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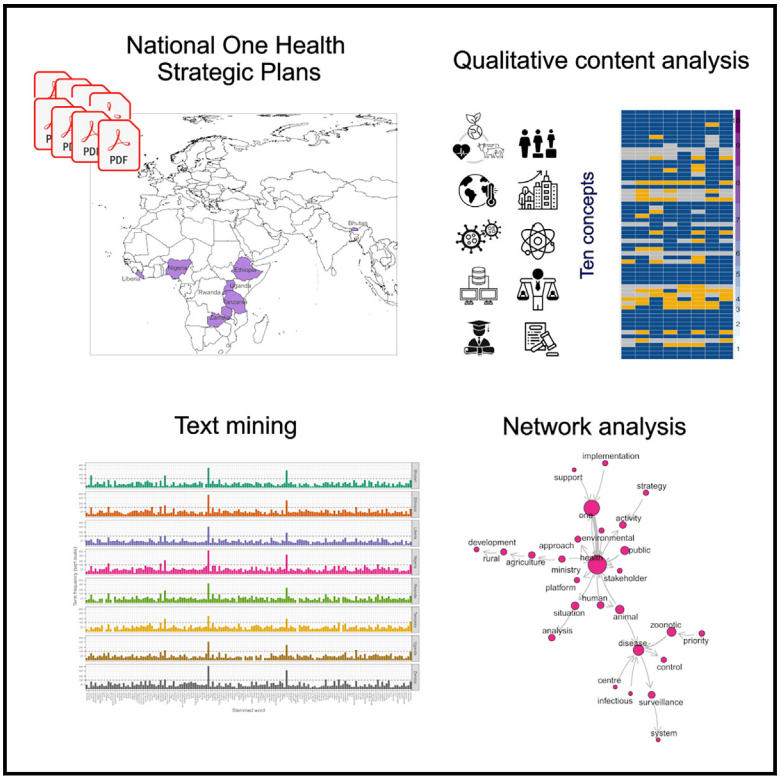
Mixed-method analysis of published national one health strategic plans

Graphical abstract



Highlights

- Discrepancy noted between One Health publications and active policy development
- Limited focus on Indigenous perspectives and broader environmental health
- Simple text analysis methods enhance One Health policy-making processes
- Focus on zoonotic diseases with gaps in climate and socio-cultural integration

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In brief

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Mixed-method analysis of published national one health strategic plans

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SUMMARY

In this article, we used a mixed analytical framework to assess existing National One Health Strategic Plans (NOHSPs) and evaluate their alignment with recognized One Health principles. Eight NOHSPs were examined following a qualitative content analysis and key One Health characteristics were identified. Quantitative text analysis was performed to assess unigrams and bigrams frequencies across the NOHSPs. Network analysis was conducted to explore the conceptual relationships surrounding the term "health" in each document. Results revealed varying levels of alignment with contemporary One Health principles. Notably, while all plans recognized the importance of cross-sectoral collaboration and environmental health, specific actions were inconsistently anticipated. Additionally, disparities in addressing issues such as climate change, anthropogenic drivers, and non-communicable diseases were evident. Overall, the study offers insights into the strengths and gaps in existing NOHSPs. Moreover, it provides a flexible analytical framework to guide stakeholders in developing and evaluating future One Health initiatives.

INTRODUCTION

In a world characterized by the intertwined and reinforcing crises of climate emergency, biodiversity loss, conflict, and global inequities,[1] health is similarly at risk. The emergence and re-emergence of infectious diseases at the ever-increasing human-animal-environment interfaces accentuate the risk of epidemics and pandemics while the same crises also drive and exacerbate non-communicable diseases (NCDs). Socio-economic factors play a foundational role in influencing health outcomes[2] with national and global inequalities and inequities impacting access to healthcare, benefit sharing, education, capacity bridging and building, as well as political empowerment and participation. However, the importance of political empowerment and participation may vary across countries, as not all nations share or prioritize these values equally. Effectively addressing these multiple root-cause drivers of disease emergence and spread in a coordinated systems-based approach is critical in maintaining good health and wellbeing for all.[3]

Global leaders, national and regional governments, multilateral organizations, and civil society widely acknowledge that an intact and functioning socio-ecological system is critical for optimal health outcomes.[4] Health, enshrined as a fundamental human right, is increasingly recognized as a global good and societal asset.[5] One Health is a systems-based approach defined by the One Health High-Level Expert Panel (OHHLEP) as "*an integrated, unifying approach that fosters the health and well-being of people, animals, and their shared ecosystems by emphasizing their interconnectedness. It mobilizes multiple sectors and disciplines to provide healthy food, water and energy, address climate change, and contribute to sustainable development.*"[6] A One Health approach to health builds on transdisciplinary and cross-sectoral collaborations at local, national, and international scale.[7] However, unifying One Health into existing, historically siloed governmental structures, budgets, and legislative texts presents significant challenges.[8] Multilateral organizations have undertaken multiple initiatives to operationalize One Health approaches and strengthen governance and funding for pandemic prevention, preparedness, and response.[9,10] The *One Health Joint Plan of Action 2022–2026*[10] provides a framework to integrate One Health systems and capacities by focusing on six pillars: One Health capacity for health systems; emerging and re-emerging zoonotic epidemics/pandemics; endemic zoonoses, neglected tropical and vector-borne diseases; food safety risks; antimicrobial resistance and environment.[11] A recent editorial in The Lancet stressed the importance of the environment by highlighting that addressing human encroachment on the environment *"was a medical intervention per se."*[12]

Recent zoonotic-origin epidemics and pandemics including those caused by SARS, H1N1, or Ebola virus have incurred a

substantial cost of US$ tens of billions, while the COVID-19 pandemic is estimated to have cost at least US$ 15 trillion.[13] In contrast, the estimated cost of prevention has been calculated to be <2% of the cost of the COVID-19 pandemic.[13] By targeting the drivers of disease emergence and prevention within the Prevention-Preparedness-Response triad significantly reduces morbidity, mortality, and the economic costs of disease outbreaks to global society.[14] Yet, despite the life-saving benefits and cost-effectiveness of primary pandemic prevention,[15] many health systems neglect to address underlying issues hindering its implementation.[16–19] Furthermore, public awareness of the value of prevention remains limited.[20]

Formal, written records are a fundamental aspect of the administrations that govern modern societies, including the field of public health, and document analysis represents a valuable tool for understanding policy content across time and regions, examining policy development processes, analyzing the presentation of information and ideas, exploring how issues are framed, and assessing the extent to which policies align with influential principles for successful implementation.[21–23] However, health policy documents may lack clarity in defining the concepts they rely on and the outcomes they aim to achieve. This issue is compounded by the fact that policy writers are often not directly involved in the implementation process, leading to overlooked semantic details that can critically affect the policy's effectiveness and overall success.[23]

Systematic procedures are crucial for maintaining rigor in qualitative research, yet specific guidance is frequently absent in health policy analysis and a variety of approaches exist.[24–28] Challenges in this field include aligning methods with research questions, thoroughly documenting search strategies, systematically gathering, organizing, and archiving documents, employing rigorous data coding and analysis processes, and ensuring clear connections between documents and study conclusions.[22,24] To address these challenges, researchers have increasingly turned to text mining techniques to systematically and objectively assess document contents.[28–30] These approaches offer efficiency and speed in text processing but can be limited in their ability to understand the nuances of human language compared to human interpretation.[28] Mixed-method approaches, which combine qualitative analysis with text mining, can leverage the strengths of both techniques, enabling the efficient process of large volumes of text while maintaining the depth and contextual understanding necessary for robust policy analysis. Furthermore, previous efforts to evaluate One Health initiatives highlighted challenges in creating an evaluation framework, emphasizing the need for mixed methods to generate comparable measures and benchmarks.[31]

The objective of this study was to assess to which extent existing National One Health Strategic Plans (NOHSPs) adhere to the various characteristics highlighted in recent definitions of One Health[6,32] and to characterize similarities and differences in these strategic plans. Here, we propose a reproducible analytical framework for stakeholders and policymakers that combines qualitative and quantitative approaches, facilitating the evaluation of One Health policies and supporting the development of future initiatives. By utilizing text mining, we relied on the assumption that the frequency and co-occurrence of key terms could serve as proxies for the emphasis placed on various One Health themes within the NOHSPs, uncovering trends and patterns not immediately apparent through qualitative analysis alone.

RESULTS

Selection and inclusion of national one health strategic plans across eight countries

The search initially retrieved 261 publications. Duplicate removal resulted in 241 documents, including 128 peer-reviewed papers and 113 One Health related national plans (see Note S1). Seven publications met the inclusion criteria, i.e., corresponded to NOHSPs; all of them were available on the One Health Commission website.[33]These plans were published by seven African nations: Ethiopia, Liberia, Nigeria, Rwanda, Tanzania, Uganda, and Zambia (Table 1). Furthermore, we received Bhutan's One Health Strategic Plan 2019 through direct contact with the national One Health commissioner. Ultimately, eight NOHSPs, published between 2014 (Rwanda) and 2022 (Zambia), were included in this study (Figure 1).

National one health strategic plans recognize key concepts but show gaps in envisioned actions

The ten overarching concepts identified through content analysis of the Berlin Principles and OHHLEP One Health definition and key principles are summarized in Table 2. Sixty One Health characteristics and 387 linked keywords were identified to best describe the respective ten concepts and were subsequently searched in the texts. Overall, 26 of 60 (43%) One Health characteristics were recognized with specific actions envisioned across the eight plans (Figure 2).

Concept 1: Recognize and take action to further the critical link between the health of humans, wildlife, livestock, plants, fungi, and their shared environment. All plans recognized the links between human, livestock, and wildlife health, as well as the importance of environmental health while outlining a path from recognition to action. The health of fungi was mentioned in two NOHSPs (Ethiopia and Zambia) while plant health was not recognized (Bhutan) or not included in specific actions (Bhutan, Nigeria, Rwanda, and Tanzania).

