value for specific expertise, perspectives and recognition of respective unique contributions to the research and subsequent development implication is key (Humboldt-Dachroeden et al. 2020). Although disciplinary relevance remains important, recognition of the value of interface between and among disciplines is critical in addressing problems in a wholistic frame.

Open and constructive communication

Effective communication is fundamental in One Health research. It fosters an environment of open and respectful dialogue where all team members feel empowered to express ideas and concerns. Practicing active listening and encouraging constructive discussions enhances collaboration and mutual understanding among team members (Buschhardt et al. 2021; AFROHUN 2019).

Collaborative decision-making

Collaborative decision-making is essential in One Health research. It is crucial to involve all relevant stakeholders—including local communities, experts and policymakers—in One Health decision-making processes. By considering diverse expertise and viewpoints, you can cultivate a collaborative atmosphere that prioritizes consensus-building and shared decision-making. This approach fosters ownership and commitment to the outcomes of the research, ensuring that strategies are comprehensive and effectively address the interconnected health challenges of humans, animals and environments (Concannon et al. 2019).

Data sharing and transparency

Emphasize the importance of data sharing and transparency within the research team. Ensure all team members have access to relevant data, methodologies and findings. Promote transparent and ethical data collection, analyses and reporting practices, adhering to data-sharing agreements and protocols. Any restrictions in data sharing, such as sensitive data, should be clearly explained and discussed (Donaldson and Koepke 2022).

Ethical conduct

Uphold the highest standards of ethical conduct in One Health research. Adhere to applicable ethical guidelines, regulations and institutional policies governing research involving humans, animals and the environment. Obtain appropriate ethical approvals for research protocols and prioritize the welfare and rights of research participants, including humans and animals (WHO 2012).

Acknowledgment and attribution

Recognize and acknowledge the contributions of all team members and collaborators throughout the research process. Appropriately attribute intellectual contributions, including authorship, in research outputs such as publications and presentations. Give credit to individuals for their specific inputs in processes and expertise.

Cultural sensitivity

One Health research often entails collaboration with diverse communities and cultures. Be culturally sensitive and respectful of local customs, practices and beliefs when conducting research. Engage with communities inclusively and respectfully, ensuring their meaningful participation and involvement in all stages of the research process.

Long-term collaboration and capacity building

One Health research frequently forms part of long-term projects or initiatives. Foster sustainable collaborations and partnerships that extend beyond individual research endeavours. Invest in capacity-building efforts to enhance the skills and knowledge of researchers, practitioners and stakeholders involved in One Health research.

Dissemination and knowledge sharing

Share research findings, outcomes and lessons learned with relevant stakeholders, including the scientific community, policymakers and the public. Disseminate research outputs through appropriate channels, such as peer-reviewed publications, conferences, workshops and community engagement. Promote knowledge sharing and translation of research findings into actionable recommendations and interventions.

Continuous learning and adaptation

One Health research is dynamic and evolving. Foster a culture of continuous learning and stay abreast of the latest research, advancements and best practices. Be receptive to new ideas and emerging evidence and adapt research approaches effectively to address complex health challenges (Lebov et al. 2017).

Recognition and support of funders

One Health research policy underscores the interconnectedness of human, animal and environmental health, and emphasizes collaborative research efforts. Governments and funding agencies provide support, resources and research grants dedicated explicitly to One Health initiatives.

Prioritizing the One Health research agenda

Prioritizing the One Health research (OHR) agenda involves discerning and addressing critical health challenges at the human-animal-environment interface. The following steps facilitate the prioritization of the OHR agenda (WHO 2023):

Identify key health challenges

Conduct a comprehensive assessment of health challenges at the human-animal-environment interface. Consider factors such as disease burden, emerging infectious diseases, zoonotic diseases, food safety, antimicrobial resistance, environmental degradation and pollution and climate change impacts. Consult existing literature, reports and expert opinions to identify priority areas.

Stakeholders engagement

Engage stakeholders from various sectors including academia, government agencies, healthcare providers, veterinarians, environmental organizations and communities. Seek their perspectives on pressing health issues and potential research priorities. Collaborate with stakeholders to align research with their needs and priorities.

Data analysis and gap identification

Analyze existing data on health risks, disease prevalence and impacts on humans, animals and ecosystems. Identify knowledge gaps and areas requiring further research. Review previous studies to pinpoint areas needing investigation.

Risk assessment and decision-making

Conduct risk assessments to evaluate the potential impacts of health challenges on human, animal and environmental health. Prioritize research areas with the highest potential for significant impact as requiring urgent attention.

Collaboration and resource allocation

Foster collaboration among researchers, institutions and funding agencies to pool resources and expertise. Identify opportunities for joint research initiatives and interdisciplinary collaborations. Allocate resources to support priority research areas, including funding, infrastructure and capacity-building activities.

Policy relevance and impact

Prioritize research areas that can inform evidence-based policies, interventions and practices. Ensure research outcomes are actionable and can translate effectively into policy and practice through engaging policymakers, communicating research findings effectively and advocating for policy change based on evidence generated through One Health research.

Long-term sustainability

Prioritize research areas with long-lasting impact and potential to be targeted as development agenda, existing health systems, policies and practices. How would the research outcome contribute to solving community level problems in the long term with full ownership of the community itself.

Tracking the research process

Establish mechanisms for tracking the research activities, challenges and measures to address the problems encountered during the process. Develop indicators that help to assess progress and extent of research outcomes in addressing the research questions. Identify the roles played by different stakeholders including the community in the research process and for its outcome.

Adaptation and flexibility

Recognize that research priorities may evolve due to changing health challenges, emerging issues and new scientific discoveries. Maintain flexibility in the research agenda and adapt to emerging needs and opportunities.

Communication and advocacy

Communicate research priorities and findings to raise awareness and advocate for their importance. Engage with policymakers, practitioners and communities to create a shared understanding of the research agenda and its significance for human, animal and environmental health.

2.2 One Health research areas

The list of research areas below is provided to guide institutions in prioritizing topics that require One Health approaches to garner a holistic understanding (Osterhaus et al. 2020). While these topics can be addressed through individual disciplinary research, what truly defines One Health research is its foundation in collaboration across disciplines. Therefore, the emphasis in One Health research should not just be on the individual disciplines but on collaborative, multisectoral and transdisciplinary approaches. These integrative methods are essential for addressing the complex interconnections between human, animal and environmental health, ensuring that solutions are comprehensive and effective.

1. Zoonotic diseases: investigating using disease surveillance transmission dynamics, emergence and control of diseases transmissible between animals and humans.
2. Antimicrobial resistance (AMR): studying the emergence, spread and mitigation strategies of antimicrobial resistance.

