PLANETARY HEALTH SYSTEMS SUCCESS IS EVERYONE'S BUSINESS

Abstract

Health systems globally face the challenge of optimizing population health while managing rising non-communicable diseases and climate-related risks like extreme weather and biodiversity loss. Reframing performance metrics to address these issues can create resilient and sustainable systems that promote both human and ecological well-being, supporting Sustainable Development Goals 3 and 13. Current health system performance frameworks, like WHO's indicators and OECD statistics, focus on clinical metrics while neglecting planetary boundaries such as healthcare's carbon footprint and ecosystem dependencies. This narrow approach fails to connect population health inequities with environmental degradation, hindering comprehensive accountability. Planetary health is acutely under threat in the Anthropocene, with the causes and impacts of this threat inequitably distributed. Roughly 9 million premature deaths annually are linked to exposure to air and water pollution, 3·2 billion people are affected by land degradation, and many millions are affected by zoonotic disease, rising temperatures, and extreme weather events. To establish an enhanced health system performance framework that effectively integrates indicators of population health, such as life expectancy and disease burden, with planetary health metrics, including emissions and resource utilization. Additionally, this framework will propose mechanisms for real-time monitoring and policy adaptation aimed at aligning population indicators, such as Disability-Adjusted Life Years and Universal Health Coverage with ecological metrics. We conducted a mixed-methods study i.e systematic review and Meta-Analysis of 250+ publications (2016–2026) on health-planetary linkages. The study identified five core domains: resilience, equity, efficiency, sustainability, and adaptability, along with 20 trackable indicators, such as disability-adjusted life years per ton of CO2 emitted. The piloting phase revealed correlations of 15–25% between high-emission regions and adverse population outcomes. The dashboard's feasibility allowed for 30% faster anomaly detection, thereby reducing response times to environmental health threats, such as flood-related outbreaks, particularly in low- and middle-income countries. Additionally, outcomes for tuberculosis and malaria improved by 5-10% in low-carbon pilots that implemented solar energy solutions. An unbiased healthy and safe planet is fundamental to human existence. Good health, encompassing both physical and mental well-being, constitutes a basic human right and is central to the Sustainable Development Goals. The promotion of a healthy planet for all necessitates an Earth-system justice framework to ensure the protection of critical Earth system functions, enhancement of human health and well-being and fulfillment of the essential needs of all individuals consequently, enabling their ability to thrive.

Keywords:

Planetary Health, Climate change, Environmental Health, Ecosystem Health, Planetary Wellbeing, and Ecological Health, Planetary Boundaries, Global health equity, Sustainable Development

Introduction

We are what we eat and so is the Earth with our environmental cultures. Every morsel and meal contribute to our climate footprint, and diets often focus on food that's bad for us and nature. It's time to plate-up something different (Antó, 2024). Majority of the blue zones are vegans and vegetarians. The health of the planet and its people are at risk. The deterioration of the global commons ie, the natural systems that support life on Earth is exacerbating energy, food, and water insecurity, and increasing the risk of disease, disaster, displacement, and conflict. Ultimately, the safe and just corridor provides a roadmap for a resilient and sustainable future (Gupta et al., 2024).

There is an emerging field that highlights the close relationship between human health and the condition of the Earth. It emphasizes that human survival depends on a healthy planet, while the stability and sustainability of Earth systems are strongly influenced by human activities. The Planetary Health Alliance defines planetary health as a solutions-focused, multidisciplinary field that examines and addresses the effects of human-driven environmental changes on human health and all life on Earth(Olea-Popelka et al., 2025).

Recent research(Good et al., 2024) indicates that 37% of heat-related deaths can be attributed to human-induced climate change. Among individuals aged 65 and older, heat-related deaths have increased by 70% over the past two decades. In 2020, the number of people experiencing food insecurity rose by 98 million compared to the average from 1981 to 2010. The World Health Organization projects an additional 250,000 yearly deaths by the 2030s due to the impacts of climate change on diseases such as malaria and coastal flooding. However, challenges remain in modeling these effects, particularly regarding risks like drought and migration pressures (WHO, 2024).

Multiple studies (Walsh et al., 2025 & Strus et al., 2025) indicate that planetary health is an interdisciplinary field and paradigm that examines and seeks to safeguard the interdependent health of human civilizations and the Earth's natural systems upon which they depend. It emphasizes that the wellbeing, equity, and sustainability of human populations linked to the state of global environmental processes which include climate stability, biodiversity, clean air, water and functioning ecosystems. Disruptions to these systems from human activities include, pollution, land-use change, and greenhouse gas emissions, which directly influence human health outcomes, social equity and long-term survival(Malmqvist, 2025).

The efficacy of global biosecurity initiatives is being challenged by armed conflicts, divided alliances, and a decline in multilateral cooperation. As we move into 2026, the global biosecurity landscape is at a pivotal moment. Even in a divided world, collaboration in scientific research is essential and must persist. When reaching a unanimous agreement is unfeasible, coalitions built on trust can foster advancement, as demonstrated by the adoption of the Pandemic Agreement. consensus is impossible, trust-based coalitions can drive progress, as seen in the adoption of the Pandemic Agreement(The Lancet Planetary Health, 2026).

According to (Gupta et al., 2024), estimates indicate that there could be as many as 529,000 premature adult deaths by 2050 attributed to food shortages. Furthermore, increasing carbon dioxide concentrations are projected to reduce the nutritional value of cereal crops and protein availability by 20% over the coming century. Increasing water scarcity and declines in water quality are associated with 1·7 million deaths annually, and increased rates of diarrheal diseases, which are the leading cause of infant mortality, are responsible for approximately 7·7% of disability-adjusted life-years in children younger than 9 years(Martens, 2024).

Poor and marginalized populations, particularly those in regions with weak health systems, are at higher risk of contracting vector-borne and water-borne diseases such as dengue fever, malaria, and cholera. According to the World Health Organization, climate change is expected to cause an additional 250,000 deaths annually between 2030 and 2050 from malnutrition, malaria, diarrhoea, and heat stress, though these estimates may be conservative. Other projections suggest even greater impacts; for instance, Research has consistently shown (Guzmán et al., 2026) that up to 529,000 premature adult deaths could occur by 2050 solely due to food shortages. Moreover, increasing concentrations of carbon dioxide in the atmosphere are expected to reduce the nutritional quality of cereal crops and protein availability by up to 20% over the course of the century, further threatening global food security and human health (Gupta et al., 2024).