Concept 2: Equity across sectors and disciplines. Develop strong One Health institutions, infrastructure, and governance frameworks while investing and facilitating multi-or transdisciplinary research and cross-sectoral collaborations. Translate science to inform policies and communicate with civil society. All plans recognized and described specific actions toward the development of One Health institutions, infrastructures, and governance framework. Similarly, multi- or transdisciplinary work, cross-sectoral approaches, as well as the promotion of research and translation of science into policy were recognized and specific actions defined. The One Health characteristics of equity across sectors and disciplines were recognized in seven plans while specific actions were only mentioned in four NOHSPs (Liberia, Rwanda, Tanzania, and Uganda). Notably, Bhutan did not address the notion of equity.

Concept 3: Recognize and take action on the climate crisis. The climate crisis is recognized by all plans. However, only three

Table 1. Overview of the eight analyzed National One Health Strategic Plans including title, authors, year of publication, and number of pages

National One Health Strategic Plan	Authors	Year of publication	Number of pages
Bhutan One Health Strategic Plan, 2ND Edition 2018-2023	Ministry of Health (Department of Public Health), Ministry of Agriculture and Forests (Department of Livestock and Bhutan Agriculture and Food Regulatory Authority)	2019	48
Ethiopia National One Health Strategic Plan 2018-2022	Ministry of Agriculture and Livestock Resources, Ministry of Health, Ministry of Culture and Tourism, Ministry of Environment, Forest and Climate Change	2018	64
Liberia National One Health Strategic Plan, 2019-2023	Ministry of Health, Ministry of Agriculture, Forestry Development Authority, Environmental Protection Agency, Ministry of Commerce and Industry, National Disaster Management Agency, National Public Health Institute of Liberia	2018	48
Nigeria National One Health Strategic Plan, 2019-2023	Federal Ministry of Health, Federal Ministry of Agriculture and Rural Development, Federal Ministry of Environment	2019	80
Rwanda One Health Strategic Plan (2014–2018)	Ministry of Health, the Ministry of Agriculture and Animal Husbandry, University of Rwanda, Rwanda Development Board	2014	74
The United Republic of Tanzania One Health Strategic Plan 2015–2020	United States Department of Defense (DoD), Defense Threat Reduction Agency (DTRA), Cooperative Threat Reduction (CTR), Cooperative Biological Engagement Program (CBEP)	2015	66
Uganda One Health Strategic Plan 2018-2022	Ministry of Health (MoH), Ministry of Agriculture Animal Industry and Fisheries (MAAIF), Uganda Wildlife Authority (UWA), Ministry of Water and Environment (MWE)	2018	52
Republic of Zambia One Health Strategic Plan 2022-2026	Ministry of Health, Ministry of Fisheries and Livestock, Ministry of Green Economy and Environment	2023	90

plans (Ethiopia, Liberia, and Zambia) described their respective actions.

Concept 4: Recognize the dynamic anthropogenic drivers to the global health crisis and the foundational importance of intact environments and respective ecosystem services. Seven NOHSPs acknowledged anthropogenic drivers on health outcomes, although only Liberia and Zambia planned to take actions to mitigate their impacts. The importance of an intact environment was recognized in all plans, but only the Liberian, Rwandan, and Ugandan plans described actions. Ecosystem services were mentioned in four NOHSPs (Liberia, Nigeria, Tanzania, and Zambia), but none described planned actions. The dynamic nature of the root causes of the global health crisis was recognized in most NOHSPs, however, apart from Nigeria, no specific actions were described. Similarly, uncertainty related to the drivers of the global health crisis was poorly addressed across NOHSPs, with only two countries (Rwanda and Tanzania) acknowledging this issue.

Concept 5: Devise adaptive, holistic, and forward-looking approaches to the prevention, detection, monitoring, control, and response to emerging or resurging communicable and non-communicable diseases. Prevention, detection, monitoring, and surveillance, as well as control, mitigation, and response, were recognized in all strategic plans and respective actions were planned. Similarly, the need for a holistic approach was recognized and included an actionable dimension across all strategic plans. Remarkably, NCDs received limited attention in the eight NOHSPs. An additional specific search conducted both manually and programmatically, was performed to identify mentions of the stemmed terms "non-communic," "non -communic," ‘‘non – communic," "non-communic," "noncommunic," "non communic," "chronic," and "NCD," revealed that the notion of non-communicable/chronic disease appeared only five times across the eight NOHSPs.

Concept 6: Recognize and integrate human behaviors and practices in One Health approaches. Develop solutions for present and future generations that draw on scientific as well as Traditional Knowledge Systems while considering animal welfare. All plans recognized the need for science-based solutions and planned actions accordingly. In contrast, Traditional Knowledge Systems were only recognized in three plans (Nigeria, Tanzania, and Uganda) with two respective defined actions. Consideration of present and future generations in the solutions

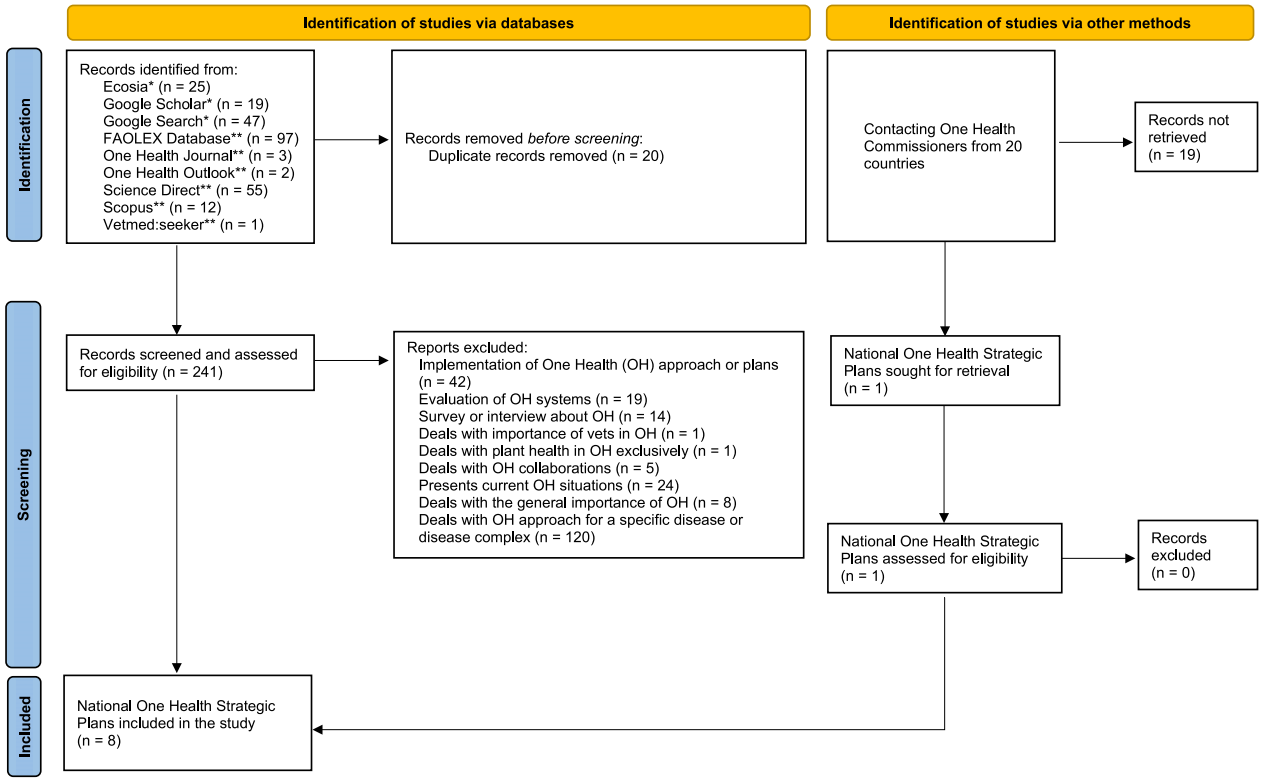

Figure 1. Flow diagram of National One Health Strategic Plans retrieval

Adapted from Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021; 372:n71. https://doi.org/10.1136/bmj.n71. For more information, visit: http://www.prisma-statement.org/.

was evident in all plans, although Ethiopia and Liberia did not describe specific actions. Seven plans recognized the importance of social sciences in One Health approaches. While Tanzania recognized benefits, it did not mention the use of social sciences in the plan. Animal welfare was not recognized as a One Health characteristic in any of the plans.

Concept 7: Enhance capacity for cross-sectoral and transdisciplinary health surveillance and data information sharing to improve the *coordination of responses across governments, Non-Governmental Organisations (NGOs), academia, and public and private sectors.* Cross-sectoral and multi-disciplinary health surveillance was recognized and actions were defined across all plans. Data analysis was seen as beneficial in all NOHSPs, with Bhutan, Nigeria, Rwanda, and Uganda outlining implementation actions. Planned actions to implement data and information sharing mechanisms were defined in all plans. Actions to improve data and information sharing were centered on improving coordination between stakeholders (government, multilaterals, NGOs, academia, and private sector). The four principles of data findability, accessibility, interoperability, and reusability (FAIR) were not collectively addressed in any of the plans. However, aspects of data accessibility were specifically mentioned by Liberia and Rwanda. The importance of coordination with multiple stakeholders was acknowledged with respective actions defined in six plans (Bhutan, Ethiopia, Nigeria, Rwanda, Uganda, and Zambia).