3. Food safety and food security: assessing risks associated with foodborne pathogens, chemical contaminants and agricultural practices. Food security involves ensuring reliable access to adequate, safe and nutritious food. This includes studying the effects of environmental changes, economic stability and agricultural productivity on food availability and access.
4. Environmental health: investigating impacts of environmental factors like air and water quality, pollution and climate change on human, animal and ecosystem health.
5. Vector-borne diseases: researching diseases transmitted by vectors such as mosquitoes, ticks and sandflies.
6. Comparative medicine: understanding common diseases, genetic factors and treatment approaches between human and veterinary medicine.
7. Ecological/ecosystem health: exploring the impact of environmental changes on disease transmission and ecosystem health.
8. Climate change and health: studying the impact of climate change on human, animal and ecosystem health and exploring adaptation and mitigation options.
9. Health economics: assessing economic impact, cost-effectiveness of interventions and societal benefits of One Health approaches.
10. Behavioural and social sciences: investigating social, cultural and behavioural factors influencing disease transmission and healthcare-seeking behaviours.
11. Data integration: merging data from multiple sources for holistic analysis and decision-making.
12. Health policy and interventions: contributing to evidence-based policymaking and intervention development at the intersection of human-animal-environmental health.
13. Capacity building and education: identifying best practices to promote collaboration and knowledge sharing between disciplines (e.g. scholarly research).

2.3 Establishing a One Health research team

Establishing a multidisciplinary One Health research team involves:

1. **Establish the One Health team with roles**: Set up a team with defined roles, operational modalities and expectations. It is critical to not only ensure a mix of disciplines and sectors but also gender.
2. **Establish communication channels**: Set up effective communication channel(s) between team members and other stakeholders during the research.
3. **Undertake the research**: Implement the research-based on agreed on (approved) research plan/protocol with all involved playing their deserving role and taking stock of the process during the research.
4. **Document process**: Document the teamwork, successes, challenges and measures taken to solve problems. Such documentation would not only help improve One Health research but could also contribute to institutional capacity in organizing and running One Health research.

2.4 Capacity building

Capacity building is essential to enhance the skills, knowledge and capabilities of the research team. Priorities for capacity building include but are not limited to transdisciplinary research, One Health ethics, teamwork, conflict management, grant management, data analysis and reporting. This can be achieved through workshops, mentorship, updates on new methods and creating knowledge-sharing platforms to promote cross-learning.

2.5 Conflict management and teamwork

Effective conflict resolution and team management foster a positive and productive environment. Fundamental principles and strategies include:

a) **Creating team spirit**: define and agree on shared team goals, individual roles and responsibilities to minimize confusion. Organize small events to foster team spirit and ensure shared objectives.
b) **Transparency and open communication**: encourage transparent and timely communication to keep all members informed of process and status
c) **Conflict prevention**: promote collaboration and address conflicts early to prevent escalation.
d) **Mediation and facilitation**: act as a neutral mediator to guide discussions towards resolution.
e) **Constructive feedback**: provide specific, timely feedback focused on behaviours and outcomes.
f) **Collaborative problem-solving**: encourage teamwork to identify solutions that benefit all parties.
g) **Recognition and appreciation**: acknowledge and celebrate individual outstanding performance to foster motivation.

2.6 One Health research funding management

Managing One Health research funding aligns with institutional policies and guidelines and involves staffing considerations for human, animal and environmental researchers who may be employed by different schools/faculties. Limited resources are a major challenge to addressing problems holistically. In view of this, the following are appropriate:

1. Ensure donors are aware of the research components and resource implications.
2. Ensure donors are informed at every state on resource use and challenges.
3. Ensure there is separate ledger for the project to document costs

These considerations ensure effective management and utilization of funds.

2.7 Recommendations for One Health research

1) **Expand collaboration**: Develop mechanisms for enhanced collaboration across disciplines, ensuring the inclusion of veterinary, medical and environmental science experts in research projects.
2) **Guideline updates**: Regularly update research guidelines to include new developments in One Health, ensuring they reflect the latest scientific research and ethical standards.

3) **Promote One Health education**: Strengthen the capacity of researchers by providing training and resources that emphasize the interconnectedness of human, animal and environmental health.

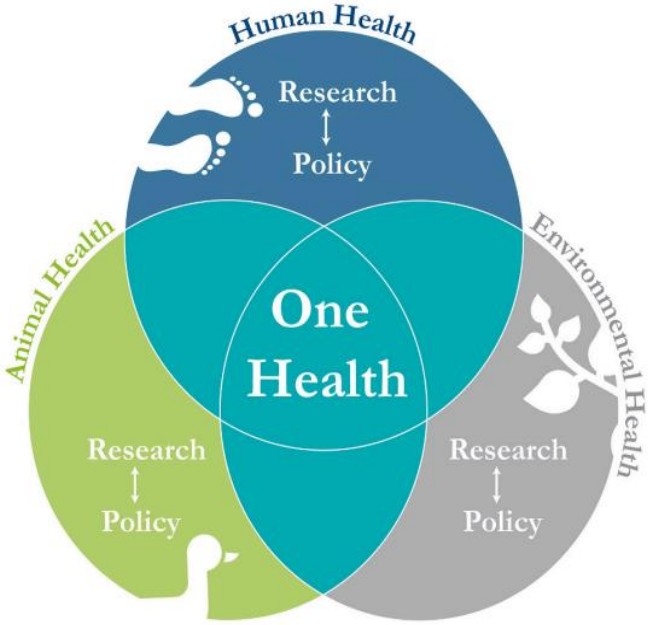
3 One Health research framework

3.1 Importance of the framework

The One Health research framework is crucial for effectively implementing One Health principles in political commitment, policy formulation, sustainable financing, program development, knowledge sharing, institutional collaboration, capacity enhancement, engagement of civil society and active community participation. The success of One Health implementation relies on institutional collaboration, joint planning and coordination. Promoting and encouraging One Health research is essential for managing risks, reducing costs, improving intersectoral coordination and translating global best practices into national action plans. To create successful research projects using a One Health approach, investigators must incorporate elements from human, animal and environmental health, considering the multiple intersections between each. It is beneficial to draw upon the expertise of research collaborators and relevant literature to inform the development of relationships and conceptual frameworks.

The framework emphasizes communication and collaboration among two stakeholder groups: (i) researchers who generate research findings about One Health issues and (ii) policymakers who use research findings to develop, implement and monitor policies and programs for preventing and responding to challenges as shown in Figure 2. These interactions occur among stakeholders from human, animal and environmental health sectors (see Figure 2) (Bahita et al. 2019; Basham et al. 2022; Lebov et al. 2017).

