Article

Exploring, Diversifying and Debating Sustainable Health (Care) Approaches

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Abstract: Today's sustainability challenges have major implications for human health and health care. At the same time, the way health care is organized and conducted has major sustainability implications. Sustainable health and sustainable health care approaches in research, which engage with health and sustainability as intertwined phenomena, feature increasingly prominently in various literatures, i.e., *(i)* literature based on the premise of '(un)healthy environments result in (un)healthy people' (e.g., *planetary health*); *(ii)* literature on the implications of ecological change for the sustainability of healthcare systems; and *(iii)* literature on healthcare systems' sustainability in view of a range of socio-economic factors. However, an integrative elaboration of the manifold relationships between health and sustainability challenges in these literatures is currently lacking. This review paper therefore maps how these three literatures represent intertwinements between health and sustainability challenges, as well as their suggestions to address these challenges. In addition, we explore which themes and questions are pertinent, meaning they have remained largely unaddressed. By performing a qualitative mapping review, we find that calls for structural attention to inequality, to in-and exclusion, and to stakeholder needs and perspectives cut across these three literatures. Furthermore, we identify three cross-cutting key questions that require future research attention. First, how do divergent ideas on *what is* and divergent ideas on *how can that be known* give rise to different health- and sustainability visions and pathways? Second, what do abstract problem statements and solutions presented in agenda-setting work look like in practice in specific and diverse empirical contexts across the globe? And third, how are diverse health and sustainability dynamics historically and spatially interconnected? Moreover, we observe that some voices have so far remained largely silent in scientific debates on health and sustainability intertwinements, namely non-expert voices such as patients and citizens, voices from a variety of social scientific and humanities disciplines, voices from relevant domains beyond (environmental) health, and voices from the global South (from non-experts, social scientific and humanities researchers and domains beyond health). We conclude that a focus on inclusive and equitable engagement with intertwined health- and sustainability challenges is imperative. This requires moving away from developing universal knowledge to address generic problems, to foregrounding plurality in terms of problem statements, knowledge, solutions, and the values embedded therein.

Keywords: health; sustainability; planetary health; sustainable healthcare systems; healthcare system transformation; inclusion

1. Introduction

Today's sustainability challenges have major implications for human health and health care (e.g., [1]). At the same time, the way health care is organized and carried out has major sustainability implications (e.g., [2–4]). Yet, research that approaches health and sustainability as intimately intertwined phenomena—i.e., sustainable health and sustainable health care approaches—remains scarce compared to the burgeoning sustainability literature. The urgency to redress this has recently been highlighted by the joint editorial published

in over 230 health journals (among them *The Lancet* and *BMJ*) in the run-up to 26th UN Climate Change Conference of the Parties (COP). This editorial called on governments to tackle the "catastrophic harm to health" from climate change [5]. The text expressed pressing concerns with the many ways in which sustainability threats are detrimental for human health, building on insights that have been developed over the past few decades. The editorial builds, amongst others, on the path-breaking work of *The Lancet Countdown*. This team of academics works "to ensure that health is at the centre of how governments understand and respond to climate change" by performing research on, e.g., the health implications of climate change and health-oriented adaptation measures [6].

While the topic is urgent and acute, interestingly, similar calls have been made since the 1970s. In 1974, the then-minister of National Health and Welfare in Canada, Marc Lalonde, pleaded to broaden the narrow focus in healthcare, which focused almost exclusively on the human body and biomedical solutions to disease. He argued that the health of human populations does not only depend on human biology and healthcare systems, but also on lifestyle and the environment [7]. This broad approach to health tallied with the then incipient environmental movement, which found an expression notably in Meadows et al.'s 1972 Report to *The Club of Rome*, Goldsmith and Allen's 1972 *The Blueprint for Survival* and Rachel Carson's *Silent Spring* [8–10]. These books each demonstrated the magnitude of human-induced environmental problems and highlighted their implications for human health. As a result, they gave way to widespread awareness of the frailty of the environment, and, given the centrality of agriculture in the foregoing, also to initiatives that focused on food as a key linking pin between planetary health and human, physical health [11]. Some 15-odd years later, the medical, environmental, and economic lines of reasoning expressed in these early publications were brought together authoritatively by the UN Brundtland Commission, formerly the World Commission on Environment and Development [12], in its report, *Our Common Future*. In this document, the WCED integrated engagement with both global socio-economic challenges and environmental problems. Brundtland, a physician, then-prime minister of Norway and later head of the World Health Organisation WHO, and her committee explicitly argued that healthcare was, along with meeting interlinked basic needs of housing, water supply and sanitation, "environmentally important" and therefore central to sustainable development [12] (p. 55). The WCED stipulated that "deficiencies in these areas are often visible manifestations of environmental stress" [12] (p. 55).

However, subsequent debates on what sustainable development might entail and how it may be achieved have predominantly focused on either ecological sustainability as stand-alone concern, or on the balancing of social, economic and ecological sustainability, in which health is, at best, considered as part of social sustainability [13]. The intimate intertwinement between ecological balance and human health has largely been bracketed out of the discussion. To the extent that it was addressed in the research, the focus was primarily on either the environmental determinants of public health in the field of environmental health [14], or on human impacts on earth environments in the field of environmental sciences, including earth systems sciences, ecology, environmental chemistry, climate sciences, soil sciences and more [15].