Concept 8: Recognize the importance of gender, socio-political, and multicultural parity and strengthening participatory, collaborative relationships across governments, multilaterals, NGOs, the private sector, and civil society including Indigenous Peoples and local communities as well as other marginalized voices to address the inter-related crisis of climate change, global health, biodiversity loss, and inequities. Parity was acknowledged as an important value in the Ethiopian (addressing gender equality, cultural sensitivity, and inclusion of disability) and Ugandan (addressing gender inequality and equity issues) NOHSPs. Remarkably, parity was not associated with specific actions in any of the plans. Gender in health issues and decisions was only recognized in two plans (Uganda and Ethiopia) while actions were planned in Uganda only. The importance of Indigenous People's voices was recognized by Ethiopia, Nigeria, and Uganda, despite no specific actions defined. The importance of integrating marginalized voices (e.g., refugees, disabled, and other vulnerable people) was mentioned in all plans except for Bhutan, with actions defined only in the Ugandan plan. The importance of cooperation with multilaterals, government,

Table 2. Ten overarching concepts aiming at summarizing both the Berlin Principles[32] and the One Health definition and key principles developed by the One Health High Level Expert Panel,[6] the 60 related One Health characteristics that described the overarching concepts, and 387 keywords used for manual search in the National One Health Strategic Plans

Overarching concepts	One Health characteristics	Keywords
1. Recognize and take action to further the critical links between the health of humans, wildlife, livestock, plants, fungi, and their shared environment.	Health links: 1. Humans 2. Wildlife 3. Livestock 4. Plants 5. Fungi	Interlinked; interconnected; connected; linked; linkages; zoonosis; zoonotic; human; animal; wildlife; livestock; domestic; plant; fungi; connection, public health; interface; socio-economy; migration; relatedness.
	6. Environmental health	Environment; environmental health; ecosystem health; health of the environment; healthy environment; contamination; ecological health; environmentally friendly practices; environmental friendliness; flora; fauna; rehabilitation.
2. Equity across sectors and disciplines. Develop strong One Health institutions, infrastructure, and governance frameworks while investing and facilitating multi-, transdisciplinary research and cross-sectoral collaborations. Translate science to inform policies and communicate with civil society.	7. Equity across sectors and disciplines	Equity; partnership; shared responsibility; equitably; adequate; synergism.
	8. Development of One Health institutions, infrastructure, and governance frameworks	Institutions; institutional; infrastructure; governance; institutional linkages; network; institutional framework; collaboration; committee; health services; working group; collaboration; platform; actors; structure; harmonization; unit; division.
	9. Multi- or transdisciplinarity	Multidisciplinary; multi-disciplinary; transdisciplinary; *trans*-disciplinary; across disciplines; ministry; cross-disciplinary; interoperable; multi-actors; connectivity; decentralized; interdisciplinary; veterinary; medicine; environment.
	10. Cross-sectorality	Cross-sectoral; cross-sectoral; across sectors; multi-sectoral; multisectoral; ministry; united; connectivity; tiers; decentralized; inter-ministerial; industry; nonprofit; NGO; government.
	11. Invest in One Health research	Research; collaborative research; joint research; publication; dissemination; innovation; development; proposal; united.
	12. Translate science	Translate; translation; science-to-policy; explain*; communication; communicating; guidelines; publication; dissemination; policy briefs; agenda; sensitization; disseminate; presentations; report; media; channel.
3. Recognize and take action on the climate crisis.	13. Climate crisis	Climate change; climate crisis; global warming; green economy; alternative energy; renewable energy; carbon; greenhouse gas emission.

(*Continued on next page*)

Table 2. ***Continued***

Overarching concepts	One Health characteristics	Keywords
4. Recognize the dynamic anthropogenic drivers of the global health crisis and the foundational importance of intact environments and respective ecosystem services.	14. Anthropogenic drivers	Human-mediated; anthropogenic; economy; driving; driver; drivers; forces; cultural influences; human activities; manmade; globalization; population growth; pollution; environmental degradation; deforestation; land-use changes.
	15. Intact environments	Intact environment; intact environments; preserve environment; preserved environments; intact habitat; intact habitats; function; conservation; protection; protected areas; restauration; biodiversity; biological diversity; water; air; balanced.
	16. Ecosystem services	Ecosystem services; benefits; services; ecological goods and services; environmental services; nature's services; land resources; natural resources; biological resources.
	17. Dynamic.	Dynamic; dynamical; changing; change; shifting; "living document."
	18. Uncertainty.	Uncertain; uncertainty; unpredictable.
5. Devise adaptive, holistic, and forward-looking approaches to the prevention, detection, monitoring, control, and response to emerging or resurging communicable and non-communicable diseases.	19. Holistic.	Holistic; integrated; comprehensive; universal.
	20. Prevention.	Prevention; preventive; preventing; prevent; preparedness; early warning; quarantine; precaution; biosecurity.
	21. Detection.	Detection; detecting; detect; inspection; investigate; diagnose; identification; hotspots.
	22. Monitoring, surveillance.	Monitoring; surveillance; monitor; oversight.
	23. Control, mitigation, response, respond.	Control; mitigation; mitigate; response; respond; stopping; stop; reduce; reducing; reduction; eradication.
6. Recognize and integrate human behaviors and practices in One Health approaches. Develop solutions for present and future generations that draw on scientific as well as traditional knowledge while considering animal welfare.	24. Human behaviors and practices.	Behavior; behavior; tradition; culture; practice; social; socio; ethical; moral; values; behavior change.
	25. Social sciences.	Social science; social; socio; questionnaire; survey.
	26. Animal welfare.	Welfare; well-being.
	27. Present and future generations, multigenerational.	Generation; future; sustainable; sustainability; multigenerational; transmit; transmission; long-term; lifespan; continuity; lasting; commitment; resilient; impending; quality of life.
	28. Science.	Evidence-based; evidence-driven; data-driven; based on science; based on evidence; based on data; laboratory; diagnostic; technological; vaccine.
	29. Traditional knowledge.	Indigenous Knowledge; Traditional Ecological Knowledge (TEK); intergenerational knowledge; traditional medicine; healing practices; healer; spiritual.

(*Continued on next page*)

Table 2. ***Continued***

Overarching concepts	One Health characteristics	Keywords
7. Enhance capacity for cross-sectoral and transdisciplinary health surveillance and data information-sharing to improve coordination of responses across governments, Non-Governmental Organisations (NGOs), academia, public and private sectors.	30. Cross-sectoral and *trans*-disciplinary health surveillance.	Multidisciplinary; multi-disciplinary; transdisciplinary; *trans*-disciplinary; across disciplines; ministry; cross-disciplinary; interoperable; multi-actors; connectivity; decentralized; cross-sectoral; cross-sectoral; across sectors; multi-sectoral; multisectoral; united; tiers; inter-ministerial; health surveillance; surveillance; disease surveillance.
	31. Data analysis.	Data analysis; analyzing data; interpreting data; editing data; statistics; process.
	32. Data and Information sharing mechanisms.	Data sharing; information sharing; sharing data; sharing information; network; networking; sharing; information exchange; information system; accessibility; coordination.
	33. FAIR data (findable, accessible, interoperable, and reusable).	FAIR data; accessibility; harmonize; centralized database; findability; accessibility; interoperability; reusability.
	Coordination: 34. governments, 35. multilaterals, 36. NGOs, 37. academia, 38. private sector.	Government; multilaterals; multi-laterals; international; NGO; academia; high education; second school; university; non-governmental organizations; public sector; non-state actors; partners; incorporate; levels; federal; civil society; agencies; private sector; parliament; internal; external; cross-border; stakeholders.
8. Recognise the importance of gender, socio-political, and multicultural parity and strengthen participatory, collaborative relationships across governments, multilaterals, NGOs, private sector and civil society including Indigenous Peoples and local communities as well as other marginalised voices to address the polycrisis of climate change, global health, and biodiversity loss.	39. Parity.	Equality; equivalence; equivalent; parity.
	40. Gender.	Gender; woman; empowerment.
	41. Indigenous People.	Indigenous people; native; rural.
	42. Local communities.	Communities; local; district; subnational level; regional; zonal; village.
	43. Other marginalized voices.	Marginalized; refugee; disability; vulnerable populations; ethnicity; neglected; nomadic; pastoral communities.
	Cooperation: 44. governments, 45. multilaterals, 46. NGOs, 47. private sector.	Government; multilaterals; multi-laterals; NGO; nongovernmental organizations; public sector; non-state actors; partners; incorporate; levels; federal; civil society; agencies; private sector; parliament; internal; external; cross-border; stakeholders.
9. Educate; build capacity and raise awareness among children, youth, and adults for global citizenship and health of the Planet utilising appropriate channels and facilities.	OH education and awareness: 48. general, 49. children, 50. youth, 51. adults, 52. communities, 53. students, universities, 54. policy.	Education educate; awareness; aware; youth; young people; children; communities; university; policy; students; school; behavior change; training; seminar; workshop; conference; sensitization; sensitize; curriculum; learning; understanding; knowledge; attitude; campaigns; skill; mainstreaming; academic; (social) media; teaching.
	55. Capacity bridging and building.	Capacity building; build capacity; capacities; human resources; supplies; equipment; mobilization; mobilize; manpower.

(*Continued on next page*)

Table 2. *Continued*

Overarching concepts	One Health characteristics	Keywords
10. Develop, strengthen, and influence policy to recognize that the health of all (including humans) ultimately depends on environmental integrity and a healthy planet.	56. Develop and influence policy.	Policymaking; policymaking; policy makers; decision-making; decision makers; policy framework; structure; policy environment; formulation; constitution.
	57. Develop and influence legislation.	Legislation; legislative; law; formulate; enforce; administrative; policy document; formulation.
	58. Multilateralism.	Multilateralism; multilateral; multi-lateral; international; governments; cross-border; neighboring country; partners.
	59. Develop and influence regulation.	Regulation; treaty; agreements; protocol; convention; accord; strategy; guidelines; standard operation procedure (SOP); standards; manual; instruction.
	60. Include One Health into policy.	Implementation; implement; One Health policy; incorporate; operationalization; integrate; policy document.

Concepts and characteristics are numbered independently.