Figure 2: Communication and collaboration supporting research translation to address One Health challenges.



Effective One Health research requires communication and collaboration: a) across sectors and b) between researchers and policymakers (Basham et al. 2022).

3.2 One Health research theme and funding

To advance One Health research in Ethiopia, academic and research institutions should have dedicated funding to support such research. Understanding of the One Health research calls in thematic areas may help take advantage of funding opportunities in the sector.

3.2.1 Formulating One Health research proposals

The One Health research framework focuses on applied research addressing population-level One Health challenges and critical gaps. Proposals should emphasize intersections between human, animal and environmental health. Research proposal titles should indicate the focus area of the study. Below are examples of One Health research titles:

- Intervention of taeniasis in communities with open defecation, addressing improved animal health.
- Detection of antimicrobial resistance (AMR) at the human-animal-environment interface.
- Epidemiology of *Brucella* infection in human, livestock and wildlife samples in Koysha National Park and Belete-Gera Forest ecosystem, southwestern Ethiopia.
- Integrated surveillance of human and animal faeces management and its determinants in three Health and Demographic Survey Sites (HDSS) areas of Ethiopia.
- Impact of gold mining to human health through consumption of dairy products sourced from animals grazed on heavy metal-contaminated fields.

3.2.2 Building a multidisciplinary team

Academic and research institutions should invest in strategies that promote formation of multidisciplinary teams e.g. requiring thematic proposals include expertise from human, animal and ecosystem health. Researchers should also be encouraged to seek relevant expertise both within and outside their institutions. Involving experts from each domain during the team-building phase encourages broader thinking and facilitates resource aggregation, including funding, staff and data (Lebov et al. 2017).

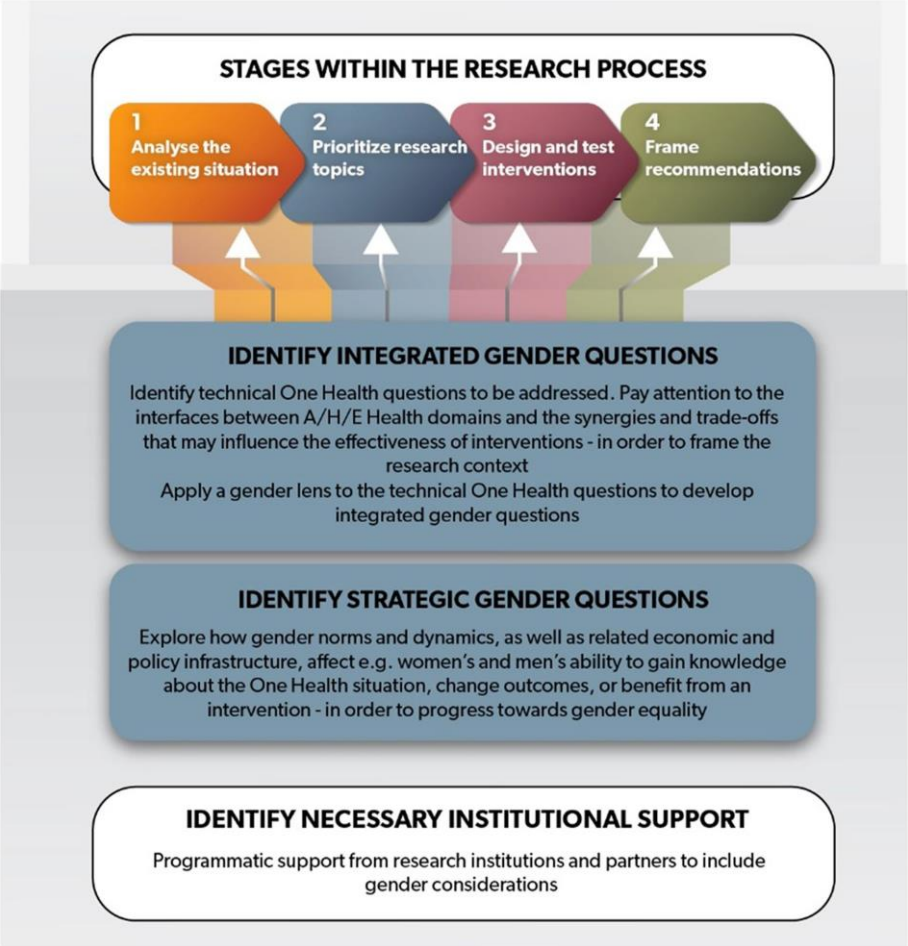
Key considerations for research team establishment:

- Members from the three key domains (human, animal and ecosystem health) should be part of the research team, including both men and women.
- Community representation in selecting study participants or team members is encouraged. Communities could be involved in research design, implementation and dissemination to ensure that research findings are relevant and beneficial to local populations.

3.2.3 Gender in the One Health framework

Studies that integrate gender considerations from the outset and consistently throughout the research process typically yield more effective and significant gender analyses as shown in Figure 3. This approach also allows for the identification and mitigation of adverse unintended consequences, contributing to the advancement of gender equality. This is done by ensuring that each research stage involves identifying both integrated and strategic gender research questions and having underlying institutional support (Galiè A .etal.2024)

Figure 3: A framework for gender in One Health research.



Source: Gender considerations in One

Table 1 elaborates on the concept of integrating strategic gender inquiries by offering examples of typical questions applicable at various stages of research within One Health. Many of the questions outlined in the framework are of a qualitative nature due to the exploratory phase of gender research in One Health. Given the limited understanding of how gender dynamics and norms intersect with One Health, qualitative methods are preferred. Nevertheless, depending on the chosen methodology, these inquiries could also be addressed quantitatively. Qualitative evidence aids in pinpointing crucial gender issues, which can be further investigated through a blend of qualitative and quantitative research methodologies. (Galie et al. 2024).