This lack of an integrative elaboration has also been highlighted by Atwoli et al.'s editorial [5]. In response, this literature review focuses on key, yet relatively small, strands of research that explicitly foreground the intimate intertwinement of health and sustainability challenges. In particular, we describe and systematize the following three bodies of literature: *(i)* literature which elaborates the relationships between human action, environmental challenges and human health, based on the premise of '(un)healthy environments, (un)healthy people.' This body of work includes research conducted under the recently introduced concept of planetary health; *(ii)* literature on the implications of ecological change for the sustainability of healthcare systems; and *(iii)* literature that is concerned with the sustainability of healthcare systems in view of a range of socio-economic factors. Rather than aspiring full comprehensiveness, we identify and discuss topical lines of argumen-

tation, as well as key avenues for future research. To the best of our knowledge, no such review exists. Earlier relevant reviews focused, for example, on definitions attributed to the term sustainability in the context of healthcare system transformation [16,17], strategies developed to reduce the environmental impacts of healthcare systems [18], or methods to sustain newly implemented innovations in healthcare on the long term [19]. The 2018 summer edition of the *Future Healthcare Journal* presents a comprehensive account on health and sustainability, which is, however, limited to the perspective of healthcare professionals [20].

This paper will first provide answers to two descriptive questions: how are intertwinements between health and sustainability, and their challenges, represented? Additionally, what suggestions are raised to address the challenges identified? Next, we ask: what themes and questions have remained largely unaddressed in the described literatures yet require research attention to address today's intertwined health and sustainability challenges? Since these challenges are pertinent to all living creatures across the world in highly diverse ways, we argue that addressing these themes and questions requires giving room to voices that have so far remained largely silent in the scientific debates reviewed in this paper: non-expert voices such as from patients and citizens, voices from a variety of social scientific and humanities disciplines, voices from relevant domains beyond (environmental) health, and voices from the global south (from non-experts, social scientific and humanities researchers and domains beyond health). Finally, we conclude that moving away from developing universal knowledge to address generic problems towards foregrounding plurality (in terms of problem statements, knowledge, solutions, and the values embedded therein) is crucial for working towards more inclusive, equitable engagements with today's intertwined health and sustainability challenges.

2. Methodology

This paper presents a qualitative mapping review, which is a type of systematic literature review suitable for categorizing and analysing existing literature with the aim of identifying key lines of argument as well as gaps [21]. To identify relevant literature, we used the following search string in the multidisciplinary database, Scopus, to search title, abstract and keywords [22]: "sustainable health" yielded 925 document results published between 1991 and 2021. The search string "sustainability AND health" was not used, because this yielded 32,000+ document results, among which very few papers met the inclusion criteria. We lacked the capacity to analyse this dataset systematically, as doing so required manual screening of all titles and abstracts. Subsequently, we screened the titles and abstracts of the 925 publications resulting from the "sustainable health" query, based on the in- and exclusion criteria listed in Figure 1, which reduced the number of publications included in this review to 37. Next, we used snowball sampling in order to identify relevant literature that could not be identified with the initial search string used, starting from key papers foregrounding relationships between ecological sustainability and human health, within and beyond healthcare system settings such as Whitmee et al.'s report of the Rockefeller Foundation-*Lancet* Commission on planetary health [23]. We note that snowball sampling may not result in a completely representative selection of publications for a field, and that important publications may be overlooked. However, this was the best possible option considering the impossibility of manually screening 32,000+ document results. Given the modest focus of this paper, namely, to provide an overview of key lines of argument with no pretentions of being entirely comprehensive, we feel snowball sampling is sufficiently robust. Overall, this resulted in 70 publications reviewed.

Inclusion criteria
- English or Dutch language
- Focus on a 2-way relationship between health and sustainability
- Agenda-setting, in terms of setting out the direction of research and/or practice or performing conceptual work

Exclusion criteria
- Exclusive focus on economic sustainability
- Exclusive focus on the (one-way) impact of the state of the environment on people's health
- Paper's line of reasoning is unintelligible

Figure 1. In- and exclusion criteria.

We grouped these publications into three categories, following the three main headings in our results section, and analysed them using a data extraction form with analytical questions that resulted from an iterative process of formulating relevant questions given our research aim, reading and analysing a number of publications using these questions, adapting and fine-tuning our questions and aim. The final data extraction sheet used for all papers contained the questions listed in Figure 2.

1. What is the problem the approach claims to be dealing with, and how do sustainability and health concerns relate to each other in this problem statement?
2. Who is affected by the problem identified?
3. What and whose values and interests underpin the problem statement?
4. How does the approach propose to address the problem identified and/or work towards the future state envisioned by the approach?
5. Who is (implicitly) attributed responsibility for the realization of this proposed pathway?
6. Who benefits (potentially) from the effects thereof?
7. In what way and to what extent can the problem statement and/or proposed solution pathway be considered systemic?

Figure 2. Data extraction sheet questions.