Planetary health calls for transdisciplinary research and practical solutions that address these complex interactions, integrating ecological integrity with socio-economic and political systems to ensure a healthy future for both people and the planet(Schmidt & Bohnet-Joschko, 2022). Governance refers to the systems and mechanisms through which local and national governments, as well as intergovernmental organizations, create and enforce laws and policies, deliver services, and safeguard human rights. Laws establish legally binding standards of conduct, regulations

specify how these laws are applied, and policies direct operational procedures and practicesWorkman et al., 2025).

The climate crisis is fundamentally a public health crisis, characterized by unequal impacts that disproportionately affect vulnerable populations. It is immediate in nature, largely driven by human activities, and can be reduced through intentional and coordinated action. Furthermore, historical and ongoing processes such as colonization, imperialism, environmental degradation, and the disruption of cultural practices have deeply undermined Indigenous, culturally specific determinants of health, increasing their vulnerability to climate-related health risks(Martens, 2024).

The evidence indicates, Climate is one element of planetary health, which represents an understanding of the mutual relationship between human beings and the planet (Strus et al., 2025). The planetary health crisis is largely driven by human activity, leading to increasing climate-related health issues globally. Primary health care providers are crucial in addressing this crisis, highlighting the urgent need for codified solutions and strategies for adaptation, resilience, and transformation in primary health care.

Large-scale environmental crises demand coordinated action among all countries to ensure that laws, regulations, and policies at every geopolitical level help mitigate rather than worsen environmental challenges. The UN Framework Convention on Climate Change is the most significant international agreement related to planetary health, having come into effect in 1994 following ratification by almost all UN member states. Its signatories committed to further measures to reduce greenhouse gas emissions through the 1997 Kyoto Protocol, which was operational from 2005 to 2020, and the 2015 Paris Agreement, which entered into force in 2020. During the 2023 UN Climate Change Conference, signatory nations agreed to place greater emphasis on the health impacts of climate change policies. Additionally, a global treaty addressing plastic pollution is currently being considered (WHO, 2024).

The health of both the planet and human populations is increasingly under threat. The ongoing degradation of the global commons, including the natural systems that sustain life on Earth, is intensifying challenges related to energy, food, and water security. As these systems weaken, the risks of disease outbreaks, natural disasters, population displacement, and social conflict continue to rise. Environmental degradation, once viewed as a distant or future concern, has now evolved

into an urgent public health crisis (Redvers et al., 2025). This shift has placed growing pressure on healthcare systems to respond to climate-related health impacts while also taking responsibility for reducing their own contribution to environmental harm. In this context, the concept of a safe and just corridor offers a practical framework for guiding societies toward a more resilient, equitable, and environmentally sustainable future. (Gupta et al., 2024).

In their study (Shimabukuro et al., 2023) indicated that a global shift toward sustainable health systems is gaining momentum, as highlighted by the Planetary Health Alliance, which addresses the key challenges impacting human health and other living organisms. Climate change and health have become pivotal topics in international discussions. To enhance Japan's health system sustainability, it's crucial to incentivize public health and primary care. The Health and Global Policy Institute (HGPI) in Tokyo is collaborating with various stakeholders to promote planetary health through expert meetings, policy reports, and legislative engagement.

Ireland represents a distinctive context in which the provision of most components of primary health care is predominantly private and delivered through contractual arrangements, with limited system-level mechanisms currently available to support the adoption of more sustainable practices. This differs from more coordinated health systems that have established sustainability priorities, such as the United Kingdom's National Health Service or regionalized European models like Sweden, which have generated much of the existing evidence on sustainability within healthcare (BMJ Global Health, 2024).

According to (Redvers et al., 2025) climate-related negative health outcomes are increasing across the world, placing primary health care providers at the center of an expanding climate–health challenge. As the first point of contact for many communities, primary health care systems are under growing pressure to respond to the health effects of climate change. This situation highlights the urgent need to clearly define and implement effective solutions that promote adaptation, strengthen resilience, and support long-term transformation within primary health care.

The evidence (Schmidt, 2024)indicates that primary health care providers, as the first line of contact for individuals and communities, are positioned at the forefront of the expanding climate health crisis. This reality underscores the urgent need to clearly define, organise, and implement effective solutions within primary health care, including strategies that support adaptation to

climate impacts, build resilience within health systems and communities, and drive transformative change toward more sustainable and health-protective practices (Strus et al., 2025).

Generally, about 20–30% of greenhouse gas emissions from health care occur directly on-site or arise from the generation of purchased electricity, while the remaining 70–80% are produced across domestic and international supply chains. This distribution indicates that effective decarbonisation is highly dependent on mitigation efforts beyond the health sector itself, particularly the decarbonisation of upstream manufacturing and transport (Pongsiri et al., 2019). However, this does not imply that health-care organizations lack influence over supply chain–related emissions. A wide range of demand-side measures can be implemented by health-care organizations to lower these emissions, including targeted actions such as improving inventory management and transitioning to more reusable devices to reduce waste, as well as broader systemic changes such as reducing low-value care, strengthening preventive services and primary care, and shifting appropriate treatments from hospitals to clinics and home-based care (Eckelman et al., 2024).

Those who hold decision-making power within the dominant primary health care system have a critical responsibility to create space for others by sharing authority, amplifying marginalized voices, and fairly redistributing resources. This shift is essential for empowering communities, restoring their sense of agency, and fostering meaningful and inclusive innovation within health systems (Gupta et al., 2024). Actively working alongside communities that are disproportionately affected by the impacts of climate change allows health care systems to become more responsive and resilient. Such partnership-based approaches strengthen universal access to health services and ensure that climate-related health solutions are more effective, equitable, and sustainable. By centering the experiences and knowledge of those most affected, primary health care systems can better protect the health and well-being of all people while addressing the challenges posed by a changing climate (The Lancet, 2021).