Table 1: Key integrated and strategic gender questions at each research stage of One Health

Research stage	Key gender question(s)	Further consideration
1. Analyzing the existing situation	• How does the way men and women, girls and boys utilize the environment influence the transmission of disease x between wildlife, livestock and humans? • How do other identity markers like age, religion, or ethnic group influence environmental use and disease transmission? • How do intra-household roles affect the way men and women, girls and boys are exposed to risks from foods of animal origin?	• To what extent do gender norms affect the ways women, men, boys and girls interact with the environment thereby influencing the transmission of a given disease between wildlife, livestock and humans? • To what extent do gender norms (across other relevant identity markers) affect the ability of men, women, boys and girls to assess risk and act accordingly?
2. Prioritizing research topics	• Which impacts (human health, animal health, environmental health) are prioritized by women and by men (across other relevant identity markers)? • What solutions/interventions would each group prefer?	• How can the chosen interventions support the empowerment of women and girls (across identity markers) and enhance their capability to reduce both transmission of disease and the related impacts?
3. Designing and test interventions	• Are the identified interventions effective at reducing, zoonotic disease transmission, food safety risk for girls, boys, men and women within existing gender norms and customs, AMR?	• To what extent do local gender norms and customs and existing government policies, affect the way the chosen intervention impacts are distributed within households and communities?
4. Framing recommendations	How can we ensure that the recommended interventions are implemented and scaled with positive societal outcomes enjoyed by women, men, girls and boys (and across other relevant identity markers)?	

4. The COHERE standards

The *Checklist for One Health Epidemiological Reporting of Evidence* (COHERE) (Davis et al. 2017) should be used to guide best practices in the development of epidemiological One Health research. COHERE enhances the reporting quality of observational epidemiology studies that integrate data on humans, animals and/or vectors, along with their shared environments; and advocates for the integration of data from these three sectors in One Health studies. The COHERE statement was crafted following the model of the widely utilized (Strengthening the Reporting of OBservational studies in Epidemiology [STROBE] statement). The COHERE authorship team comprised both established and emerging One Health researchers across various disciplines. Beyond the authorship team, international experts were engaged for an external review. The involvement of numerous experts in the process has yielded a robust and distinct tool that many believe meets a significant need. The authors envision COHERE as a "living document" to be revised whenever necessary and encourage users to provide feedback through the corresponding author. The COHERE standards can be found in Annex 1.

4.1 One Health research project quality evaluation criteria

In addition to the specific considerations outlined above, the quality evaluation criteria for research development align with the specifications provided by the Canadian Institute of Health Research (CIHR). The proposed One Health Research project should meet the following requirements, which are also summarized in Table 2:

4.2 Research approach

Clarity of research question: Have a clearly defined research question that aligns with the One Health approach, demonstrating a clear understanding of the interconnections between human, animal and environmental health.

Literature review: A comprehensive literature review relevant to the study design and research plan including recent advancements, gaps and methodological considerations, showcasing a nuanced understanding of the existing knowledge landscape.

- Rationale clarity: clearly articulated for the chosen research approach and methodology, with explicit connections to the One Health framework.
- Research design appropriateness: suitability of the chosen research design, considering its alignment with the research question, feasibility and ethical considerations.
- Methodology appropriateness: appropriateness of the research methods for collecting, analyzing and interpreting data from multiple sectors.
- Feasibility: feasibility of the research approach, including subject recruitment, project timeline, preliminary data and proactive management plans for anticipated difficulties.

4.3 Originality of the proposal

- Potential for new knowledge: potential to create new knowledge that advances understanding of One Health issues.
- Research originality: originality in hypotheses/research questions, technology/methodology, or applications thereof.

- Interdisciplinary integration: integration of interdisciplinary approaches and methodologies to address complex One Health challenges.

4.4 Applicant(s) and team

- Qualifications: qualifications of the applicant(s), including training, experience and independence.
- Relevant experience: applicant(s) experience in the proposed research area and methodology. Demonstrated experience in conducting interdisciplinary research.
- Expertise: scientific productivity over the past five years, considering publications, grants held, etc.
- Diversity and inclusivity: diversity of perspectives and backgrounds within the research team, including gender, ethnicity and disciplinary expertise.

4.5 Research environment

- Availability and accessibility: accessibility of personnel, facilities and infrastructure necessary for conducting interdisciplinary research.
- Institutional support: support from the host institution(s) for fostering interdisciplinary collaboration and supporting One Health research initiatives.
- Training suitability: suitability of the environment for personnel training (if applicable).
- Community engagement: engagement with local communities and stakeholders to ensure the relevance and applicability of research.

4.6 Impact and knowledge translation

- Addressing a significant need: alignment of the research objectives with identified gaps or priorities in One Health research or practice.
- Potential health and societal improvement: potential to significantly improve health globally and/or enhance health services and products.
- Knowledge dissemination and translation plan: appropriateness and adequacy of the proposed knowledge dissemination and exchange plan, including strategies for sharing research findings with diverse audiences and translating evidence into policy and practice.

Table 2: Summary of the One Health research project quality evaluation criteria

Criterion	Description
Research approach	- Clear research question - Comprehensive literature review - Rationale for One Health perspective - Appropriate research design and methodology - Feasibility assessment
Originality and innovation	- Potential for new knowledge

	- Research originality - Interdisciplinary integration
Applicant(s) and team	- Qualifications and expertise - Research experience - Collaborative track record - Diversity and inclusivity
Research environment	- Availability and accessibility of resources - Institutional support - Community engagement
Impact and knowledge translation	- Addressing significant need - Potential health and societal impact - Knowledge dissemination and translation

4.7 One Health research framework recommendations

In order to Mainstreaming One Health approaches and principles into research in Ethiopia, the following recommendations are made:

- Enhance interdisciplinary integration: promote the development of interdisciplinary research teams that work across the spectrum of One Health, including sectors like public health, animal health and environmental science.
- Support innovative funding models: advocate for funding models that support One Health research, particularly those that facilitate cross-sectoral and transdisciplinary studies.
- Regular review and adaptation: ensure the research framework is regularly reviewed and adapted to remain aligned with international One Health initiatives and findings.

5. One Health research ethics

5.1 Importance of ethics

The integrated approach of One Health, as defined by the United Nations Quadripartite, aims to optimize the sustainable health of people, animals and ecosystems. Ethics plays a pivotal role in evaluating past, present and future actions, underpinning the scientific research rigor with internal and external dimensions. Internally, it addresses scientific research practices such as data falsification, financial conflicts of interest and treatment of subjects. Externally, it concerns the application and consequences of scientific knowledge, including subject selection and the impact on individuals and communities (Lindenmayer et al. 2022[a]).

One Health faces the unique challenge of simultaneously addressing the health and well-being of people, animals and nature. It advocates for a moral connection between the planet's life support system and the environment's cultural value, reframing positive environmental change as a principle of natural connection (Capps 2022). One Health ethics establishes principles, policies and practices to institutionalize ethics within the framework. It requires an egalitarian approach coupled with recognition of natural alterity, acknowledging the claims of all cohabitants to equivalent basic goods (Coghlan and Coghlan 2018)

One Health ethics promotes population health by fostering connections to nature, enabling individuals to balance preferential and public relationships with natural entities. It envisions the earth as indispensable for supporting all life and encourages bioethics to engage seriously with non-human health and ethics (Coghlan and Coghlan 2018). Pragmatic ethics, grounded in philosophical reasoning, facilitates negotiation of conflicting positions emerging from practical situations within the community (Boudreau LeBlanc et al. 2022).