We end this methodology section with a note of modesty. We are engaging with topics (health and sustainability) that each have received vast research attention in various disciplines, fields and approaches, over many years. Hence, this paper by no means aims to be fully comprehensive. Instead, we hope the overview presented here is helpful in terms of coming to grips with main lines of argumentation raised as well as key silences and invisibilities—although there is, inevitably, some work out there in which the silences and invisibilities identified in this paper are audible and visible.

3. Results

Table 1 displays the number of articles, book chapters and reports analysed for each of the three strands of literature analysed in this section.

Below, we first discuss approaches based on the premise of '(un)healthy environments result in (un)healthy people', which elaborates the relationships between human action, environmental challenges and human health, and which includes the planetary health and one health approaches (Section 3.1). Next, we focus on the literature on healthcare systems' sustainability (Section 3.2), first in the context of ecological change (Section 3.2.1) and then in the context of socio-economic challenges (Section 3.2.2). In both sections, we answer our first two questions, namely: how are intertwinements between health and sustainability,

and their challenges, represented? Additionally, what suggestions are raised to address the challenges identified?

Table 1. Number of articles, book chapters and reports reviewed for each strand of research.

	(Un)Healthy Environments, Unhealthy People	**Socio-Ecologically Sustainable Healthcare Systems**	**Socio-Economically Sustainable Healthcare Systems**
Articles	10	22	16
Book chapters	2	0	7
Reports	6	5	2
Total	18	27	25

3.1. (Un)Healthy Environments, (Un)Healthy People

Efforts in the field of public health to help people maintain or improve their health are considered 'public' because of the non-private nature of the consequences of an individual's particular health and well-being, and in view of the expenditure involved in such efforts [24]. Indeed, one of the most influential definitions deployed by the WHO is "the science and art of preventing disease, prolonging life and promoting health through the organized efforts of society" [25]. Since the term sustainability came to be deployed in the context of human health, yet another aspect of publicness was added, namely the state of the physical environment [23]. Interestingly, many interpret this in terms of attributing top-priority to safeguarding the environment in order to safeguard human health: "we have been mortgaging the health of future generations to realise economic and development gains [at the detriment of our environments] in the present" [23] (p. 1973).

Indeed, the idea of planetary health extends, as argued by the Rockefeller Foundation-*Lancet* Commission, the Earth System science's concept of the Anthropocene to include concerns with human health and wellbeing, especially of future generations [23]. The notion of the Anthropocene presents humankind as a geological force that changes the planet's systemic properties, resulting in biophysical changes across six key dimensions [26]: (1) a disruption of the global climate system; (2) widespread pollution of air, water, and soils; (3) rapid loss of biodiversity; (4) a reconfiguration of biogeochemical cycles, including that of carbon, nitrogen, and phosphorus; (5) pervasive changes in land use and land cover; and (6) resource scarcity, including that of fresh water and arable land [27]. Planetary health advocates argue that on-going changes across these dimensions are likely to undo the gains in public health achieved over the past decades, and worse. Hence, the idea of planetary health breaks down some of the boundaries between humanity and nature that modernity has arguably put in place [28,29]: humans, including their health, and the environments in which they live are both seen as the product of a complex interplay between the two. It also claims attentiveness towards the highly differentiated roles and experiences of people across the globe, highlighting that those who contribute most to the biophysical changes mentioned above and those who suffer most from health consequences are often very different groups of people [1].

The Rockefeller Foundation-*Lancet* commission argues that the following three challenges need to be overcome in order to maintain human health: a) an imagination challenge, or the ability to imagine life through different concepts than those that currently dominate the scene, such as a strong reliance on GDP as indicator of well-being; b) a knowledge challenge, particularly a scarcity of relevant transdisciplinary research; and c) a governance challenge, particularly institutions' and governments' delayed and failing response to reduce planetary health challenges, including a lack of effective laws [23,30]. Furthermore, extending the idea that we live in the Anthropocene to its implications for human health comes with implications of a strong moral nature (what is bad for the planet is bad for public health, and vice versa) and with an (implicit) claim to a universalistic righteousness: the unspecified 'we' implied refers to all and everyone on this planet, provided of human heritage, without exception. Indeed, in their path-breaking edited volume, Myers and

Frumkin observe that placing these values centre stage will require exploring "new ethical terrain" [1] (p. 11) when making decisions for planetary health, although they do not explicate what kinds of decisions are to be made. Instead, the volume presents a range of generically described ways to enhance planetary health, thereby hiding friction from view.

Planetary health research builds on longer-standing work in the field of environmental health. Historically, the field of environmental health has positioned itself as a subfield of research on public health more broadly [31], and primarily focuses on the health implications of the state of the physical, and sometimes social, environment on either an individual body (i.e., from a toxicological perspective) or populations (i.e., from an epidemiological perspective) [32–34]. However, some research engages with the state of our physical environments and the implications thereof for human health as sustainability challenges (e.g., [35,36]. Indeed, irrespective of the 'planetary health' label, environmental sciences have met health-related disciplines in various ways. As Bikomeye et al. for instance argue, the disciplines meet in efforts at climate adaptation and mitigation strategies, where these produce "positive externalities or health co-benefits" [37] (p. 3). Such mitigation strategies, the authors argue, serve to promote and improve global public health, particularly for the most vulnerable (ibid. p. 16). Likewise, research has focused on the co-production effects that may result from attempts at improving the health benefits of social settings and physical environments, such as of combating 'food deserts' or reducing air pollution in relation to human ecosystems, of which health is the product (e.g., [33,38]).