NGOs, academia, and the private sector was generally acknowledged, and actions were planned for implementation.

Concept 9: Educate, build capacity, and raise awareness among children, youth, and adults for global citizenship and health of the Planet utilizing appropriate channels and facilities. Although all eight countries recognized and planned actions to improve general One Health education and awareness, the plans inadequately documented which population cohorts were targeted. Interestingly, One Health education rarely addressed specific age groups such as children, youth, or adults, except for the Ugandan plan, which explicitly mentioned these three age segments. In contrast, One Health education and awareness raising in communities, students, and policy are clearly recognized with respective actions planned in all NOHSPs with the exception of Uganda. Capacity bridging and building were consistently recognized, with actions planned across all NOHSPs.

Concept 10: Develop, strengthen, and influence policy to recognize that the health of all (including humans) ultimately depends on environmental integrity and a healthy planet. The importance of including One Health framing into policy was recognized and actions to achieve this goal were described in all plans. All NOHSPs noted the relevance of multilateralism and described means to influence policy, legislation, and regulations to recognize the importance of environmental integrity and a healthy planet. An exception is the Tanzanian NOHSP which did not describe actions to develop specific legislation.

Quantitative text analysis highlights common focus but varying contextual associations across countries

The corpus counted 6,050 unique tokens appearing across the eight documents after stop words removal, with sparsity reaching 71%, implying that almost three-quarters of the terms only occurred in a few documents.

Unigram and bigram frequency patterns across NOHSPs

The unigrams "health" (frequency = 3,930 occurrences) and "one" (2,509) were the most common across the eight NOHSPs (Table S1). They were followed by the word stems "diseas" (1,292), "develop" (804), "anim" (725), "active" (647), "zoonot" (610), "human" (594), "surveil" (571), "sector" (567), "implement" (535), "public" (535), "respons" (529), "research" (458), "coordin" (450), "emerg" (405), "level" (392), "ministri" (389), "conduct" (382), and "institut" (380) (Figure 3). Unigram frequency patterns were highly similar across NOHSPs (all Spearman's Rho were comprised between 0.34 and 0.60, with all p-values ≤ 0.001) (Figure S1).

The bigrams "one health" exhibited the highest frequency (2,298 occurrences) across the NOHSPs, followed by "zoonotic disease" (423) "public health" (402), "animal health" (223), "human animal" (175), "health approach" (172), "preparedness response" (133), "health surveillance" (124),"health threat" (119), "infectious disease" (114), "health activity" (103), and "health secretariat" (103) (Figure 4). The top 10 bigrams showed slight variations between countries. For instance, "climate change" uniquely appeared in the top 10 bigrams in Ethiopia's NOHSP, while "food safety" was featured in Zambia's top 10 (Figure S2). The bigram frequency patterns between the following pairs of NOHSPs were significantly similar (i.e., p-value ≤ 0.05): Ethiopia-Liberia, Liberia-Rwanda, Liberia-Bhutan,

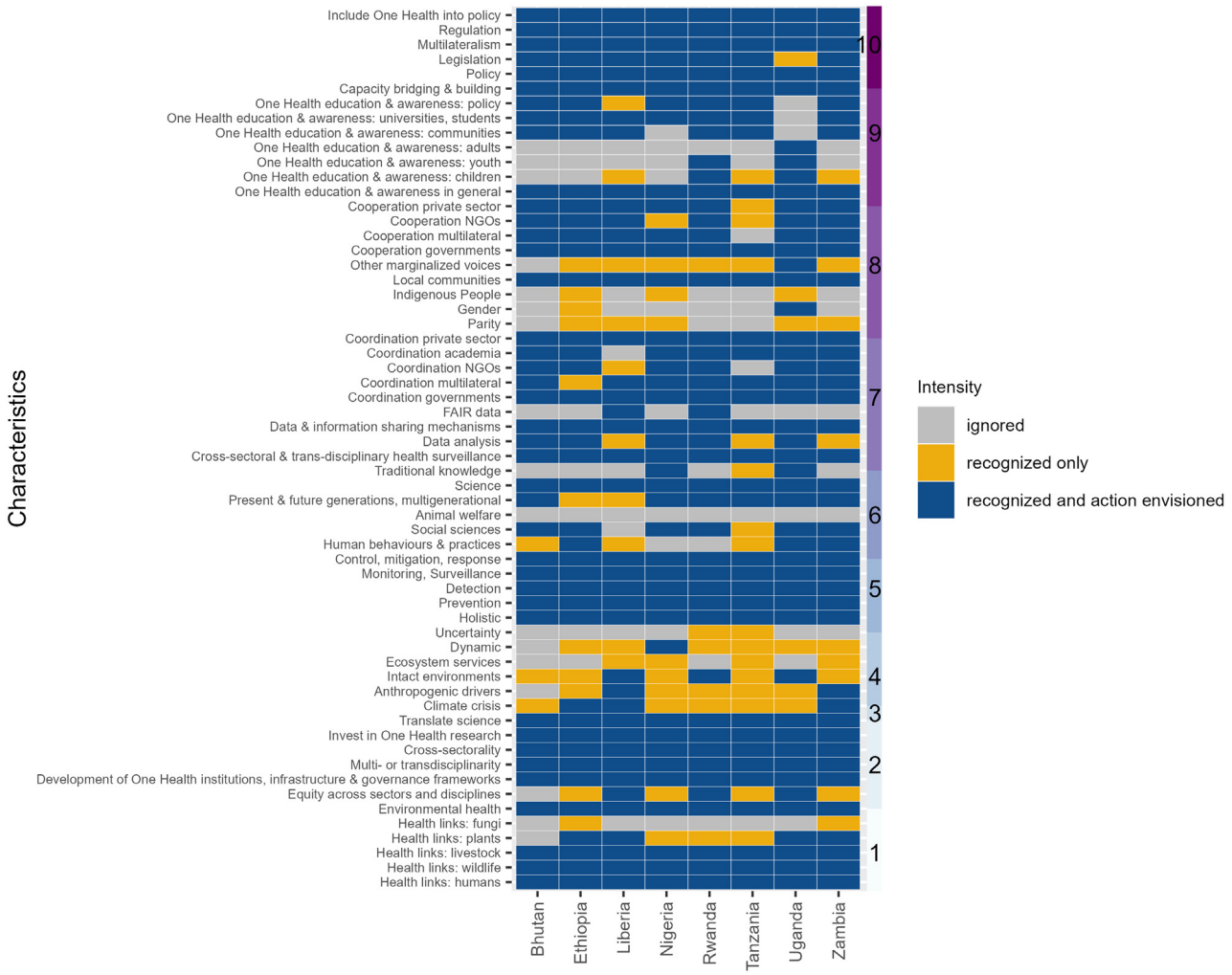

Figure 2. Heatmap summarizing the results of the qualitative content analysis of eight National One Health Strategic Plans

The y axis represents the 60 One Health characteristics summarizing the ten overarching concepts (concept numbers are indicated on the right side of the matrix); the x axis represents the countries; the colors represent the degree to which each One Health characteristic is addressed in the plan (i.e., ignored, recognized, or recognized with envisioned actions).

Rwanda-Bhutan, Rwanda-Tanzania, Rwanda-Nigeria, Bhutan-Tanzania, Bhutan-Nigeria, and Nigeria-Uganda (Spearman's Rho between 0.35 and 0.6). Other bigram pattern pairwise comparisons among NOHSPs revealed poor correlation (Figure S3).

Clustering analysis reveals divergent patterns in one health keywords across National One Health Strategic Plans

The hierarchical clustering analysis (HCA) groups similar documents based on their textual content, focusing on word associations and patterns rather than explicit thematic labels. The HCA demonstrated that both qualitative and quantitative approaches to One Health keywords captured distinct patterns and characteristics within the NOHSPs. Notably, the analysis of the binary matrix showed that Uganda's NOHSP significantly diverged from those of the other countries, while Nigeria, Bhutan, Ethiopia, and Zambia form one cluster, and Tanzania, Liberia, and Rwanda form another (Figure 5A). In contrast, the HCA based on the frequency matrix identified three clusters: cluster 1 comprised Nigeria and Zambia, cluster 2 included Tanzania, Ethiopia, and Rwanda, and cluster 3 included Bhutan, Uganda, and Liberia (Figure 5B).

Quantitative analysis supports qualitative findings: Strong focus on zoonotic diseases, less on environmental health

Consistent with the qualitative content analysis, the quantitative approach demonstrated that terms related to the recognition of health links, especially at human-animal interfaces (e.g., "human" "health," "animal," and a combination thereof) were the most frequent, with a strong emphasis on infectious diseases (frequent use of terms such as "diseas," "infectious disease," "threat," "outbreak") and public health ("public health"). In contrast, both approaches pointed to a comparatively lower emphasis on environmental health. The analyses further highlighted that the NOHSPs predominantly centered on zoonotic diseases, as reflected by the recurring presence of words such