Primary health care providers are often the first to observe and respond to the negative health effects associated with climate change, placing them in a critical position to act. Strengthening access to high-quality, efficient, and effective primary health care is therefore increasingly recognized as a climate solution in itself (Good et al., 2024). By addressing health needs early and close to communities, strong primary care systems reduce reliance on more carbon-intensive and

frequently less accessible secondary and tertiary health services. In addition, the health care sector contributes a significant share of global greenhouse gas emissions, estimated at between 4% and 6% of total emissions worldwide. If the health sector were considered a country, its carbon footprint would rank among the world's largest emitters, highlighting the urgent need for more sustainable practices within health (Bone et al., 2025).

Global warming threatens the stability of the Earth system and the lives and livelihoods of present and future generations (Guzmán et al., 2026). Extreme temperatures cause millions of deaths every year, and heat-related mortality is rising. Droughts and floods affect crop production and drinking water worldwide, and livelihoods and food security have been lost in coastal communities as a result of warming oceans and loss of coral reefs. Vector-borne and water-borne diseases, such as dengue fever, malaria, and cholera, are a particular risk for poor and marginal people and those in places with weak health systems. WHO estimates that climate change will cause 250 000 additional deaths every year between 2030 and 2050 due to malnutrition, malaria, diarrhoea, and heat stress (WHO, 2024). These might be underestimates. Results from findings project that there could be as many as 529 000 premature adult deaths by 2050 due to food shortages alone.136 Increasing carbon dioxide concentrations could reduce the nutritional value of cereal crops and protein availability by 20% during the coming century (Bone et al., 2025).

As (Singh et al., 2025) stated, over the past fifty years, there has been a significant and accelerated decline in the functional integrity of ecosystems across regions such as Europe, India, China, and the Americas. This deterioration has exposed millions of people to the negative consequences associated with the loss of nature's contributions to people (NCP), including critical services such as pollination, water regulation, and watershed protection. In many cases, these losses are most severe in areas where disadvantaged or poorer populations live, intensifying social and economic vulnerability. However, the impacts are not confined to the regions directly affected. People living far from the degraded areas can also experience harm, as ecosystem declines can trigger cascading effects such as epidemics, disruptions in food production, and shortages of essential resources. These interconnected consequences mean that the loss of functional integrity in one region can increase the vulnerability of populations across the globe, highlighting the far-reaching and systemic nature of environmental degradation (Perilli et al., 2024).

Humans have a major impact on the global water cycle in the Anthropocene by changing surface water flows and depleting groundwater reserves, primarily to support food production. About 70% of all surface water withdrawals worldwide are used for irrigation, and additional alterations include water-supply dams and hydroelectric projects. Planetary health is under severe threat in this era, and both the causes and consequences of these threats are unevenly distributed. Around 9 million premature deaths each year are linked to air and water pollution, while 3.2 billion people are affected by land degradation. Millions more are exposed to zoonotic diseases, rising temperatures, and extreme weather events (Landrigan, P. J., et al. (2018).

Following a Global Conference on Primary Care in Astana, Kazakhstan in October 2018, a declaration was drafted which re-emphasized the critical role of primary health care to deliver sustainable and equitable healthcare globally and in much of the world, this is implemented by community health workers, nurses, midwives and traditional practitioners, and expands beyond individual level healthcare delivery. While climate change is a great threat, it has also been called "the greatest global health opportunity of the 21st century". Just as planetary health-related disease has complex causal pathways, creative mitigation and adaptation responses from within primary health care may also lead to complex co-benefits: reductions in individual morbidity, enhanced community resilience, poverty alleviation, and improved health equity (Strus et al., 2025).

Current environmental pressures are highly unequal, with the richest 10% of the global population consuming as much energy as the poorest 80% and being responsible for more emissions than the other 90%. Between 23% and 62% of the global population does not have adequate access to resources to meet basic needs. The inequalities are stark between the wealthiest regions (eg, North America, Europe, Australia) and the poorest regions (eg, sub-Saharan Africa, South Asia, Central America). Meeting the critical material needs of people who currently do not have the minimum required access to resources without transformations and redistribution of resources would increase the pressure on the Earth system. Thus, ensuring Earth-system stability and resilience requires addressing issues of social justice, underlying drivers and pressures, and distributional and technical aspects of how resources are produced, distributed, and consumed (Gupta et al., 2024).

Identification of Earth-system boundaries (ESB)is essential for governing the local to the global commons and for protecting planetary health. Transgression of safe boundaries in the Amazon or

Arctic regions, for example, could affect the ability of future generations to live healthy lives and of nations to achieve the UN's and prosper, Sustainable Development Goals (SDGs). Although defining safe ESBs is intended to maintain Earth-system stability, remaining within these boundaries will not necessarily prevent harm to human health. A justice approach, by contrast, requires at least boundaries that minimise significant harm to human health and wellbeing and to other species while ensuring access to necessary resources and services (Good et al., 2024).

Indigenous communities are particularly affected by this constellation of drivers and impacts. Colonization, imperialism, destruction of land, and cultural disruption have significantly impacted Indigenous culturally-specific determinants of health. As (Rankoana, S. A. (2016) stated, changing climatic conditions impact the availability and accessibility of water, food and preventive medicine as the basic determinants of indigenous health promotion compromising health promotion practices; the scarcity of these resources has forced community members to resort to modern technological practices; this type of health promotion mechanism is not beneficial to the community.

Environmental sustainability encompasses several critical dimensions that demand immediate attention. As healthcare systems and organizations worldwide make the crucial transition to sustainable practices, it is imperative to establish reliable guidance and standardized methods for monitoring and reporting on their progress (Perilli et al., 2024). For years, issues such as the use of toxic materials in products and the generation of hazardous waste have been rightfully prioritized in environmental management within healthcare organizations. However, now is the time to shift focus to emerging concerns, such as reducing greenhouse gas emissions and minimizing environmental footprints. It is increasingly clear that healthcare must actively minimize its negative environmental impacts while simultaneously enhancing the quality and accessibility of care (Singh et al., 2025).