Finally, the idea of 'healthy environments, healthy people' is also reflected in the One Health approach. In this field, experts in human health, animal health and environmental sciences collaborate to understand how (wild and domesticated) animal health, their living environments, and human health are related, for example via zoonoses, antimicrobial resistance and food security [39,40]. This perspective has gained terrain widely in the face of the zoonoses that plagued the human and veterinarian health system from the 1990s onwards (cp [41]) and has spurred interdisciplinary research in which veterinary medicine often takes the lead in collaboration with other relevant sciences [42]. This literature is predominantly natural scientific in nature, although the interest to involve societal stakeholders in knowledge production to address the complex challenges that foster infectious diseases and microbial resistance is growing [43]. Suggestions to improve both human and animal health largely revolve around implementing healthier livestock raising methods and improving wild animals' living environments through ecosystem restoration and conservation.

3.2. Sustainable Healthcare Systems

In the context of '(un)healthy environments, (un)healthy people', the term sustainability mainly focusses on the direct intertwinement of human health and the healthiness of their environments, including the planet as a whole. The notion of sustainability has also been brought to bear on healthcare systems, the institutions that are directly responsible for safeguarding human health through cure and, though to a lesser extent, prevention. Two distinct, yet overlapping, approaches can be identified here, one in which the notion of sustainability is interpreted in a socio-ecological sense (Section 3.2.1) and one in which the notion of sustainability is interpreted in a socio-economic sense (Section 3.2.2). Section 3.2.1 and Section 3.2.2 both answer our first descriptive question for these two approaches, namely: how are intertwinements between health and sustainability, and their challenges, represented? Section 3.2.3 answers our second descriptive question for both approaches to sustainable healthcare systems at the same time, namely: what suggestions are raised to address the challenges identified?

3.2.1. Socio-Ecologically Sustainable Healthcare Systems

The idea of '(un)healthy environments, (un)healthy people', particularly as reflected through the planetary health approach and insights from environmental health research, has also been brought to bear on healthcare systems. There is a growing recognition that

healthcare systems are going to have to deal with the health implications of the decreasing health of the planet, and that healthcare systems themselves also contribute to the lack of planetary health. Much of this work foregrounds that the health implications of the lacking planetary health are unequally distributed: they often hit the already-vulnerable the hardest [2–4,44–50]. The WHO's approach to sustainable healthcare systems in Europe constitutes a notable exception, and places strong emphasis on ecological, rather than socio-ecological, sustainability [51]. This observation does not hold for the WHOs wider work on environmental health and on the public health consequences of climate change. In much of this work, the unequally distributed health implications of ecological challenges features more prominently.

Overall, this body of literature argues that healthcare systems in the global North are ill-prepared to address the healthcare needs arising from current and future ecological challenges, let alone sustain the health of communities, due to problems within and beyond the healthcare system that have been the focus of longer-standing research on the socio-economic sustainability of healthcare systems discussed in the next section. However, unlike those looking to render healthcare systems more socio-economically sustainable (see Section 3.2.2), literature on socio-ecologically sustainable healthcare systems envisions healthcare systems that have a low ecological footprint and provide (increasingly) high-quality care to all current and future patients, including those suffering from health problems induced by ecological challenges such as climate change, pollution or water shortages. The future is thus presented as a win-win situation in which nobody, including animals and the planet as a whole, loses out.

3.2.2. Socio-Economically Sustainable Healthcare Systems

Concerns with the long-term affordability and accessibility of care pre-date the off-take of the idea of sustainable healthcare systems. In international declarations on health, Toebes identified four values that were frequently mentioned in relation to health care: affordability, accessibility, acceptability and quality [52]. In debates on sustainable health care and sustainable health care systems, affordability and accessibility feature most prominently [53]. Debates on the need to reduce inequalities in access to care are similarly long-standing, particularly, but certainly not exclusively, in the context of the US healthcare system. Building on these debates, the term sustainable healthcare systems, understood in a socio-economic sense, has come to refer to a financially viable healthcare system that provides and can continue to provide affordable and acceptable care to all (e.g., [53–58] and more).

This perspective on sustainable healthcare systems builds on various problem statements that each reflect a different understanding of the way in which a healthcare system's performance (in terms of providing care for all) relates to socio-economic sustainability challenges within and beyond the healthcare system. For example, some are concerned with outside pressures acting on healthcare systems: "ever-evolving challenges and constant pressures wrought by rapid and unprecedented change", due to which the financial burden of healthcare systems on individuals and governments are rising [54] (p. 825). In a radically different vein, Borowy and Aillon point at the centrality of economic growth in our societies as a key driver of the increasing demand for care [59]. Others point towards elements within healthcare systems that render it unsustainable, and which are often specific to particular healthcare systems. For example, in 1997, Jameton and Pierce argued that the US healthcare system's primary focus on providing the best available care to any individual who can afford it has severe negative implications for public health in the US and globally [60]. Pelster et al. point at a wide range of issues in the German healthcare system, including, amongst others, inadequate hospital planning and a lack of functioning quality measurement systems, which render healthcare unaffordable [56]. Some of the problem statements situated within the healthcare system point at what Broerse and Grin call "structurally embedded features" of the healthcare system: features which cut across the healthcare system and which play a fundamental role in how the system

works [57,58]. They identify six key structurally embedded features that obstruct the way to sustainable healthcare systems: (1) compartmentalization of care from other domains; (2) conventional medical rationality; (3) the status of the RCT as the most valid form of knowledge; (4) specialization of care tasks; (5) supply driven healthcare innovation and (6) the limited agency and space that health system players have to advocate for change.