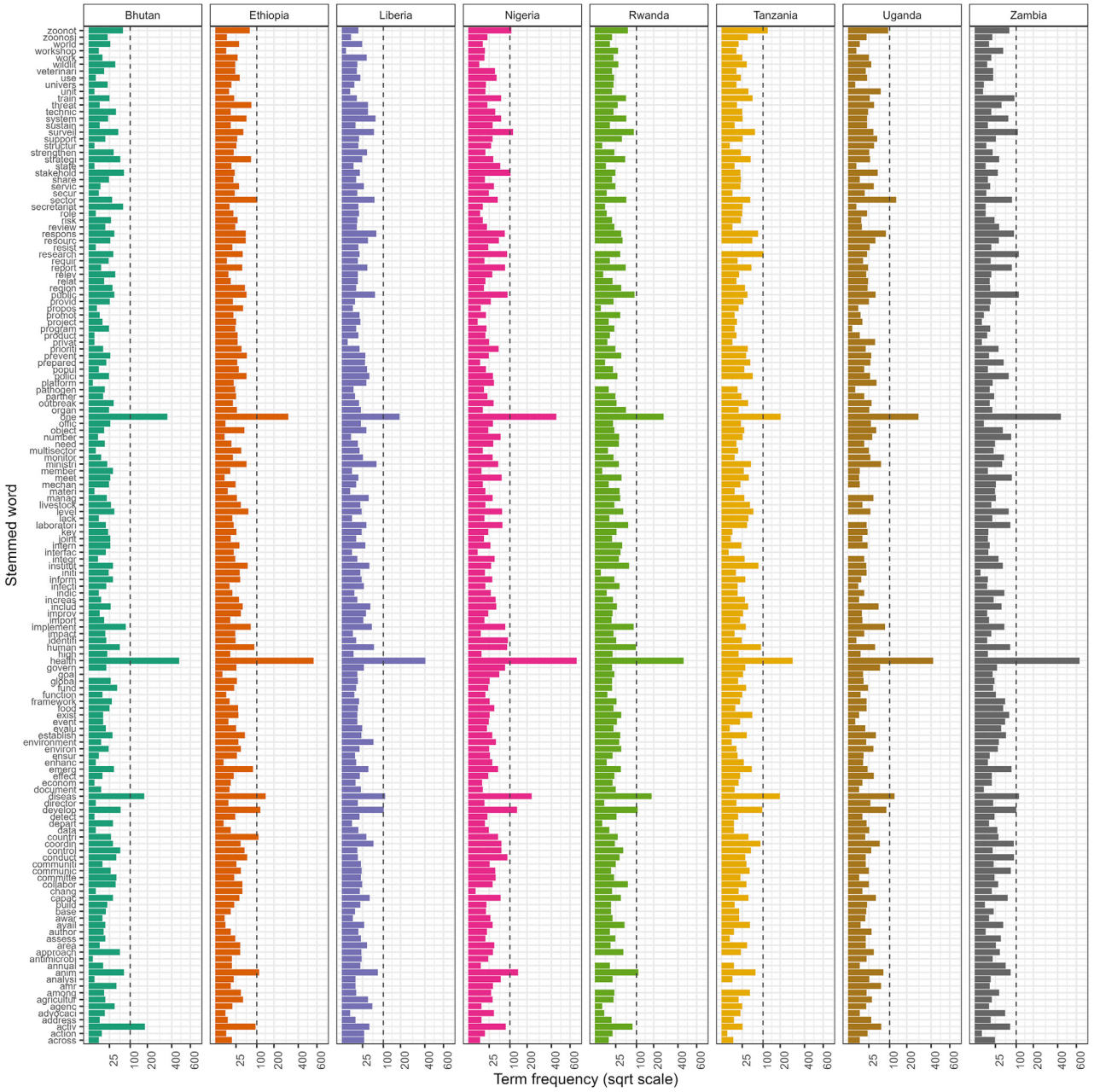

Figure 3. Frequency distribution of the top common 150 unigrams used in the eight National One Health Strategic Plans (NOHSPs)

Only unigrams that appeared at least 100 times across the eight NOHSPs were considered in this analysis. Frequencies were computed using the term frequency weighting method.

as "zoonot," "emerg," and "zoonotic disease" across the eight NOHSPs. The emphasis on strengthening the health systems, particularly in the areas of disease monitoring, prevention, and outbreak control was underscored by the frequent use of terms such as "system," "control," "prevent," "surveil," "monitor," "laboratori," and "health surveillance" across the Plans. The NOHSPs also showed commitment in building capacity and strengthening overall preparedness to address One Health challenges, as reflected in the prevalence of terms such as "laboratori," "train," "strategi," and "resource." The frequent mention of terms such as "research," "institut," "train," "support," "health activity," and "health approach" further indicated a strong commitment to enhancing research capacity and developing the necessary infrastructure. The critical role of coordination, collaboration, and cooperation among multiple stakeholders, including both private and public sectors, in addressing One Health challenges at different levels is evident from the prominence of terms such as "stakehold," "coordin," "collab," "level,"

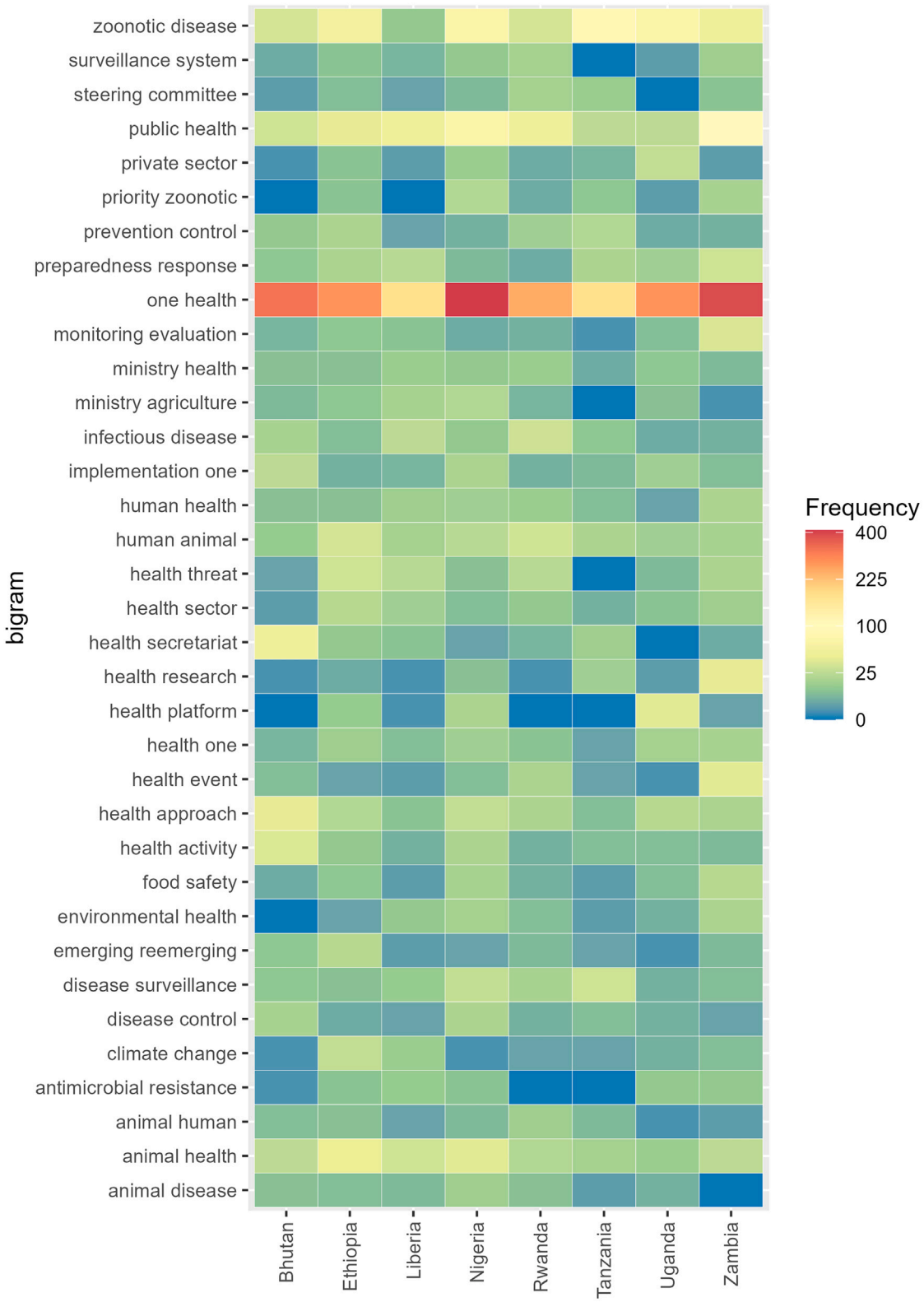

Figure 4. Heatmap representing the bigram frequency in each National One Health Strategic Plan (NOHSP)
Only bigrams that appeared at least 50 times across the eight NOHSPs were considered in this analysis.

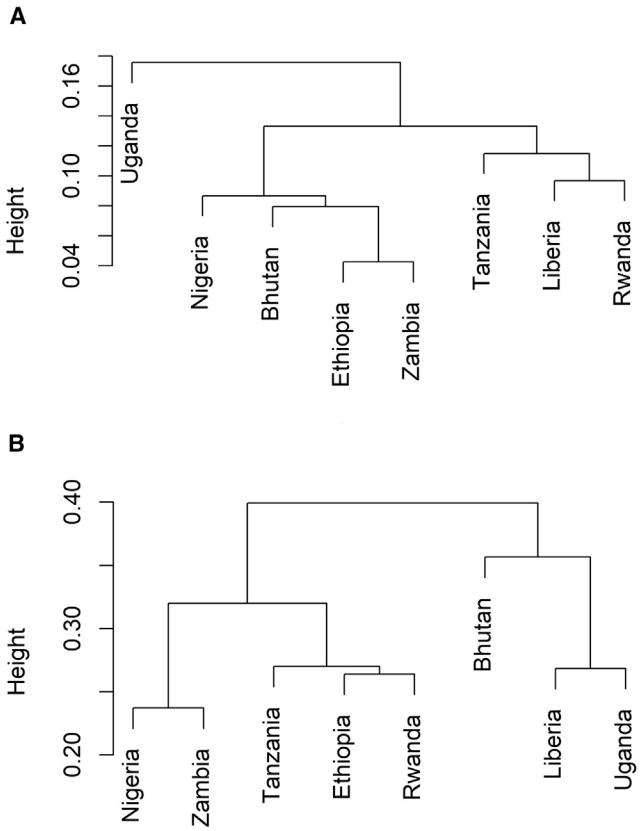

Figure 5. Dendrograms from the hierarchical clustering analysis of the eight National One Health Strategic Plans

Dissimilarity matrices were computed using the Bray-Curtis index using the R package vegan. The hierarchical clustering analysis was conducted using the *hclust()* function with the complete linkage method. The vertical axis represents the distance between clusters; the longer the vertical line, the greater the dissimilarity between the clusters being merged.