Ethics guides collaborations of public-private-academic partnerships, allowing pragmatism and empirical methodologies from bioethics. Traditional ethical frameworks often prioritize human health over animal welfare. However, a One Health approach calls for balancing benefits and burdens across humans, animals (agricultural and wild) and the environment (O'Mathúna et al. 2020). Approaches to ethics must recognize the interrelatedness and interdependence of humans, animals and the environment to address global challenges effectively. Furthermore, evidence reveals that One Health interventions tend to focus on proximal issues, be it zoonoses, AMR, or food safety, with little to no attention to distal implications of what is done as part of interventions and its consequences. Consideration of such distal factors may have more profound and lasting benefits for all, human and non-human. It is critical to be mindful in One Health research regarding which aspects of interdependencies to study, how to extend health and well-being beyond humans and what tradeoffs to consider when optimizing the health of people, animals and the nature at large (Zinsstag et al. 2021).

5.2 Principles and applications of ethics in One Health

The ethical foundation of One Health is anchored in four fundamental principles, providing a framework for understanding its ethical dimensions (Lindenmayer et al. 2022[b])

1. **Interdependence**: One Health acknowledges the interconnectedness of health and well-being among humans, animals and the environment.
2. **Holistic well-being:** One Health incorporates physical, mental, emotional and social well-being across species and ecological systems.

3. **Optimal health:** striving for optimal health simultaneously for humans, animals and the environment, One Health accommodates necessary tradeoffs that don't solely prioritize human interests.
4. **Acknowledgment of scientific uncertainty:** One Health recognizes the complexity and constant evolution of our understanding of the world, embracing scientific uncertainty.

While some argue that One Health does not necessitate a new ethical framework and can align with existing frameworks, others contend that developing a dedicated framework ensures the preservation of its unique concerns (Lindenmayer et.al 2022[b]). The philosophical attention to One Health remains limited, despite its significance in addressing complex issues at the human-animal-environment interface.

5.3 Core concerns of One Health in ethics

Environmental dimension emphasis: One Health highlights an environmental dimension in ethical decision-making, reviving its importance in domains like bioethics.

Interdependence valuation: The approach acknowledges and values the interdependence of human and non-human health, a crucial aspect often overlooked in traditional ethical frameworks.

Recognition of broader social factors: One Health recognizes and values the broader social factors influencing disease transmission, providing a more comprehensive ethical perspective.

The necessity of a new ethical framework for One Health hinges on the perception of existing frameworks. While alignment with current frameworks is crucial, developing a dedicated framework may ensure that its core concerns receive due attention.

One Health projects involving human, animal and environmental dimensions often require ethics and regulatory approvals from various committees and agencies, sometimes spanning different countries. Challenges emerge when these committees are geographically dispersed and emphasize the need for different standard operating procedures (SOPs), guidelines and protocols. During emergencies like disease outbreaks, SOPs should facilitate swift and rigorous ethical reviews without compromising scientific, ethical or cultural considerations. Familiarity with relevant issues becomes paramount for efficient and timely reviews during such critical situations (Johnson and Degeling 2019; Ladbury et al. 2017; Nguta et al. 2022).

6. Research ethics practice in Ethiopia

This section presents a review of available documents in Ethiopia to assess their inclusivity with respect to One Health issues. The findings are organized into three sub-sections covering human, animal and environmental ethics practices at different Ethiopian institutions.

6.1 Human ethics

National Research Ethics Review Guideline: The 6th draft guideline from the Ethiopian Ministry of Science and Technology (MoST) focuses on the protection of human study subjects, emphasizing ethical justification, scientific validity and community engagement. It, however, lacks diversity in Institutional Review Board (IRB) membership and has a narrow focus that excludes animal use and environmental health concerns.

Jimma University: The draft document from Jimma University aligns closely with the national guidelines, concentrating primarily on human subjects' protection. Like the national guideline, it lacks comprehensive coverage of animal and environmental ethics.

Addis Ababa University College of Health Sciences (AAU-CHS) IRB: This IRB adopts elements from the national guidelines and acknowledges One Health by considering environmental and animal health. Nevertheless, it falls short in providing detailed guidance on these topics.

6.2 Animal ethics

Mekelle University Animal Ethics and Experimentation Committee (AEEC): Focused on ethical principles for animal research, the AEEC adheres to the 3Rs principle (Reduction, Refinement, Replacement). It struggles with diversifying its membership and properly prioritizing research issues, particularly those concerning the environment.

Addis Ababa University College of Veterinary Medicine and Agriculture, Guideline for Animal Research ethics: This guideline has established the institutional animal care and use committee/Animal Research Ethics Review Committee (ARERC) to guide, monitor and contribute to the improvement of the standard of research in general and the care and use of animals in research and teaching. The ultimate goal is ensuring any scientific activities performed on animals observe national and international guiding principles and regulations.

Addis Ababa University College of Health Sciences (AAU-CHS) IRB: While primarily focused on human ethics, this body needs clarification on its role or the existence of separate committees like the Institutional Animal Care and Use Committee (IACUC), which would typically handle animal ethics.

6.3 Environmental ethics

Ethical considerations in environmental research encompass recognizing the intrinsic value of nature, promoting responsible stewardship and adhering to precautionary principles. Balancing evidence-based decision-making with protecting human and environmental health is crucial. Environmental justice and the precautionary principle underscore the need for fair treatment and proactive decision-making, especially concerning marginalized communities. Environmental health research activities as part of public health research have drawn attention to ethical issues and the need for ethical clearance. However, some environmental research does not get full attention on issues like how the data is collected, environmental safeguarding, handling of toxic laboratory chemicals and protection of biota and humans (Sharp 2003).

In conclusion, while the importance of ethical practices in health research in Ethiopia is recognized, there is a notable gap in explicit consideration of environmental ethics. Though attempts are made to integrate environmental concerns within the broader scope of One Health, specific guidelines or committees dedicated to environmental ethics are not prominently mentioned or developed. Enhancing awareness and incorporating One Health ethics into existing guidelines can foster more comprehensive and inclusive research practices.