3.2.3. Towards Sustainable Healthcare Systems

This section focuses on the suggestions that have been made to realize more socio-economically and socio-ecologically sustainable healthcare systems. These suggestions cut across both bodies of work and we distinguish between four types, discussed below in the following order: (1) ideas for optimizing current systems, (2) ideas for transforming healthcare systems, as well as other systems that have an impact on health, (3) ideas to on changes in medical education; and (4) ideas on reshaping the very concepts and narratives on which healthcare systems (in the global North) are based. The latter constitutes a particularly fundamental aspect of healthcare system transformation. To oversee and coordinate changing healthcare systems in the various ways discussed below, calls have also being made to establish (national) coordination units, often with explicit reference to the example of the UK and its NHS Sustainable Development Unit that was established 2008 (e.g., [50]). It should be noted that it goes beyond the scope of this section to engage in-depth with the vast literature on innovation in healthcare, although this work is relevant to questions of healthcare system transformation (see, e.g., [61–64] for reviews). Hence, a strengthened conversation between this body of work and the literature reviewed here would be worthwhile.

Optimizing the Current Healthcare System

Prevalent among suggestions to address the sustainability challenges highlighted above are ideas to improve and optimize healthcare systems. These predominantly centre around ideas of enhancing economic and ecological efficiency and reducing waste of energy and materials (for examples, see [47,50,65,66] and see planetary health work on sustainable healthcare systems, [67]). Suggestions on how to do so often remain abstract, and include optimization of hospital management systems, strengthening the system's reliance on evidence-based knowledge [68] and rendering medicine and medical technologies cheaper by increasing the competition between suppliers [56]. Critically, some also suggest to substantially enhance spending, particularly to ensure the availability of enough and well-trained staff now and in the future [69]. A second set of suggestions centres around a techno-optimistic belief in the potential of technology, arguing for the promotion and implementation of sustainable biomedical and technological innovations to reduce the ecological footprint of medical treatments and the healthcare systems' material infrastructure such as buildings [46,48,50,66,69]. Importantly, such suggestions are often raised without recognition of the complex challenges involved in to successfully implement and scale such innovations. Third, and finally, adaptations to health insurance systems are raised, such as Richie's proposal that health insurance companies could offer green insurance plans, which offer more options for preventative care and fund (more expensive) low-carbon treatments [45]. Of course, there are potential tensions between some of the ideas listed above, such as between enhancing spending on qualified staff versus enhancing efficiency. However, none of the work reviewed here explicitly acknowledged or discussed these tensions.

Healthcare System Transformation, and Beyond

Calls for health system transformation, rather than optimization, are gaining traction in both academic literature and practice in the global north [70–72]: to create healthcare systems with different structural features with regard to the way in which healthcare is conceptualized, organized, and takes shape materially [46,49,58,73]. These structural features arguably require dedicated attention because they bring along a high degree of

undesirable resilience, resulting in lock-in that obstructs the actual realization of sustainable healthcare systems beyond small improvements realized through adaptations to the current system [74,75]. In this section, we present an overview of the structural features that are presented in the literature as being in need of change, and the suggestions raised to do so. Structural change in the form of redefining the conceptual foundations of today's healthcare systems is discussed in a separate at the end of this section.

First, in contrast with the idea to render healthcare more evidence-based to optimize healthcare systems (see [56,68] as discussed in above), some call for moving away from top-down expert-driven systems that fail to provide effective care because the needs and perspectives of patients are not well understood, towards systems in which the needs and perspectives of patients and other non-professional stakeholders take the centre stage. To do so, different ideas have been raised, which vary with regard to the specific role such stakeholders may play. For example, some argue for direct participation, while others favour the use of techniques deployed by experts to understand stakeholder needs more thoroughly, such as deep listening [48,76]. In most cases, this suggestion is raised in the context of changing the way care is organized and provided, but others also argue for participation in (currently highly supply driven) healthcare innovation [58]. Closely related is the suggestion to use transdisciplinary science to widen the healthcare system's knowledgebase: combining natural sciences with economic and behavioural sciences, as staff and patients' knowledges, to produce medical knowledge [3,44,48,59]. A second set of suggestions focuses on changes in physicians' roles, from a dominant focus on providing the best available care to individual patients towards a wide set of responsibilities that includes disease prevention, taking the well-being of patients' social surroundings into account and discussing ecological challenges' health implications with patients [3,77,78]. Others have suggested physicians should also play a role in making healthcare institutions more sustainable, by setting up or joining green teams that run sustainability projects (i.e., avoiding waste, promoting green procurement, etc.) [45]—something which is increasingly common in practice [77]. Fostering changes in physicians' roles, regarding their interaction with patients or as green team members, requires wider institutional changes, for example in the guidelines that steer physicians' decision-making when deciding on treatment methods, medication or narcotics [79]. Thirdly, and relatedly, are ideas to enlarge the space for and importance attributed to prevention within the healthcare system. This involves changes in, amongst others, laws and regulations, healthcare funding structures, and the very way in which good health care is conceptualized (see the final paragraph of this section). For example, Pelster et al. suggest that the German government should change its health insurance regulations in order to enable health insurance organizations to invest in prevention [56]. Fourth, and finally, there is the suggestion to limit the possibilities for patent monopolies on crucial healthcare innovations as they render health care expensive and exclusive [59]—a suggestion which is embedded in wider healthcare innovation studies literature.