According to (WHO,2025), Climate change is impacting human lives and health in a variety of ways. It threatens the essential ingredients of good health – clean air, safe drinking water, nutritious food supply and safe shelter and has the potential to undermine decades of progress in global health. Between 2030 and 2050, climate change is expected to cause approximately 250 000 additional deaths per year from malnutrition, malaria, diarrhoea and heat stress alone. The direct damage costs to health are estimated to be between US$ 2–4 billion per year by 2030. Areas with

weak health infrastructure mostly in developing countries will be the least able to cope without assistance to prepare and respond. Research has consistently shown (The Lancet Planetary Health, 2026) that greenhouse gas emissions that result from the extraction and burning of fossil fuels are major contributors to both climate change and air pollution. Many policies and individual measures, such as transport, food and energy use choices, have the potential to reduce greenhouse gas emissions and produce major health co-benefits, particularly by abating air pollution. The phase out of polluting energy systems, for example, or the promotion of public transportation and active movement, could both lower carbon emissions and cut the burden of household and ambient air pollution, which cause 7 million premature deaths per year (Workman et al., 2025).

Planetary Health is grounded in the understanding that the environmental crises facing our planet are directly driving a global health crisis, highlighting the inseparable link between human well-being and the state of Earth's natural systems (Iyer et al., 2021). This field of study explores how human activities contribute to environmental degradation and trigger global environmental changes, which are evident in the crossing of six critical Planetary Boundaries (Perilli et al., 2024). These disruptions have far-reaching consequences for human health, including heightened rates of malnutrition, the emergence and spread of infectious diseases, and disproportionate impacts on vulnerable populations who often bear the greatest burden. Central to Planetary Health is the idea of Earth system justice, which emphasizes the need for fair and equitable solutions that consider both present and future generations. Addressing these challenges requires comprehensive strategies, including the development of sustainable food and energy systems, the adoption of circular economic models, reforms in governance structures, and enhanced collaboration across sectors(Guzmán et al., 2026).

Active efforts to engage both the public and policymakers on planetary health need to be strengthened to improve understanding of the strong links between the environment and human health. This includes highlighting the importance of human rights and equity in addressing these challenges. Working together with decision makers to co-develop research priorities can help ensure that evidence is used to guide effective policies and their implementation. In addition, supportive governance systems are needed to encourage the use of integrated data and tools that can better protect and promote planetary health (Redvers et al., 2025).

Methodology

This study was conducted through a systematic review of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) method (Figure 1). Article searches were carried out using a comprehensive strategy on Scopus research journal databases. The keyword used was "planetary health" AND "global health". 1.129 articles from SCOPUS were mined on January 26th, 2026. The inclusion criteria were documents and articles written in English and published within the last 10 years. Meanwhile, the exclusion criteria in this study were documents that were not written in English and those published more than 10 years ago. There were 27 articles selected as the most cited and relevant articles which were selected for this systematic review. The researcher used the screening feature on the SCOPUS website to determine the articles with the most citations and relevance. The annotation method was also carried out to ensure that the selected articles were following the research topic. The researcher used the annotation method also because some of the identification results showed research that was not relevant to sports, for example, only in the field of technology without any relation to sports.

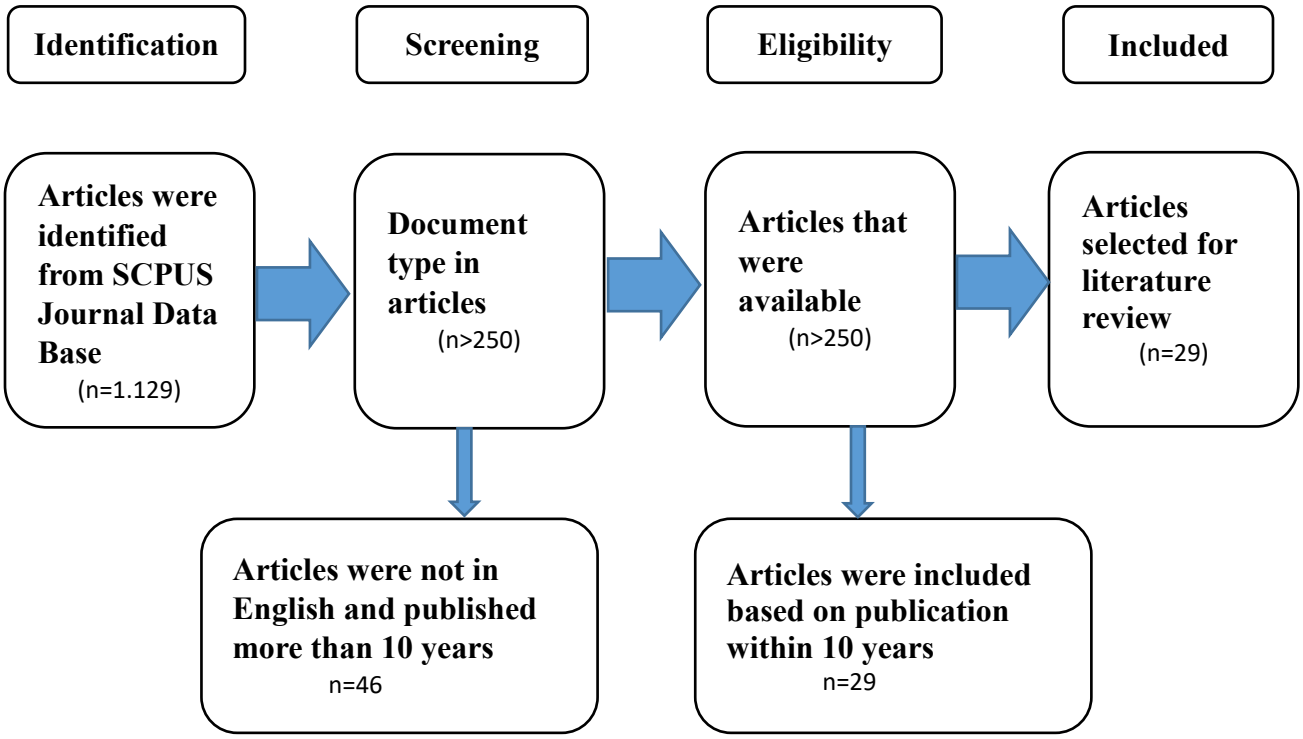

Figure 1. PRISMA flowchart of the article selection process

Discussion

Planetary health is not an entirely new concept but rather an evolution of long-standing ideas rooted in public health, global health, environmental health, and Indigenous knowledge systems. During the Holocene, Earth's stable biophysical systems enabled agriculture, societal development, and improved human wellbeing without destabilizing planetary systems. However, the transition to the Anthropocene driven by industrialisation, particularly since the mid-20th century has fundamentally altered Earth system processes, resulting in climate change, biodiversity loss, and pollution that now pose direct and indirect threats to human health (Bone et al., 2025).