(A) Dendrogram from the hierarchical clustering based on qualitative text analysis. The qualitative analysis is based on a manual search of the keywords to locate mentions of the respective One Health characteristics. Furthermore, it was determined if the characteristics were merely acknowledged ("recognized") or if the plans defined specific actions related to the respective characteristic ("action envisioned").

(B) Dendrogram from the hierarchical clustering based on keywords frequency.

"multisector," "sector," "across," and "privat." Additionally, references to One Health institutions, infrastructure, and governance frameworks (e.g., "ministi," "platform," "agenc," "institut," "structure," "health secretariat"), as well as the integration of One Health into the policy (e.g., "polici," "integr," "implement"), highlighted the need for cohesive strategies and clear governance to effectively tackle One Health challenges. Focus on agriculture and associated risk management was suggested by the high frequency of terms such as "agricultur" and "livestock." Additionally, the importance given to the environment was reflected by the high frequency of the terms "environ" and "environment" (Figure 2; Figure 4; Table S1).

Overall, the quantitative approach supported findings from the qualitative approach, showing that keywords related to concepts 1, 2, 5, and 10 were the most frequent and revealed a similar pattern of gaps as observed in the qualitative content analysis. These findings suggested that, within our documents, the frequency of token occurrence may serve as a proxy for the emphasis placed on the corresponding One Health characteristics and concepts in the text.

Health subgraphs reveal variations in the conceptualization of the term "health"

The bigram network analysis of the terms most related to the term "health" underlined how each country thinks about health and translates it into its NOHSP. Figure 6 illustrates the network graphs of the most common bigrams associated with health in the eight NOHSPs. The network analysis showed that the terms "one" and "public" generally preceded the term "health." Similarly, "human" and "animal" preceded the term "health" across all NOHSPs. The term "environmental" preceded the word "health" in the NOHSP of Liberia, Nigeria, and Zambia. Notably, the term "water" appeared in relation to health solely in the Ugandan NOHSP. Network graphs depicting the health-related bigrams in the Nigerian and Rwandan NOHSPs exhibited a similar shape characterized by two clusters: one related to the node "health" and a second one related to the node "disease." The network graph depicting the health-related bigrams in the Bhutan NOHSP also showed two main clusters; however, in addition to the health-centered component, a second one was related to the term "activity" mostly referring to project management or implementation. Reference to the term implementation, in relation to One Health, was also observed in the NOHSP of Nigeria and Uganda. The term "research" was associated with health in the NOHSP of Zambia and Tanzania. Communication and training in the context of health were only mentioned by Zambia.

DISCUSSION

This study presents a methodology for identifying trending topics in NOHSPs, enabling an exploration of One Health strategy formulation and related social challenges at different levels of granularity. Our approach focused on straightforward methodologies of text analysis: (manual) qualitative content analysis, quantitative unigram and bigram token analysis, and analysis of the "health subgraphs," as an initial step to uncover key patterns and trends in One Health policy documents. Simple and understandable text analysis techniques, such as text mining, can significantly enhance policymaking, particularly during the agenda-setting and policy formulation phases.[23,30] Combining a traditional approach that is inherently subjective[34] with a more objective one, i.e., fully reproducible and customizable because relying on quantitative approaches and shared code, offers a multi-dimensional perspective on the NOHSPs. By using a free software (R[35]), alongside customizable and FAIR (Findable, Accessible, Interoperable, Reusable) code, our method remains accessible to policy analysts with basic programming knowledge.

We were only able to source eight publicly available NOHSPs. Notably, all these plans are from the "Global South," with seven originating from African countries and Bhutan representing the only Asian country. Moreover, all plans, except from Zambia,

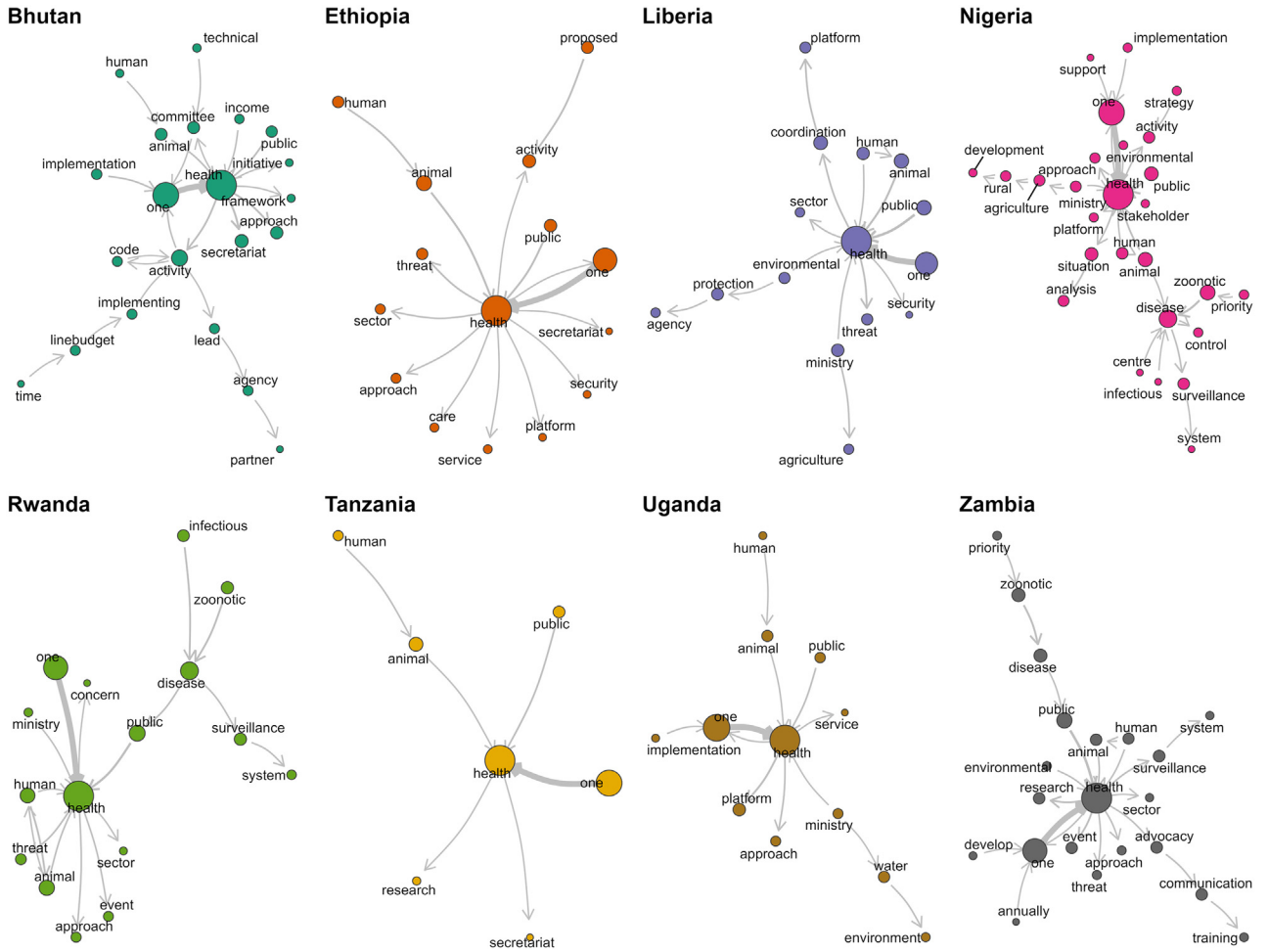

Figure 6. Bigram network graphs of the terms related to "health" in the eight National One Health Strategic Plans (NOHSPs)

The size of the nodes is proportional to the frequency of the individual term across all bigrams within the eight NOHSPs; the arrow width is proportional to the frequency with which related linked terms co-occurred in the documents (i.e., bigram frequency); the arrow shows the direction of the association (i.e., sequence) between the two terms of a bigrams.

were published before the onset of the COVID-19 pandemic in 2020. To the best of our knowledge, no finalized and publicly shared NOHSP exists across the "Global North." The pioneering efforts of the countries in this study must be applauded and acknowledged across the field. There is a growing interest in One Health, as evidenced by increasing peer-reviewed publications. For example, a PubMed search on the term "One Health" for the period 2012–2023 yielded 11,904 hits. In contrast to the NOHSPs, these publications primarily originate from high-income countries,[36] highlighting a discrepancy between countries publishing on the topic, and those actively developing comprehensive NOHSPs. This could be due to a heightened awareness and experience with zoonotic diseases across tropical and subtropical regions, paired with global funding opportunities that support the development of NOHSPs[37] in lower resource settings.

The qualitative content analysis identified key concepts within One Health that were similarly acknowledged across the NOHSPs: concepts 1 (the link between the health of humans, wildlife, livestock, plants, fungi, and their shared environment), 2 (equity across sectors and disciplines), 5 (adaptive, holistic, and forward-looking approaches to emerging or resurging communicable and non-communicable diseases), and 10 (develop, strengthen, and influence policy). This indicates a common core One Health ethos, recognizing shared health threats and alignment in proposed strategies.[38,39] However, significant differences were evidenced in how the countries addressed concepts 3 (recognize and take action on the climate crisis), 4 (recognize the dynamic anthropogenic drivers to the global health crisis, the importance of intact environments), 6 (recognize and integrate human behaviors and practices in One Health approaches), 7 (enhance capacity for cross-sectoral and transdisciplinary health surveillance and data information sharing to improve coordination), 8 (recognize the importance of gender, socio-political, and multicultural parity and strengthening participatory, collaborative relationships), and 9 (educate, build capacity, and raise awareness). Important gaps were observed, particularly in areas such as equity, gender,

Indigenous Peoples, Traditional Knowledge, and non-communicable diseases. The text mining results confirmed these gaps by showing low keyword frequencies for these concepts, underscoring the need for more comprehensive integration in future strategic plans. Additionally, the qualitative content analysis revealed that less than half (43%) of the One Health characteristics (that were used to encapsulate the ten One Health overarching concepts) were both acknowledged and envisioned for implementation across the eight NOHSPs. This strongly suggests a significant gap between the conceptualization of One Health and planned practical application in national strategic plans.