Crucially, suggestions to transform healthcare systems also stretch beyond the healthcare system itself towards other systems. This is predicated on the argument that wider changes are required to increase people's overall health and thereby reduce the pressures that render today's healthcare systems unsustainable. In this context, Broerse and Grin's socio-economic take on sustainable healthcare systems points at the need to reduce socio-economic inequality and render lifestyles healthier through changes in the food system, mobility systems, urban planning, science, and more [58]. Borowy and Aillon illustrate how these suggestions can stretch far beyond the realm of health by advocating changes in economic rationales in order to move away from striving to maximum productivity towards making fewer working the norm: this would allow for healthier lifestyles, as well as an overall non-growth-oriented take on economics [59]. Additionally, calls have repeatedly been made to address the ecological challenges that increase todays and particularly future healthcare needs [4,44,59]. For example, some call for health professionals and patients to lobby for more effective (inter)national climate and sustainability policies [3,45,47]. The

'emergency editorial' mentioned at the onset of this paper, which was recently published in over 200 health journals around the world calling for action among world leaders to reduce global warming and biodiversity loss because of the catastrophic implications thereof for human health is an important case in point [5]. Additionally, others call for a range of other changes that reduce the role of the healthcare system itself in creating these ecological challenges as discussed over the previous few pages.

Much of the work discussed above primarily hones in on the changes that might be required and less on the possible ways in which such changes may be realized in practice. By means of exception, Crowley argues that sustainability policies for healthcare systems' ecological sustainability performance (in terms of carbon emissions, pollution, etc.) would be a helpful means to exert pressure on healthcare systems to improve its performance [47]. Charlesworth and Jamieson suggest creating a sense of urgency among healthcare institutions' management and staff and putting in place a performance management system in order to stimulate the development and uptake of sustainability measures [46]. Such a performance management system would have to be adaptive, given the authors' argument that the trajectory towards sustainable health-care systems will continually change. Essink et al. present a more overarching approach, arguing that healthcare system transformation should be guided by a constant balancing of the system's key values [80]. These values are to be defined in a context-dependent manner, although affordability, accessibility, acceptability and quality dominate in much of the global North. The process of defining and balancing a set of core values, the authors suggest, can facilitate getting an extended set of stakeholders on board, creates a shared sense of urgency to act if a shared value is not sufficiently protected, generates direction for concrete action, and allows for foregrounding future benefits against short-term losses. Finally, Broerse and Grin present a number of suggestions for the governance of transformative change in the healthcare system [58]. In particular, they argue for a process that starts with developing new, and shared, long-term sustainability visions for a particular healthcare systems, doing experiments in which structurally embedded features that hinder the realization of this vision are challenged, linking these experiments to the mainstream healthcare system (and other relevant systems), and running 'transition programmes': programmes in which diverse actors from the healthcare system work together to identify and understand problems and develop solutions as well as strategies for scaling up. Johansen et al. have elaborated on the latter, particularly highlighting the need to anchor and institutionalize sustainability among healthcare managers combined with experiments that challenge current "ways of thinking and doing" [49] (p. 889).

Education for Sustainable Healthcare Systems

The field of medical education has developed several lines of thought on ways in which medical education may be able to play a role in rendering health systems more sustainable, with a dominant focus on ecological sustainability, by changing the way in which healthcare professionals think and act [81]. While some of these suggestions extend the appropriate role of medical professionals beyond providing individual care to also include diplomacy, mitigation, advocacy, and activism [82–84], most work centres on changing the ways in which clinical, technical, and professional skills are taught. With regard to the former, Barna et al. suggest developing protocols, and teaching skills to use these protocols, which focus on prevention, patient empowerment, avoiding unnecessary care and choosing low carbon alternatives [85]. Tun argues sustainability should be a cross-cutting element embedded in all courses of medical education programmes, implying that sustainability-oriented protocols proposed by Barna et al. should be developed tailored to the different medical specialties [86]. This would integrate the topic solidly into the curriculum and avoid debates over inserting yet another teaching module in an already crowded educational programme. At the same time, Tun highlights that there is a lack of knowledgeable educators to teach healthcare sustainability, and that the topic may be overwhelming and emotionally challenging for students—although she also identifies

that students themselves are increasingly eager to learn about the topic [86]. Finally, with regard to extending a doctor's role beyond providing care towards becoming agents of change, Huss et al. suggest embedding the following three humanistic principles in medical education: (1) self-auditing through reflection on one's position in the natural environment and their feelings about how they relate to that environment; (2) immersion in the natural environment to experience the 'self' as part of the whole or to acquire an 'embodied' knowledge of that environment; (3) connect with communities whose culture, spirituality, health and well-being are symbiotically connected to all elements of the natural environment [87] (p. 1098).