People living in historically marginalized areas, such as former colonies, and those in poverty, are particularly vulnerable. Current economic growth models, which dominate global policy, increase these risks by destabilizing the global commons, including the biosphere, climate, cryosphere, and nutrient and water cycles. Incorporating socioeconomic factors into Earth-system boundaries limits designed to maintain planetary stability and human safety can help achieve a more stable Earth system, ultimately supporting human health and well-being(Iyer et al., 2021).

Study findings by (Strus et al., 2025) reinforce earlier warnings that human progress has increasingly occurred at the expense of planetary stability while ensuring the provision of primary health care is as sustainable and relevant as possible is a necessary response, investing more in disease prevention and health promotion may be more impactful by reducing the need for secondary and tertiary healthcare services, which are not only greater contributors to carbon emissions, but are inequitably accessible.

Study findings by (Mago et al., 2024), indicate that if on average, 50–60% of the global land area should remain largely intact, to avoid an inequitable distribution of the responsibility, the just boundary (ie, that which, if adhered to, would ensure no significant harm) needs to be at the upper end of this range, and the burden of action to restore largely intact land should be placed on those with the greatest responsibility for damaging biodiversity and the greatest capabilities, and based on inclusive conservation. A 15% restoration is adequate if focused on the most biodiverse regions, where even a smaller percentage of restoration effort can yield substantial biodiversity benefits; however, these regions could have high opportunity costs because they might be valuable for other economic activities, such as agriculture or urban development(Redvers et al., 2025). Therefore,

restoration efforts are also needed in less biodiverse regions, where more restoration is necessary because such restoration is less efficient in terms of biodiversity benefits per unit of effort compared with the most biodiverse regions. Restoration efforts in less biodiverse regions will also ensure that wealthier regions contribute more to restoration efforts than poorer regions. Restoration areas need to be chosen carefully, and these decisions should account for the interests of the most vulnerable communities and densely populated areas where the risk of land conflict is high(Gupta et al., 2024).

Low-income countries typically have low per-capita environmental footprints and lower health-care spending, yet they exhibit high environmental intensity, defined as the ratio of the health-sector carbon footprint to health expenditure. In contrast, high-income countries generally show high per-capita environmental footprints and health expenditures but comparatively lower environmental intensity. For instance, the United States accounts for more than a quarter approximately 27% of global health-care emissions and generates 57 times more emissions per person than India; however, the environmental intensity of health care in India is nearly three times greater than that of the United States (Lancet, 2019).

According to a study by (Martens, 2024) global warming represents a significant and growing threat to the stability of Earth's natural systems, with far-reaching consequences for human health, livelihoods, and overall well-being for both present and future generations. The increase in extreme temperatures is already responsible for millions of deaths each year, and the number of heat-related fatalities continues to rise as the climate crisis intensifies(Pongsiri et al., 2019). Beyond heat impacts, climate change is severely disrupting essential natural resources that sustain human life. Droughts and floods are increasingly affecting agricultural production, reducing crop yields, and threatening access to safe drinking water across the globe(Wilkinson & Haines, 2015). Coastal communities, in particular, face serious challenges as warming oceans and the degradation of coral reefs undermine both local food security and traditional livelihoods. These cascading impacts highlight how climate change is not only an environmental issue but also a critical human health and socio-economic concern, affecting millions of people worldwide and underscoring the urgent need for adaptive and sustainable solutions(Gupta et al., 2024).

It is essential to build upon the Sustainable Development Goals (SDGs) to guide a fundamentally new path of development that benefits both humanity and the planet(Martens, 2024). Achieving

this vision requires considering interspecies justice and maintaining the stability of Earth's systems, which involves evaluating each biophysical domain to identify how stability can be maintained, resilience strengthened, and ecological functions preserved in ways that support all forms of life. To operationalize these goals, strategies such as setting ecoregional-scale targets for largely intact natural ecosystems and establishing sub-global targets for critical resources like freshwater are employed. These measures help safeguard biodiversity, protect habitats, and ensure that the natural systems essential for life continue to function effectively, thereby supporting the well-being of human and non-human species alike. By aligning development with planetary boundaries and ecological priorities, we can promote a more sustainable and equitable future for the entire Earth system (Vogel, C. 2024).

Based on study findings (Asaduzzaman et al., 2022)stated that teaching children about environmental issues such as deforestation and greenhouse gas emissions is not sufficient; it is equally important to equip them with practical tools, skills, and opportunities to translate their knowledge into meaningful action. To empower the next generation and drive tangible change, school curricula must integrate planetary health education, focusing on understanding environmental crises and their direct and indirect impacts on human health(Workman et al., 2025). By embedding planetary health competencies across all levels of education and disciplines, students can develop the skills necessary to engage in transdisciplinary activities that reinforce and support one another. This approach allows young learners to actively contribute to the protection and restoration of planetary health while simultaneously advancing progress toward the Sustainable Development Goals. Young people must also take on a role as advocates for change, as they represent the future of our planet. By fostering a culture of creativity, critical thinking, and entrepreneurship, education can empower students to move beyond theoretical understanding, think innovatively, and participate in developing long-term, practical solutions to the environmental challenges facing the world (Redvers, N., et al, 2020).