6.4 Challenges of research ethics review processes

In many academic and research institutions, the ethics review process faces several challenges that impact effectiveness and quality of service delivery:

- **Delayed response times**: significant delays from Institutional Review Board (IRB) members. It often takes a minimum of a month to provide feedback.
- **Lack of community representation**: inadequate representation from the community, potentially leading to oversight of community perspectives and concerns.
- **Absence of One Health integration**: IRB structures typically lacks expertise from diverse fields such as public health, animal and environmental health, resulting in a siloed approach to ethics and an under-recognition of ethical principles pertaining to animal research subjects.
- **Limited community consultation:** communities affected by research are not adequately consulted during the review process, limiting their input and engagement.
- **Focus on researchable issues:** Existing guidelines predominantly focus on research-related matters rather than community engagement projects, which are equally vital.
- **Limited awareness on community engagement:** IRB members often lack awareness of how to effectively measure and evaluate community engagement during the review process.
- **Lack of standardized guidelines for animal and environmental ethics:** Ethiopia lacks standardized guidelines for conducting ethical reviews specifically addressing issues related to animal use and environmental health.

Addressing these challenges is crucial to enhancing the quality and responsiveness of the research ethics review process and ensuring that it adequately protects the interests of all stakeholders involved, including (human and animal) participants, communities, researchers and the environment.

7. Recommended approaches for integrating One Health ethics in research

Various recommendations are made here to facilitate the integration of One Health ethics into research. By implementing these recommendations, Ethiopia and other countries can enhance the ethical oversight of One Health research, ensuring the protection of human, animal and environmental welfare while fostering collaborative and inclusive research practices (Johnson and Degeling 2019; Ladbury et al. 2017; Nguta et al. 2022). These recommendations are presented below and summarized in Table 3.

7.1 Policy and program development

National authorities responsible for ethical and research review should develop policies and support programs aimed at:

- Integrating One Health ethics and community engagement agendas into the research and review process to enhance the ethical decision-making skills of One Health investigators, researchers, reviewers and regulators.
- Strengthening the capacity of practitioners, researchers, reviewers and regulators through training in One Health ethics, ranging from short courses to degree programs.
- Formulating guidelines, policies and standard operating procedures (SOPs) to guide the ethical review of One Health projects during disease outbreaks, emergencies and pandemics, particularly zoonotic ones.
- Allowing communities to engage in projects from inception to dissemination of results and designing intervention plans.
- Establishing ethical review committees with multidisciplinary expertise to ensure critical review of projects at the interface of human, animal and environmental health.

7.2 Standardization of ethics review documents

Standard national ethics review documents should be established for animal and environmental health issues, integrated with existing ethical review guidelines for human subjects.

7.3 Composition of IRB members

Institutional Review Board (IRB) members should include professionals specializing in veterinary medicine/animal Science, human and environmental health. The responsibility of reviewing One Health research proposals lies with the Institutional Review Board/Committee (IRB/C) of the institution where clearance is sought. One Health research proposals can be assessed by IRB members with One Health experience or exposure, or they can undergo training in One Health research ethics. For instance, at Addis Ababa University's Health Science College IRC, delays in reviewing One Health research proposals were observed when research ideas fell outside the scope of the members. However, after receiving training on One Health research and its ethical considerations, IRC clearance was expedited. Besides training, establishment of an ad hoc

review committee comprising experienced professionals in One Health research can be explored.

7.4 Training and certification of IRB/C members

A comprehensive One Health research ethics training manual should be developed in collaboration with experts and accredited trainers of IRB/C members. The manual and training should provide guidelines on essential aspects of ethical concerns on humans, animals and the environment, as well as their interactions. Insight into the establishment and operation of institutional review board (IRB) members, incorporating expertise from at least the three disciplines should also be covered. Upon completion of the training, committee members should receive certification from the organizing institution(s).

7.5 Community engagement

Community members in the target area/community should be consulted during the ethical clearance process to ensure smooth research operations. This engagement fosters ongoing ethical oversight throughout the research project, ensuring compliance with ethical guidelines and regulations. Any changes or deviations from the approved protocol should be promptly reported to relevant review boards or committees. Community engagement also facilitates the integration of local knowledge and expertise, builds trust and collaboration, encourages co-design and co-creation and enhances research outcomes, knowledge translation and implementation.

7.6 Ownership

The lead institution typically obtains IRB clearance for One Health research proposals. Alternatively, appropriate institutions within the research team can also seek clearance. Ethical clearance for research proposals should be obtained from biomedical research institutions such as veterinary medicine, medical colleges, public health colleges and relevant professional associations. The national IRB should provide the ethical clearance document, including respective professionals in the review process.

Table 3 : Key recommendations for One Health research ethics

#	Recommendation	Details
1	Policy and program development	• Develop and support policies and programs to integrate One Health ethics into research and review processes. • Include community engagement, multidisciplinary training and specific guidelines for emergencies.
2	Standardization of ethics review documents	• Establish standard national ethics review documents that incorporate considerations for animal and environmental health. Align these with existing guidelines for human subjects.
3	Composition of health ethics IRB members	• Include professionals with expertise in veterinary medicine/animal science, human health and environmental health in health ethics IRBs.
4	Training and certification of IRB/C members	• Develop a comprehensive One Health research ethics training manual and certify IRB/C members upon completion of training.
5	Community Engagement in OHR	• Involve community members in the ethical clearance process to ensure ongoing oversight, compliance and integration of local knowledge.
6	Ownership	• Obtain ethical clearance from relevant biomedical research institutions, ensuring a multidisciplinary review involving professionals from various health domains.

8. References

Addis Ababa University. 2021. Addis Ababa University College of Health Sciences Institutional Review Board. *SOP# AAUCHSIRB* Version 3.0.

AFROHUN (Africa One Health University Network). 2019. One Health Communication: Facilitator's guide. OHCEA.

Ahmad, I., Huang, L., Hao, H., Sandérs, P. and Zhang, Y. 2016. Application of PK/PD Modeling in Veterinary Field: Dose Optimization and Drug Resistance Prediction. *BioMed Research International*. https://doi.org/10.1155/2016/5465678.

Bhatia R. 2019. Implementation framework for One Health approach. *Indian Journal of Medical Research*. 149(3):329-31. doi: 10.4103/ijmr.IJMR_1517_18. PubMed PMID: 31249197; PubMed Central PMCID: PMCPMC6607818.

Basham, C., Billings, E., El Rifay, A.S., Badra, R., Ali, M.A., Asy, A., et al. 2022. Designing and validating a One Health Research Translation Framework through literature-based case studies in Egypt. *One Health*. 2022; 15:100454. Epub 20221104. doi: 10.1016/j.onehlt.2022.100454. PubMed PMID: 36532666; PubMed Central PMCID: PMCPMC9754929.