Our quantitative approach based on One Health keywords and token frequency analysis provides insights into the emphasis placed on One Health characteristics within NOHSPs, offering a quick way to identify priority areas in strategic plans. However, the quantitative approach alone lacks the ability to differentiate between mere recognition of these characteristics and the actionable steps planned. The HCA reveals that while both qualitative and quantitative approaches to One Health keywords provide valuable insights, they each highlight different dimensions of the data. The qualitative approach, through the binary matrix, provides insight into which One Health characteristics are recognized or envisioned, while the quantitative approach, through the frequency matrix, highlights the relative emphasis placed on these characteristics within the text. This underscores the necessity of combining both approaches to fully grasp the similarities and differences across the NOHSPs, particularly in understanding the context, prioritization, and intended actions related to the One Health concepts.

The analysis of unigram and bigram frequency patterns across the NOHSPs uncovered significant correlations, highlighting linguistic commonalities and significant lexical similarities among the eight NOHSPs and further supporting the notion of a unified ethos across NOHSPs. This correlation not only implies a common semantic but may also demonstrate shared focus, themes, interests, and/or priorities. For instance, we demonstrated a strong focus on human-animal interfaces and zoonotic diseases across the eight NOHSPs. Although all countries addressed environmental health in their plans, the general neglect of the environmental pillar suggests that the nations included in the study have prioritized human and animal health in their One Health strategies, reflecting a shared commitment to addressing critical health challenges at the human-animal nexus.[40,41] However, this focus on zoonotic diseases may also indicate a narrower interpretation of One Health, potentially overlooking other critical areas such as environmental health and socio-political equity, as evidenced by the lower frequency of terms related to these broader concepts.

The network analysis revealed a consistent and expected emphasis on the connection between the nodes "one" and "health" across the eight health subgraphs, reflecting the centrality of One Health in the NOHSPs. Mapping the health subgraph for each country provides valuable insights into the unique perspectives and areas of focus that each nation contributes to the One Health framework; notably, it highlights variations in how the concept of "health" is contextualized across different national strategies. For instance, Bhutan's NOHSP emphasizes an active and collaborative approach, where terms such as "implementing," "implementation," "activity," "initiative," "line budget," "lead," "agency," "partner," and "technical" are closely linked to "health." This suggests a focus on operationalizing health strategies through coordinated actions and partnerships. In contrast, the Rwandan and Nigerian NOHSPs place a strong emphasis on "disease" within their health subgraphs, with connections to terms such as "zoonotic," "infectious," "surveillance," and "control." This indicates a priority on disease management, particularly in monitoring and controlling zoonotic and infectious diseases. The term "environment" or "environmental" is prominently associated with "health" in the subgraphs of Liberia, Nigeria, Uganda, and Zambia, reflecting a recognition of the critical link between environmental health and overall public health in these countries' strategies. Additionally, the term "platform" appeared in the health subgraphs of Ethiopia, Liberia, Nigeria, and Uganda, suggesting a focus on establishing or utilizing platforms for health-related initiatives, possibly for collaboration, data sharing, or policy implementation. These distinctions may reflect cultural diversity or differences in the health threats and challenges encountered by the respective countries.

Unsurprisingly, NCDs received significantly less attention across the NOHSPs, mirroring the present global One Health focus on infectious diseases and antimicrobial resistance (AMR)[42] (e.g., our search yielded 70 One Health AMR strategic action plans). Limiting One Health initiatives solely to AMR and infectious diseases only addresses partially the six One Health Joint Plan of Action Tracks for tackling critical health challenges at the human-animal-plant-environment interfaces, as outlined by the Quadripartite.[11] Consequently, the current efforts remain insufficient in achieving sustainable health and food systems, mitigating global health threats, and enhancing ecosystem management.[11]

Similarly, the climate crisis was recognized in all plans, but only three countries, Ethiopia, Liberia, and Zambia, outlined envisioned actions. The absence of explicit strategies related to the climate crisis in the NOHSPs does not reflect a diminished commitment, as evidenced by separate national plans on climate.[43–47] It does however demonstrate that climate considerations and drivers are not seamlessly integrated into national One Health strategy formulation. Despite three countries having coastlines that contribute significantly to food security and other ecosystem services, they did not consider and integrate the coastal and marine environments into their NOHSPs.

The qualitative analysis revealed a low recognition and limited envisioned actions regarding One Health education and awareness in the NOHSPs (overarching concept 9). This observation is further supported by the quantitative analysis, which shows a low frequency of keywords and bigrams related to this theme. To enhance engagement and interest in One Health-related topics, it is crucial to tailor educational content to diverse audiences, taking into account factors such as age, accessibility to information, and socio-economic background. A notable example of a national commitment to this approach is Rwanda's University of Global Health Equity, which offers students an innovative One Health education model.[48]

Our findings demonstrate that the socio-cultural dimensions of health, i.e., those related to human behaviors and practices and

social sciences, are generally overlooked within NOHSPs. This conclusion is based on both the qualitative content analysis and the frequency of relevant keywords related to overarching concepts 6 and 8, highlighting a significant gap in addressing these dimensions within the strategic plans. For instance, only one country, Uganda, both recognized and planned action regarding gender, although gender inequalities and inequities continue to exert a substantial negative influence on health outcomes globally, including inequalities in living conditions, access to health services and health protection, susceptibility to communicable and non-communicable diseases, and representation in leadership positions.[3,49–52] In lower- and middle-income countries, women frequently bear a greater burden of zoonotic and infectious diseases due to their gender-specific responsibilities in household tasks and animal husbandry.[51,52] In Uganda, for instance, gendered social roles shape behaviors linked to the transmission of Rift Valley fever, such as handling raw meat or consuming unpasteurized milk.[53,54] Without alignment between policy and practice, particularly in addressing sociocultural determinants such as gender, these One Health policy initiatives risk being ineffective or only partially successful. Ensuring that these disparities are addressed is essential for achieving the comprehensive and equitable health outcomes that the One Health framework aspires to.

Indigenous Peoples' voices and rights are minimally addressed in the NOHSPs, with Traditional Knowledge Systems only acknowledged in three plans (Nigeria, Tanzania, Uganda), and actions envisioned in just two (Nigeria, Uganda). This is further evidenced by the scarce appearance of terms related to Indigenous Peoples, local communities, and other marginalized groups across the eight NOHSPs. The Ethiopian NOHSP briefly mentions traditional practices but dismisses their role in One Health strategies, citing concerns about limiting access to modern healthcare and fostering misbeliefs. Indigenous communities face unique health challenges, often linked to marginalization and environmental factors.[55–59] There is growing consensus on the importance of integrating Indigenous Knowledge and Traditional Medicine into One Health strategies, to decolonize attitudes toward Indigenous Knowledge and Traditional Medicine, and embrace a broader perspective that encompasses traditional, complementary, and integrative medicine with existing health systems.[60,61] Including Indigenous Peoples in these strategies ensures their rights, needs, and contributions are recognized, while also addressing the broader drivers of health and wellbeing.[62–64]

Future NOHSPs will profit from a harmonized core set of concepts and characteristics that align with the OHHLEP, Berlin Principles, and future reflections.[6,32] This could constitute a "One Health strategic master plan" that provides the initial step in developing harmonized but context-specific NOHSPs. The success of a master plan approach is dependent on clear definitions and a well-defined scope to bridge semantic and language barriers. The strategic plans will need to be embedded into a social-ecological framework, ensuring that shared goals for One Health are distinctly defined in a broader context, while considering an equitable continuum of care across species and generations.[65] Future plans will clearly benefit from including resilience and solidarity elements. While resilience, defined by the World Organization for Animal Health (WOAH) as *"the ability to flexibly prepare for, adapt and recover from adverse events*," "One Health resilience" remains to be precisely defined.[66] Incorporating currently overlooked One Health characteristics and anticipating their potential importance in the future is critical for strategic plans that will necessarily be updated and adapted in response to the dynamic and uncertain nature of the global health landscape.

Limitations of the study

The study is based on the analysis of only eight NOHSPs. To ensure meaningful comparisons, we applied strict inclusion criteria, focusing on documents that addressed similar challenges, utilized the One Health approach, were not centered on a specific disease or disease complex, and had some level of government acknowledgment. As a result, we may have overlooked documents published in languages other than those included in our search. Many national plans predate COVID-19, but the pandemic significantly advanced the recognition and implementation of One Health actions. Some policies may have integrated One Health concepts without explicitly using the term, making them harder to identify. Additionally, the available sample may not fully capture the wider range of strategies and approaches employed by different countries. Future research could benefit from including a broader spectrum of documents and controlling the analysis for document type and the specific health challenges addressed.

The study relies primarily on the textual content of the NOHSPs, using content analysis and analysis of n-grams. While these methods are useful for identifying trends and key terms, they might miss out on the deeper contextual understanding that could be gained from qualitative methods, such as interviews with stakeholders, involved in creating these plans. While keywords are essential for indexing and retrieval, they often fall short in capturing the full essence of a document. Comparing the NOHSPs across different countries is challenging due to variations in national priorities, health systems, and governance structures. Our study attempts to standardize the approach to a certain extent, but the complexity and diversity of the documents analyzed mean that some contextual factors might not be fully accounted for.