Rethinking Health and Care, the Medical Rationality and the Healthcare System

The way in which the healthcare systems' central concepts, such as the notions of "health" and "care", are understood arguably constitute a particularly fundamental and obdurate structural feature of healthcare systems. They inform how care is conducted on a day to day basis and are key building blocks for other structural features of healthcare systems (e.g., institutional set-up, rules and regulations, biomedical innovation, etc.). As such, they hinder healthcare innovations geared to improving healthcare systems' sustainability [88]. Although reconceptualizing these central notions has received less explicit attention in work on sustainable healthcare systems than the suggestions for change discussed above, they do underpin many of the points raised there. In this section, we elaborate on three key notions that have been suggested to require rethinking, namely the medical rationality, which includes the notions of health and care, the notion of value in healthcare, and the notion of a system.

Broerse and Grin characterize the medical rationality as a mode of thinking which is focussed on "(1) diseases, (2) located in the body, and (3) to be remedied by an outside, medical intervention. Body and mind are considered (4) separate entities, while (5) the body is conceived of as universal" [58] (p. 272). This rationality can be problematic from a sustainability perspective because of its dominant reliance on a particular form of knowledge, namely evidence-based medicine (EBM). EBM arguably silences patients' voices and is poorly equipped to understand let alone provide care for patients' diverse, complex and non-linear health-trajectories in which diverse forms of mental and physical health are often intertwined, and which emerge in part from the environments within which people live [58]. In a related vein, Dunphy argues that the centrality of objectivity in the conventional medical rationality makes it difficult for medical professionals to engage with environmental sustainability, which often requires a discussion on people's values, in their care practices [89]. To take patients' and other stakeholders' voices more seriously in matters of both health care and health prevention and produce knowledge that is relevant to today's and the future's healthcare challenges, including environmental sustainability, the conventional medical rationality would need to be replaced by a more integrated and situated or co-produced understanding of health and disease [58]. Ideas to render health care less compartmentalized and less centred around specific physical and psychological specializations feature particularly in empirical examples of successful health system transformation [46,58,73]. Doing so would also widen the space for transdisciplinary, more inclusive and more relevant forms of knowledge production. Interesting examples of reconceptualization in this direction include the 'positive health' approach, the 'settings approach to health promotion' and 'people-centred healthcare', although such new approaches often find a niche within the mainstream healthcare system and seldom have the opportunity to challenge the system's structural features in practice. Van Bortel et al.'s positive health approach is predicated on the observation that both individual care and activities to promote public health are currently based on so-called 'deficit models' that seek to redress health problems once they have emerged [90]. They argue that preventing such health problems would be more effective and promote the idea of enhancing people's health assets: fostering health-promoting factors at the community- and individual level which enable people to actively "create acquire and maintain health" [90] (p. 2). Health, then, is no longer the

absence of disease but the ability to take care of oneself. In a related vein, Dooris revives the 1986 settings approach to health promotion, suggesting that sustainable healthcare systems' public health activities must focus on creating environments that keep people healthy rather than trying to keep people away from what makes them ill [91]. Health, according to the settings approach, is the result of people's direct interactions with their natural and social environments: "health is created and lived by people within the settings of their everyday life; where they learn, work, play and love" [91] (p. 29). Additionally, Sturmberg and Njoroge's 'people-centred health care' approach revolves around communities and care providers jointly identifying health care needs and developing strategies to address these needs [92]. The provisioning of people-centred care in practice places the patient in its entirety, including the setting in which he/she lives at home, centre stage rather than evidence-based knowledge on possible treatment options for a disease in a specific part of the body or mind.

Next, and as discussed in Section 3.2, transforming healthcare systems arguably requires re-identifying and rebalancing the notion of value in healthcare systems [80]. Indeed, reconceptualizing the medical rationality discussed in the previous two paragraphs changes what good health and good care constitute. Others have suggested to replace the healthcare systems' central value of 'curing disease' with a sustainable value that accounts for the environmental, social and financial impacts of today's healthcare activities on future generations (see Equation (1)) [81]. Finally, taking environmental impacts of care seriously arguably implies that the individual right to healthcare may be untenable due to the increasingly frequent, severe and unequally felt catastrophes caused by human-induced global environmental change. As an alternative, Lautensach foregrounds the notion of health security to indicate safeguarding health as a collective good rather than an individual right [93]. Others have challenged that the central value of providing the best available care to those who can afford it, particularly in US health systems, should be replaced with a notion of value that encompasses the well-being of a health care system's target community as a whole [60,69]. In particular, this includes the suggestion that decision-making by actors throughout the different elements of the healthcare system, including research and innovation, health insurance, primary care management, and hospitals, etc., should be based on the question of which choice is most beneficial for the target population as a whole, even if this comes at the cost of withholding particularly expensive treatments from well-to-do individuals: Equation 1- Sustainable value (cf. Mortimer et al. 2018).