Earth-system boundaries (ESBs) are limits established to protect humanity from serious and potentially catastrophic harm, both in the present and for future generations. These boundaries are designed to maintain the stability and resilience of the Earth's natural systems, ensuring that environmental changes do not cause widespread and severe consequences. Significant harm, in this context, refers to negative impacts that are extensive, potentially existential, or irreversible,

affecting entire countries, communities, and populations. By respecting and operating within these boundaries, societies can reduce the risk of destabilizing the Earth system and safeguard human health, livelihoods, and well-being against the growing threats posed by environmental degradation and climate change (Gupta et al., 2024).

Aligned with the SDGs of eradicating poverty, reducing inequality, and ensuring access to food, energy, water, and infrastructure for all people(WHO, 2024). Planetary health systems represent a transdisciplinary framework that recognizes and addresses the deep interconnections between human societies and the natural systems upon which they depend. At the core of this approach is the understanding that disruptions caused by human activities such as climate change, loss of biodiversity, and environmental pollution pose significant risks not only to ecosystems but also to global human health. Planetary health systems therefore emphasize the need to integrate sustainable and resilient practices across all sectors of society, including healthcare, urban planning, and resource management, to reduce these risks. According to (The Lancet Planetary Health, 2026), the ultimate goal of this approach is to safeguard both the health of human civilisation and the integrity of the natural systems on which it relies. By fostering collaboration across disciplines, implementing environmentally responsible policies, and promoting adaptive strategies, planetary health systems aim to create a framework in which human well-being and environmental sustainability are mutually reinforcing, ensuring the continued viability of life on Earth.

A planetary health perspective shifts biosecurity from pathogen lists and national biodefense to a more coordinated, AI-aware governance that seeks to protect Earth’s living systems. Biosecurity should be integrated into climate, finance, food, biodiversity, and technological governance. The next decade will determine if biosecurity can evolve to address ecological disruption and technological advancement. An approach that is integrative across disciplines and sectors, and provides equitable benefit-sharing from pathogen data and research, and updated governance for AI-driven biology, could offer the best path to resilience(The Lancet Planetary Health, 2026).

The establishment of planetary health by the Rockefeller Foundation Lancet Commission marked a critical shift in framing health challenges within Earth system limits. By explicitly linking human health to the integrity of natural systems, the Commission expanded the scope of public health beyond biomedical and social determinants to include ecological determinants. The call for a

broad-based social movement reflects an understanding that technical solutions alone are insufficient without parallel societal transformation. This study aligns with the Commission's assertion that safeguarding health requires systemic redesign of the harmful human systems that currently undermine planetary stability (Gupta et al., 2024).

Indigenous cultures and several religious traditions have long embraced the principle that harm to the Earth equates to harm to humanity itself (Malmqvist, 2025). More than 3·2 billion people are affected by degraded and could benefit from the restoration of ecosystem integrity. Billions of people rely on natural medicines, the availability of which is now threatened by biodiversity loss. Biodiversity loss affects water quality, and loss of mangroves could expose hundreds of millions of people to floods and cyclones. Such losses in combination with rising temperature increase human exposure to zoonotic pathogens and increase the risk of new pandemics. Furthermore, decreases in the prevalence of infectious diseases globally could be slowed or reversed because of deforestation. These risks underscore how biodiversity loss undermines progress towards many social Sustainable Development Goals (SDGs) (Good et al., 2024).

Over the past decade, planetary health has gained significant institutional traction, evidenced by the growth of global alliances, academic programmes and policy frameworks. The expansion of research output, educational initiatives and international declarations demonstrates increasing legitimacy and visibility of the field. Nevertheless, the geographical concentration of research in high-income Western countries suggests persistent inequities in knowledge production. This imbalance may limit the relevance of planetary health solutions for low- and middle-income settings, where environmental and health burdens are often greatest (Gonzalez-Holguera et al., 2022).

In their study findings (The Lancet Planetary Health, 2026) indicated that global warming poses a serious threat to the stability of Earth's systems and to the health, livelihoods, and well-being of both current and future generations. Rising extreme temperatures are already causing millions of deaths each year, and heat-related mortality continues to increase. Climate change also disrupts essential resources, as droughts and floods affect crop yields and drinking water supplies worldwide. Coastal communities are losing livelihoods and food security due to warming oceans and the degradation of coral reefs.

The upper limit of the safe and just corridor is set by the strictest environmental boundaries needed to prevent serious harm and to keep Earth's systems stable. The lower limit is determined by the minimum levels of food, water, energy, and infrastructure that everyone in the world needs to live. Staying within this corridor is essential, because crossing environmental limits or failing to meet basic human needs puts both human health and life on Earth at risk (Asaduzzaman et al., 2022). However, remaining within these limits alone does not guarantee fairness, since resources can still be unevenly shared within the corridor, leading to poor health outcomes and further environmental damage. To ensure that this space is truly fair, both fair decision-making processes and fair distribution of resources are required (Guzmán et al., 2026).

The integration of planetary health into education and policy represents a positive shift, particularly within health professional training and national health strategies. However, evaluations of planetary health education reveal uneven progress and variable depth of integration. This suggests that while awareness is increasing, the translation of planetary health principles into competencies and practice remains inconsistent. Embedding planetary health more systematically into curricula is therefore essential to equip future professionals with the skills required to address complex, interconnected health challenges (The Lancet, 2021).

A central finding of this review is that planetary health must retain the normative values of public and global health, particularly social justice and equity. The uneven distribution of environmental harms where high-income countries in the Global North have historically contributed most to greenhouse gas emissions while low-income countries in the Global South bear disproportionate health impacts underscores the ethical dimensions of planetary health (Malmqvist, 2025). Socioeconomic vulnerability further exacerbates exposure to climate-related health risks, reinforcing the need to integrate justice-oriented perspectives from public and global health into planetary health policy and practice.

The discussion further indicates that planetary health provides a systems-thinking framework capable of addressing the limitations of fragmented development approaches. By recognising the interconnectedness of economic systems, environmental sustainability, and population health, planetary health supports transformative strategies such as transitioning to net-zero economies, sustainable food systems, and climate-resilient infrastructure (Malmqvist, 2025). These integrated

approaches offer opportunities for co-benefits, including employment creation, reduced pollution, and improved population health, while remaining within planetary boundaries.