Boudreau LeBlanc, A., Williams-Jones, B. and Aenishaenslin, C. 2022. Bio-ethics and one health: a case study approach to building reflexive governance. *Frontiers in Public Health* 10, 648593.

Buschhardt, T., Gunther, T., Skjerdal, T. , Torpdahl , M., Gethmann, J., Filippitzi, M. et al. 2021. A one health glossary to support communication and information exchange between the human health, animal health and food safety sectors, One Health, Volume 13. 100263, ISSN 2352-7714, https://doi.org/10.1016/j.onehlt.2021.100263.

Capps, B. 2022. One Health ethics. *Bioethics* 36, 348-355.

Coghlan, S. and Coghlan, B. 2018. *One Health, bioethics and non-human ethics*. 18: 3-5. *The American Journal of Bioethics*.

Concannon, T. W., Grant, S., Welch, V., Petkovic, J., Selby, J., Crowe, S., Synnot, A., Greer-Smith, R., Mayo-Wilson, E., Tambor, E. and Tugwell, P. 2019. Practical guidance for involving stakeholders in health research. *Journal of General Internal Medicine* 34(3): 458–463. https://doi.org/10.1007/s11606-018-4738-6.

Davis, M. F., Rankin, S. C., Schurer, J. M., Cole, S., Conti, L., Rabinowitz, P., Gray, G., Kahn, L., Machalaba, C., Mazet, J., Pappaioanou, M., Sargeant, J., Thompson, A., Weese, S. and Zinnstag, J. 2017. Checklist for One Health Epidemiological Reporting of Evidence (COHERE). *One Health* 4, 14–21. https://doi.org/10.1016/j.onehlt.2017.07.001.

Donaldson, D.R. and Koepke, J.W. 2022. A focus groups study on data sharing and research data management. *Scientific Data* 9(1): 345. https://doi.org/10.1038/s41597-022-01428-w.

Galiè, A., McLeod, A., Campbell, Z.A., Ngwili, N., Terfa, Z.G. and Thomas, L.F. 2024. Gender considerations in One Health: A framework for researchers. *Frontiers in Public Health* 12, p.1345273.

Hernando-Amado, S., Coque, T., Baquero, F. and Martínez, J. 2019. Defining and combating antibiotic resistance from One Health and Global Health perspectives. *Nature Microbiology* 4, 1432 – 1442. https://doi.org/10.1038/s41564-019-0503-9.

Humboldt-Dachroeden, S., Rubin, O. and Sylvester Frid-Nielsen, S. 2020. The state of One Health research across disciplines and sectors - a bibliometric analysis. *One Health*. 10:100146. doi: 10.1016/j.onehlt.2020.100146. PMID: 32835067; PMCID: PMC7274982.

Jimma University. 2019. Institute of Health Institutional Review Board: written procedure for ethical review. Draft.

Johnson, J. and Degeling, C. 2019. Does One Health require a novel ethical framework? *Journal of Medical Ethics* 45, 239-243.

Karesh, W., Dobson, A., Lloyd-Smith, J., Lubroth, J., Dixon, M., Bennett, M., Aldrich, S., Harrington, T., Formenty, P., Loh, E., Machalaba, C., Thomas, M. and Heymann, D. 2012. *Ecology of zoonoses: natural and unnatural histories.* Lancet (London, England), 380, 1936 - 1945. https://doi.org/10.1016/S0140-6736(12)61678-X.

Ladbury, G. et al. 2017. One health research in Northern Tanzania – challenges and progress. *East African Health Research Journal* 1(1): 8-18. doi: 10.24248/EAHRJ-D-16-00379.

Lebov, J., Grieger, K., Womack, D., Zaccaro, D., Whitehead, N., Kowalcyk, B., MacDonald, P.D.M. 2017. A framework for One Health research. *One Health* 3, 44-50.

[a]Lindenmayer, D.B., Lavery, T. and Scheele, B.C. 2022. Why we need to invest in large-scale, long-term monitoring programs in landscape ecology and conservation biology. *Current Landscape Ecology Reports* 7, 137–146. https://doi.org/10.1007/s40823-022-00079-2.

[b]Lindenmayer, J. M., Kaufman, G. E., Baker, L., Coghlan, S., Koontz, F. W., Nieuwland, J., Stewart, K. L. and Lynn, W. S. 2022. One health ethics: "What then must we do?". *CABI One Health*.

Mekelle University. 2016. Guideline on laboratory animals use and care (for use by Animal Ethics and Experimentation Committee, AEEC and researchers).

Mettenleiter, T.C., Markotter, W., Charron, D.F., Adisasmito, W.B., Almuhairi, S., Behravesh, C.B., Bilivogui, P., Bukachi, S.A., Casas, N., Becerra, N.C. and Chaudhary, A. 2023. The one health high-level expert panel (OHHLEP). *One Health Outlook* 5(1):18.

Ministry of Science and Technology. 2020. National Research Ethics Review Guideline: Federal Democratic Republic of Ethiopia, Ministry of Science and Technology (MoST). 6th ed. AEEC and researchers.

Nguta, J. M., Belaynehe, K. M., Arruda, A. G., Yimer, G. and O'Mathúna, D. 2022. 'One Health Research Ethics in Emergency, Disaster and Zoonotic Disease Outbreaks: A case study from Ethiopia. *Ethics, Integrity and Policymaking: The Value of the Case Study*, 151–164.

O'Mathúna, D. P., Arruda, A. G. and Yimer, G. 2020. One health research ethics. *Ethiopian Journal of Health Development* 34.

Osterhaus, A.D.M.E., Vanlangendonck, C., Barbeschi, M. et al. 2020. Make science evolve into a One Health approach to improve health and security: a white paper. *One Health Outlook* 2: 6 2020. https://doi.org/10.1186/s42522-019-0009-7.

Sharp, R.R., 2003. Ethical issues in environmental health research. *Environmental Health Perspectives* 111, 1786-1788.

WHO (World Health Organization). 2012. Research priorities for zoonoses and marginalized infections. World Health Organization.

WHO. 2023. A one health priority research agenda for antimicrobial resistance.

Zinsstag, J., Waltner-Toews, D. and Tanner, M. 2021. Why One Health? In: One Health: The theory and practice of integrated health approaches. CABI Wallingford UK, 15-24.