Moreover, employing more sophisticated semantic analysis techniques, such as topic modeling or sentiment analysis, could provide deeper insights into the nuances and underlying themes within the national plans. However, implementing these more advanced techniques across different cultural contexts presents significant challenges, notably because they often require careful interpretation by experts in psychology, linguistics, and cultural studies to ensure that the nuances of language and cultural expressions are accurately captured and understood.[67,68]

Finally, while our study focuses on the content of strategic plans, it does not address their implementation or outcomes, which may limit the practical implications of our findings. However, by excluding implementation plans and maintaining a clear focus on policy formulation, we aimed to provide a clear and comparable assessment of how national strategies align with the identified core One Health principles. This targeted approach allows us to evaluate the core elements of policy formulation without the complexity introduced by implementation factors.

RESOURCE AVAILABILITY

Lead contact

Requests for further information and resources should be directed to the lead contact, Chris Walzer (cwalzer@wcs.org).

Materials availability

This study did not generate new materials.

Data and code availability

- The data and original code used to produce the results and figures of this article have been deposited on figshare under https://doi.org/10.6084/m9.figshare.25353277 and are publicly available as of the date of publication.
- The READ.ME file contains the necessary instructions to run the code and replicate our results.
- Any additional information required to reanalyze the data reported in this article is available from the lead contact upon request.

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AUTHOR CONTRIBUTIONS

Conceptualization: C.W.; methodology: C.W. and A.D.L.; software: A.D.L.; validation: C.S.W.; formal analysis: C.S.W. and A.D.L.; investigation: C.S.W.; data curation: C.S.W. and A.D.L; writing – original draft: C.S.W.; writing – review and editing: C.S.W., A.D.L., and C.W.; visualization: A.D.L.; supervision: C.W.

DECLARATION OF INTERESTS

The authors declare no competing interests.

STAR★METHODS

Detailed methods are provided in the online version of this paper and include the following:

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SUPPLEMENTAL INFORMATION

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STAR★METHODS

KEY RESOURCES TABLE

REAGENT or RESOURCE	SOURCE	IDENTIFIER
Software and algorithms		
Dependencies - Windows 10 - R Statistical Software version 4.4.1 2024-06-14 ucrt) – "Race for Your Life" - RStudio 2024.04.2 + 764 "Chocolate Cosmos" Release (e4392fc9ddc21961fd1d0efd47484b43f07a4177, 2024-06-05) for Windows.	The data and code used to produce the results and figures of this article have been deposited on figshare.	https://doi.org/10.6084/m9.figshare.25353277
Dependencies - Windows 10 - R Statistical Software version 4.4.1 2024-06-14 ucrt) – "Race for Your Life" - RStudio 2024.04.2 + 764 "Chocolate Cosmos" Release (e4392fc9ddc21961fd1d0efd47484b43f07a4177, 2024-06-05) for Windows.	The data and code used to produce the results and figures of this article have been deposited on figshare.	https://doi.org/10.6084/m9.figshare.25353277

METHOD DETAILS

Literature search

We defined NOHSPs as comprehensive policy frameworks developed by countries' administrations to address health challenges at the human-animal-environment interfaces. To retrieve publicly available NOHSPs we conducted a systematic online search between August 2022 and February 2023 and queried nine different search databases: Ecosia (https://www.ecosia.org/), Google Search and Google Scholar, FAOLEX Database,[69] vetmed:seeker (https://www.vetmeduni.ac.at/universitaetsbibliothek/virtuelle-bibliothek/suchmaschinen), Science Direct (https://www.sciencedirect.com/), One Health Outlook (https://onehealthoutlook.biomedcentral.com/), One Health (https://www.sciencedirect.com/journal/one-health), and Scopus (https://www.scopus.com/). The following English search terms were used and combined with the Boolean operators AND and OR: ''one health'', ''strategic plan'', ''strategic'', ''plan'', ''one health concept'', ''one health strategic plan'', ''one health plan.'' The search was additionally conducted across all search engines in German, Spanish, French, Dutch, Portuguese, Russian (translation was made automatically using DeepL, https://www.deepl.com/en/translator), and Arabic (using Google Translate as DeepL did not translate Arabic). Documents written in the eight languages were considered for inclusion. We double-checked all translations, with particular attention to the accuracy and contextual relevance of articles, such as "un" and "une" in French, to ensure precise application across all languages.

In addition to the online search, we directly contacted One Health commissioners from 20 countries which had a One Health-related website (Uzbekistan, France, Norway, Netherlands, Bhutan, Fiji, Germany, New Zealand, Italy, Bangladesh, Mongolia, Chile, Costa Rica, Uruguay, Bolivia, Suriname, Argentina, Romania, UK, and Canada). We received responses from France, Norway, The Netherlands, Bhutan, Fiji, Mongolia, and Canada (n = 7).

Retrieved publications were entered and deduplicated in Mendeley Reference Manager before selection process. Records were screened and publications were included if they were policy or strategic documents describing a NOHSP and declared as such. Scientific publications detailing NOHSP were also considered. Since our study focused on One Health policy formulation rather than implementation, we aimed to include a homogeneous set of documents to enable meaningful comparisons. Therefore, we excluded publications that addressed One Health implementation or described implementation of One Health plans, evaluated One Health systems, presented surveys or interviews' results about One Health, dealt with the importance of veterinarians in One Health, dealt with plant health in One Health exclusively, or described One Health collaboration, current One Health situations, or the general importance of One Health. Moreover, publications depicting One Health approaches to a specific disease or disease complex (e.g., AMR, zoonotic diseases) were excluded.

Definition of one health concepts, characteristics, and associated keywords

We selected the Berlin Principles[32] and the OHHLEP definition of One Health, along with its key underlying principles,[6] as references for defining One Health because they were developed by larger multi-disciplinary cohorts, ensuring a comprehensive approach. We initially summarized both foundational documents. This process involved identifying recurring themes, concepts, and ideas across them. Through an iterative process of searching for and grouping related themes, we condensed them into ten overarching concepts. This was followed by discussions among the co-authors to reach consensus on the summaries of these concepts. In a second step,

each identified overarching concept was deconstructed by CSW into more granular components, called One Health characteristics, that captured the essential elements of each concept as defined in the source documents. The list of One Health characteristics was discussed and refined with CW and ADL. For each of these characteristics, we compiled an exhaustive list of (One Health) keywords, encompassing synonyms and related terms that was utilized in subsequent analyses.

Qualitative content analysis

We used the compiled One Health keyword list for a manual search and read within the NOHSPs to locate mentions of the respective One Health characteristics and their context. Furthermore, it was determined if the characteristics were merely acknowledged ("recognized") or the plans outlined or anticipated specific actions related to the characteristic, even if implementation details were not provided ("action envisioned"). The result of the search was compiled into a dedicated binary matrix.

Text cleaning, normalization, and tokenization

The NOHSPs were imported into the software R[35] as PDF files and transformed into a corpus object. Text pre-processing converted all texts to lowercase, removed punctuation, numbers, common English stop words, and extra spaces. The stop word list was customized by incorporating domain-specific terms that contained minimal informative value (e.g., terms related to country of publication and document structure) (Note S2). Additionally, acronyms were spelt out (e.g., ''one health'' for ''oh'') and plural noun singularization was performed. When identified, typological errors were rectified. Lastly, stemming was performed prior to the unigram analysis using the Porter's stemming algorithm.[70] This process reduces words to their root form allowing grouping variations of the same word (analysis of bigrams was performed without applying a stemming process). The cleaned corpus was then tokenized into unigrams or bigrams (two-word sequences) for further analysis.

QUANTIFICATION AND STATISTICAL ANALYSIS

Unigram and bigram token analysis

Unigram and bigram frequencies were computed using the term frequency weighting method in which the weights represent the frequency of the term in a specific document. Unigrams that appeared at least 100 times and bigrams that appeared at least 50 times across the eight NOHSPs, were filtered and visualized. Spearman correlations were performed to assess pairwise differences in N-gram frequency patterns across the strategic plans.

Comparative one health keyword analysis: Hierarchical clustering

We performed hierarchical cluster analysis (HCA) using both qualitative and quantitative data derived from the text analysis. HCA group documents or text data based on the dissimilarity of the words; a larger distance indicates more dissimilarity between documents. This method iteratively merges clusters with similar content, ultimately resulting in a hierarchical structure. However, HCA does not explicitly identify specific themes within these groups.

We used a qualitative (binary) matrix, which categorized the presence or absence of keywords representing One Health characteristics, whereas the quantitative matrix captured the frequency of these keywords. We extracted keyword frequencies from the term-document matrix, applying stemming to ensure all variations were captured.[70] Dissimilarity matrices for both approaches were computed using the Bray-Curtis index, specifying the binary parameter as appropriate. The HCA was conducted using the complete linkage method.

Network analysis and "health subgraphs"

To describe and compare the conceptual concepts surrounding the term ''health'' across NOHSPs, we used graph theory[71] and investigated the structural relationships between the term ''health'' and other terms in each document, using bigrams that appeared at least ten times across the NOHSPs. First, for each NOHSP, we built a directed weighted network of terms where each node represents an individual term, and each edge represents the association (relationship) between terms. Node size represented the frequency of the individual term across all bigrams while edge weight represented the frequency with which linked terms co-occurred in the documents (i.e., bigram frequency). The edge arrows represented the direction of the association (i.e., sequence) between the two terms of a bigrams (e.g., one → health correspond to the bigram ''one health'', in this specific order). In a second step, we generated a ''health subgraph'' for each NOHSP by extracting the connected component of the network (i.e., nodes accessible to each other through at least one path[19]) that included the node labeled "health."

Software and packages

Analyses for this study were performed using the open-source software R v. 4.4.1.[35] We used the pdftools package[72] for text extraction of PDF documents and the tm package[73] for text analysis. Dissimilarity matrices were computed using the R package vegan.[74] The HCA was performed using the *hclust()* function (base package stats). Network analysis and visualization were conducted using the igraph[75] and ggraph[76] packages, respectively.