Governance structures emerge as a central barrier to achieving planetary health. Existing decision-making systems are characterised by fragmentation, competition and short-term economic priorities, limiting their ability to respond effectively to complex global threats. Achieving planetary health will require radical transformation of governance arrangements to enable collaboration, long-term thinking and equitable inclusion. Such transformation inevitably challenges entrenched power structures, suggesting that resistance and conflict are likely components of any meaningful transition(Workman et al., 2025).

The alignment between planetary health and the Sustainable Development Goals (SDGs) is another key theme identified in this review. The SDGs, introduced in 2015, provide a shared global framework for sustainable development across both high- and low-income countries. Evidence from Pham et al. shows that planetary health research has predominantly focused on SDG 13 (climate action) and SDG 3.9 (reducing pollution-related health impacts), while receiving comparatively less attention in areas such as marine ecosystems (SGD 14) (WHO, 2024). This imbalance highlights the need for a broader ecological focus within planetary health, particularly given the essential role of biodiversity and aquatic ecosystems in sustaining human health.

Despite increasing policy momentum around healthcare decarbonisation, this study highlights a continued imbalance in mitigation efforts, with sustainability initiatives predominantly concentrated in secondary care. This mirrors previous research suggesting that hospitals receive greater attention due to their high visibility, intensive resource use and the relative ease of measuring emissions reductions within centralized organisational structures. However, the limited focus on primary care is problematic given evidence that this sector contributes up to a quarter of healthcare-related emissions. The findings therefore underscore the need to broaden sustainability strategies beyond hospitals to include community-based care, where cumulative environmental impacts are substantial but often overlooked (BMC Health Services Research, 2024).

Ireland’s national climate commitments and the Health Service Executive’s Climate Action Strategy demonstrate strong policy intent; however, the study reveals a clear implementation gap at the primary care level. Similar to Ireland’s mixed success in meeting previous climate targets,

sustainability ambitions within healthcare risk remaining aspirational unless translated into practical, system-wide actions. The prioritization of secondary care initiatives such as the Green Healthcare Programme reflects structural and governance realities rather than the full distribution of environmental impact across the health system. Achieving the 2030 and 2050 targets will therefore require explicit integration of primary care into national mitigation pathways (Climate Action Plan 2023).

As stated by (WHO, 2024), within the SDG process, countries are granted flexibility in the approaches they use to achieve their SDG targets. This adaptability creates an opportunity to use planetary health evidence and integrated analytical tools to maximise co-benefits across health and non-health sectors, while also identifying trade-offs and unintended outcomes arising from policies implemented outside the health sector. For instance, initiatives in the United States aimed at lowering carbon emissions through the promotion of biofuel production increased demand for palm oil from Indonesia (Martens, 2024). Consequently, old-growth forests and peatlands were cleared for cultivation, releasing stored carbon that contributed to global greenhouse gas emissions and negatively impacted human health at local and regional levels. A planetary health perspective could have guided the early design of mitigation measures and informed strategies for assessing policy implementation, with particular attention to communities that are most vulnerable and least resilient to adverse effects on health and wellbeing.

Biodiversity loss emerges as a critical but often under-emphasized determinant of planetary health. The degradation of ecosystems threatens food security, clean water, air quality, and increases the risk of zoonotic disease outbreaks while limiting opportunities for pharmaceutical discoveries (Malmqvist, 2025). The review underscores that planetary health must move beyond climate change and pollution alone to fully incorporate ecosystem integrity and species preservation as core health determinants.

Interdisciplinarity and transdisciplinarity are identified as defining characteristics of planetary health. Similar to the One Health approach, planetary health integrates insights from social sciences, natural sciences, humanities, and biomedical sciences to better understand disease causation, prevention, and health promotion (Malmqvist, 2025). This broad lens is essential for addressing complex, interconnected challenges that cannot be solved within traditional disciplinary boundaries.

Advocacy is presented as a foundational pillar of planetary health, drawing historical parallels with major public health achievements such as sanitation reforms, workplace safety regulations, and tobacco control (Shimabukuro et al., 2023). The review argues that neutrality in the face of evidence indicating existential threats to human health is neither scientifically nor ethically justifiable. Instead, scientists and health professionals have a responsibility to translate evidence into policy-relevant action and public advocacy (Malmqvist, 2025).

The review highlights the critical role of healthcare professionals in advancing planetary health through climate-sensitive health counselling and policy engagement. Evidence suggests that patients are receptive to health-framed climate messaging, particularly when counselling is actionable and linked to tangible benefits such as reduced energy costs or improved child health outcomes (WHO, 2024). However, time constraints and knowledge gaps remain major barriers to clinician advocacy, emphasising the importance of tools such as the WHO's evidence synthesis platform to support informed decision-making. Strengthening such mechanisms is essential for translating planetary health knowledge into effective practice and policy.

According to (Olea-Popelka et al., 2025), humans substantially influence the global hydrological cycle in the Anthropocene by altering surface water flows and draining groundwater reserves. Most of these alterations are made to enable food production, with 70% of surface water withdrawals worldwide used for irrigation. Water-supply dams, hydroelectric development, and groundwater extraction substantially disrupt natural patterns of ground and surface fresh water flows (ie, blue water), thereby displacing people and threatening biodiversity and ecosystem services (eg, inland and coastal fisheries that support the protein needs of billions of people). Equally, land subsidence from excessive groundwater extraction causes infrastructural damage, and increases vulnerability to flooding, particularly in coastal regions that are already affected by rising sea levels (Good et al., 2024).

Collectively, anthropogenic changes to the hydrological cycle are a barrier to the achievement of the SDGs, which aim to meet the needs of the 30% of the world's population who do not have access to drinking water and the 60% who do not have sufficient access to sanitation. Given that surface and groundwater flow cross national boundaries, the transformations necessary to meet the water-related SDGs and reverse these trends requires ESBs be translated to scales that are relevant for actors involved in the alteration of blue water flows (Martens, 2024). Generally, local-scale

research is necessary to establish functional relationships between blue-water flows and important response variables (eg, biodiversity losses), which can then be used to define safe levels of change to blue water (Gupta et al., 2024).