Annex 1: The COHERE standards

The COHERE standards

Item	Standard number	Recommendation
Introduction/ background	1	Review the human, animal and environmental context of theproblem and justify why a One Health study is appropriate toaddress the scientific question
Rationale	2	Clearly state the research aims and/or hypotheses in the context of the relationship among the three domains (human, animal and environment), or state and defend the nature of the study if it is not hypothesis driven.
Methods study design	3	(a). Explain or describe the relationship/interaction (epidemiologic, biological, ecological, spatial/temporal, etc.) of the collection of the human, animal and environmental specimens and/or data[a] (b). Provide inclusion and exclusion criteria for all domains. According to study design, follow other guidance, e.g. STROBE and its extensions (STROBE-VET, STROME-ID), CONSORT, PRISMA, etc., as indicated.
Human participants	4	(a). Provide qualitative and/or quantitative description of the human population or human data, including characteristics related to inclusion or exclusion from the study, sample size (at all relevant population levels) and sample size justification, as appropriate. (b.) Ensure human subject assurances adhere to the highest standards of ethics governing human subjects' research.
Animal participants	5	(a). Provide qualitative and/or quantitative description of the animal population (domestic, captive exotic, or free-ranging wild), including characteristics related to inclusion or exclusion from the study, sample size (at all relevant population levels) and sample size justification. (b). Include, at minimum, the common or generic name for the species of animal or animals studied and provide the taxonomic Genus species if indicated (i.e. for less common species) if the species chosen is dependent on study design[a]

Item	Standard number	Recommendation
		(c). Ensure animal subject assurances adhere to the highest standards of ethics governing animal subjects research.
Environment[b]	6	(a). Identify environmental (abiotic) and/or ecosystem (biotic) factors, including vector characteristics[b] if appropriate, that are under investigation. (b). Describe the type and purpose of any environmental samples or data collected. Provide qualitative and/or quantitative description of the study location, including geographic locale (e.g. region and country, latitude/longitude or a centralized point if the location of the site is sensitive information), ecosystem type (e.g. mangrove forest) and/or land use description (e.g. urban, agricultural, etc.) and number and description of where samples were obtained[b].
Measurement	7	(a). If indicated, include the frequency of sampling (i.e. sample interval) and calendar timing (i.e. date, month, season, year)[b] (b). Describe the relationships/interactions (epidemiologic, biological, ecological, spatial/temporal, etc.) among human, animal and environmental samples and data, as well as other significant differences in data collection methods between domains[a]. (c). Describe and justify testing or analysis measures used and indicate the validity of such measurements for use among human, animal and environmental domains.
Analysis	8	(a). Identify how data among the three domains were collected. (b). Explain how any hierarchical relationships within and between domains (e.g. at the individual or group level) were handled. (c). If data were handled differentially among the three domains (e.g. collection of data from one domain at a different time interval than from another domain), describe this in sufficient detail to allow assessment of potential bias introduced by this decision.
Study team	9	(a). If applicable, describe the involvement of study team members, stakeholders and community

Item	Standard number	Recommendation
		members (e.g. farmer participant stakeholders, industry, etc.). (b). Indicate how study team members representing all three domains contributed to development of the research question and study design.
Ethics	10	(a). Report animal (IACUC/ACUC) and human ethics (IRB) approvals, as well as other relevant permissions that were obtained. (b). If applicable, describe the framework for adhering to community based research standards (e.g. community approval, cultural respect, knowledge translation).
Results		
Human participants	11	(a). Report recruitment data provide study population percentages and describe generalizability of study population to underlying population. (b). Describe demographics (i.e. sex, age, race/ethnicity etc.) or case characteristics, as well as exposure factors and behavioral characteristics evaluated, of human subjects.
Animal participants	12	(a). Report study population percentages and describe generalizability of study population and study species to the underlying animal population of interest. (b). Describe demographics (i.e. sex, age, breed, etc.) or signalment, as well as exposure factors, of animal subjects. (c). If applicable, describe animal management characteristics (i.e. housing, diet, other environmental factors).
Environment	13	(a). Report findings from collected samples and/or measurements, including measures of heterogeneity that could impact generalizability of findings. (b). Provide descriptive statistics for all appropriate environmental/ecosystem variables. (c). If appropriate, provide geographic referencing for all samples or data submitted to public databases.
Measurement	14	(a). Identify populations, pathogens and/or vectors to the same taxonomic level across all three domains.

Item	Standard number	Recommendation
		(b). Report findings in a way that is standardized or equivalent across all three domains.
Analysis	15	(a). Provide comparative statistics, qualitative comparisons or integrated analyses among human, animal and environmental variables, including (as appropriate) measures or descriptions of uncertainty (e.g. variance, confidence intervals, qualitative limitations). (b). Consider the potential for lack of independence or group effects that may impact statistical inference (e.g. at the household or building level, pen or other animal cohort level and community level). (c). If indicated, provide geospatial comparisons or illustrations of spatial relationships (e.g. maps) to describe the distribution between human and animal populations.
Discussion Overall	16	Provide a comprehensive discussion that integrates the human, animal and environmental aspects of the results Indicate generalizability of findings to local, national and/or international levels
Limitations	17	(a). Discuss any discordance in the acquisition, analysis, or interpretation of data among the three domains (e.g. identify problems with the application of different methods among the domains) (b). Identify where methods lack validation (e.g. animal methods used in human populations or vice versa) (c). Identify any methods that may not have been optimal to address research aims and suggest how future studies could overcome such limitations (d). Comment on issues that may impact the reproducibility of the study as appropriate (e). Identify and discuss potential sources of bias (f). Discuss species-specific differences that may impact the results or the interpretation of the results (g). Identify other potential populations of humans or animals that could be involved in the problem and were not measured or addressed in the study

Item	Standard number	Recommendation
One Health Contribution	18	(a). Describe how a One Health approach to the study— specifically incorporation of expertise among the discipline and integration of findings from human, animal and environmental domains— furthered the understanding of the data/research problem. (b). If appropriate, describe lessons learned from the One Health interdisciplinary study team approach, e.g. successes and challenges identified as part of the process of conducting the study, methods for operationalizing participation among the disciplines and cost-benefit analyses of the resource efficiencies of One Health studies (c). Identify how the conclusions relate to the promotion of human, animal and ecosystem health. (d). Include "One Health" as a keyword and, if appropriate, also in the title of the manuscript.
Acknowledgment	19	Indicate funding source(s) and potential conflicts of interest

[a] Please adhere closely to STROBE or extension (e.g. STROBE-VET, STROME-ID, etc.) guidelines for reporting of observational epidemiology studies, which may impact placement of these COHERE checklist data. Where indicated, data should be placed in methods or results sections per STROBE guidance.

[p]lease see the additional discussion of definitions of biological vectors and when and how to report them as part of the animal participants or part of the environment.

[t]he authors and working group strongly encourage collection of and consideration of additional data on human subjects as appropriate, particularly occupation/work-related exposures, socioeconomic parameters and other community parameters.