Proposed actions for public health professionals, researchers and policymakers emphasize the need for capacity building, reflexive practice and structural reform. Strengthening skills in systems thinking, broadening impact assessment to include non-human and distal effects, and reforming research funding and evaluation mechanisms are essential steps toward genuine transformation. Together, these actions position planetary health not merely as a conceptual framework but as a practical guide for reorienting public health toward sustainability, equity and long-term resilience(Guzmán et al., 2026). Should just nine nations adopt measures to reduce greenhouse gas emissions in accordance with the targets set by the Paris Agreement by the year 2040, it is projected that approximately 5.9 million lives would be preserved annually through dietary modifications, 1.2 million through improved air quality, and 1.1 million as a result of increased physical activity from active transportation. It is important to note that there may be some overlap among these figures. (Hamilton et al., 2021).

Conclusion

In conclusion, planetary health provides a comprehensive and ethically grounded framework for understanding and responding to the intertwined crises of environmental degradation and declining human health. The scale, complexity, and urgency of these challenges demand a fundamental rethinking of how societies organise health systems, manage natural resources, and pursue development. Human health cannot be safeguarded in isolation from the Earth systems upon which it depends, making planetary stability a prerequisite for sustainable wellbeing. International agreements such as the Sustainable Development Goals and global climate treaties already address many components of planetary health. However, their effectiveness depends on stronger integration of health, equity, and environmental protection within governance structures. An Earth-system justice approach is essential to ensure that planetary boundaries are respected while meeting the minimum needs of all people. Protecting ecological integrity, reducing health inequities, and ensuring universal access to essential resources must be pursued simultaneously rather than sequentially. The concept of the safe and just corridor offers a powerful guiding framework for policy and practice. By defining an upper limit based on Earth-system boundaries

and a lower limit based on basic human needs, it highlights the necessity of balancing environmental protection with social justice. Remaining within this corridor requires transformative changes in production, consumption, healthcare delivery, and resource distribution, particularly in high-income countries with the greatest historical responsibility and capacity for action. Primary health care systems have a pivotal role to play in this transformation. By prioritizing prevention, community engagement, and sustainability, primary health care can reduce environmental pressures while improving resilience and equity. Strengthening these systems is not only a health intervention but also a climate adaptation and mitigation strategy with wide-ranging co-benefits. Ultimately, achieving planetary health requires collective responsibility, inclusive governance, and long-term commitment across all sectors of society. By embracing systems thinking, fostering interdisciplinary collaboration, and centering justice and equity, planetary health systems can help secure a future in which both humanity and the Earth's life-support systems can thrive. This approach is not optional but essential for safeguarding the health and wellbeing of present and future generations.

Recommendation

The 3Rs principles

The 3Rs principles—Reduce, Reuse, and Recycle—are essential for sustainable waste management and are increasingly incorporated into planetary health frameworks to reduce the environmental impacts of health systems, such as greenhouse gas emissions and pollution. These principles emphasize the relationship between healthcare waste generation and planetary degradation, promoting resource stewardship in facilities. Technological innovations focused on the 3Rs are transforming healthcare waste management by enhancing safety, compliance, and recycling of regulated medical waste (RMW). These advancements can lower operational costs by 25-35%, improve collection efficiency by up to 40%, and minimize environmental impacts.

Reduce

Reducing waste at the source is emphasized in planetary health literature as the most effective strategy for minimizing materials in healthcare. Hospitals can significantly cut greenhouse gas (GHG) emissions by limiting non-urgent testing, opting for bulk packaging, and eliminating disposables like exam table paper. This approach conserves resources while reducing emissions equivalent to thousands of tons of CO2 annually. Frameworks advocate for a "reduce first" strategy in circular economies for health IT and facilities, linking it to lower energy use and pollution in high-waste areas such as operating theaters. AI-driven analytics can identify waste hotspots, optimizing procurement to reduce unused supplies and expired drugs by up to 30%. Hands-free systems like Medismart also minimize the handling of regulated medical waste (RMW) and forecast demand to cut single-use plastics.

Reuse

Reuse extends product lifecycles through refurbishing or repurposing, reducing demand for new materials in planetary health systems. Literature highlights switching from disposable to reusable sharps containers and medical devices in hospitals, yielding economic savings and GHG cuts, though requiring careful hygiene protocols to avoid cross-infection risks. In health systems, telemedicine replaces physical visits, cutting transport emissions while reusing digital infrastructure for equitable care. Reusable innovations like Sharpsmart containers paired with Washsmart robotic washers sanitize via high-pressure cycles, extending lifecycles 50-80 times while meeting WHO hygiene standards. RFID and barcoding track reusables across facilities, reducing contamination risks and enabling predictive maintenance for devices.

Recycle

Recycling in healthcare conserves energy and resources while reducing landfill use. Integrated recycling, composting, and material recovery in hospitals lower emissions compared to incineration, with programs focusing on plastics and batteries to limit pollution. Planetary health frameworks promote recycling within stewardship programs, supporting circular models that align with sustainable development goals. AI sorting and robotic systems classify waste materials with 81-90% accuracy, increasing recycling rates to 55-80%. Waste-to-energy technologies like plasma pyrolysis convert non-recyclables into syngas, reducing landfill volume and emissions by 55-80%.

Research shows that the 3Rs principles can cut costs by 23-30% and enhance planetary health by reducing incineration in resource-limited areas. These principles support Planetary Health policy, integrating health considerations across sectors to improve social determinants of health and tackle ecological degradation that endangers habitability and human survival.

Ultimately, the future of planetary health system will depend on collective choices about knowledge transfer, openness versus isolation, inclusion versus elite capture, and long-term investment versus short-term gains. Whether it becomes durable will hinge on how societies organize politically and economically in the years ahead. Although progress is uneven, fragile, and increasingly shaped by disparities within countries rather than between them. Any selfish motive could weaken these convergence forces and slow, or even reverse, recent gains. Planetary health system should be internalized as a process where the end product (after collective/collaborative efforts from everyone) would either be a haven or hell.

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