$$\text{Sustainable value} = \frac{\text{Outcomes for patients and populations}}{\text{environmental} + \text{social} + \text{financial impacts}}$$

The third notion that arguably requires rethinking is that of the system. In literature on sustainable healthcare systems, and particularly on socio-economically sustainable systems, we observed a movement from understanding healthcare systems as a collection of individual and replaceable parts towards understanding healthcare systems as complex systems, in which the individual parts are interlinked and interdependent in manifold ways. Such a complex system reacts in unexpected ways to outside pressure and attempts to change it [73]. In most work we reviewed, such systems thinking is not elaborated in-depth or followed through in formulating further suggestions for change but highlighted as key requirement for rendering healthcare systems more sustainable. Both Sturmberg and Broerse and Grin constitute an exception to the foregoing [55,58]. The former argues for a redesign of healthcare systems on the basis of fostering productive relationships between parts of the system rather than optimizing its individual parts. The latter do not explicitly engage with healthcare systems as complex systems but mobilize system innovation studies to identify structural features of healthcare systems that obstruct transitioning to more sustainable systems. These features are discussed in the second paragraph of this section (on 'healthcare system transformation, and beyond').

4. Discussion & road ahead

4.1. (Un)Healthy Environments, (Un)Healthy People, and (Un)Sustainable Healthcare Systems

The first ambition of this paper was to answer two descriptive questions, namely: how are intertwinements between health and sustainability, and their challenges, represented? And what suggestions are raised to address the challenges identified? We first zoomed in on research that elaborates relationships between human action, environmental challenges and human health ('(un)healthy environments, (un)healthy people'). Second, we explored two research approaches to sustainable healthcare systems: research on socio-ecologically sustainable healthcare systems and research on socio-economically sustainable healthcare systems. We noted that the latter inspired the former in terms of solutions to render healthcare systems more sustainable, and that the former takes its cue from the '(un)healthy environments, (un)healthy people' literatures for its problem statements. Hence, both the '(un)healthy environments, unhealthy people' literatures and work on socio-ecologically sustainable healthcare systems place the interactive relationship between human health (and healthcare systems) and (socio-)ecological environmental health centre stage. Recognizing and elaborating this interplay is important in order to build support for sustainability measures, or so is at least the hope of those who support the joint editorial, published by 230 health journals, calling to tackle the "catastrophic harm to health" from climate change [5].

Table 2 summarizes our key findings answering the two descriptive questions with regard to the three bodies of work reviewed. We note that they each represent a distinct line of investigation, but in practice they overlap. For example, some work on sustainable healthcare systems takes both socio-ecological and socio-economic sustainability concerns into account (e.g., [20,48,84]). Across these three strands of literature, we observed omnipresent concerns with inequality and in- and exclusion, and many called for a more explicit valuation of diverse stakeholders' perspectives on health and sustainability. At the same time, and crucially, in the next section we argue that a number of key voices have so far remained largely silent.

Table 2. Key findings of the three strands of literature reviewed.

	(Un)healthy Environments, Unhealthy People(Planetary Health, Environmental Health and one Health Literature)	Socio-Ecologically Sustainable Healthcare Systems	Socio-Economically Sustainable Healthcare Systems
How are intertwinements between health and sustainability, and their challenges, represented?			
What suggestions are raised to address the challenges identified?	Creating healthier environments, inspired by solutions developed in wider sustainability research, environmental sciences, ecology, veterinary sciences, etc.	Optimizing the current healthcare system; transforming healthcare systems and interrelated systems (food, energy, industry, etc.); educating healthcare professionals; rethinking health and care, the medical rationality and the healthcare system.	

4.2. Key Research Avenues

The second ambition of this review was to explore which themes and questions have remained largely unaddressed yet require research attention to address today's intertwined health and sustainability challenges. Based on the review results, we argue that three key research avenues require attention in order to equitably address today's intertwined health and sustainability challenges.

First of all, we argue that more research is needed on such fundamentals, including the meaning of key terms such as health, sustainability, nature, economy, rights, etc. fundamental ideas underpinning research on the intertwinement of health and sustainability—such as ideas on *what is*, and *how that can be known*, on worldviews and on the meaning and

importance of values, etc.—are rarely made explicit let alone discussed and challenged in the literatures reviewed in this paper. Instead, the dominant role of modern healthcare systems in the global North in these literatures resulted in a limited visibility of non-modern pathways—often referred to as traditional, indigenous, tribal, and alternative or complementary—and the roles these could play a role in reconceptualising and addressing health and sustainability challenges (see Arora and Stirling for an elaboration on this argument in the wider context of the UN and its work on sustainable development [94]).

Secondly, we argue that research producing substantial empirical knowledge, which situates problem statements and solutions in specific settings, is required. Currently, there is relatively little substantial, practiced-based and locally situated understanding of how health and sustainability challenges are variously intertwined within healthcare systems and beyond, nor of the ways in which proposed solutions may be realized and work out in practice. We argue such knowledge would be valuable for three reasons. First, it can bring the manifold obstacles that may come into play when attempting to realize change in practice into view [95]. This would take away the sense of naivety with which some of the solutions discussed in Section 3.2.3 are presented, by engaging actively with the difficulties that may emerge when realizing these solutions. Second, such knowledge can bring into view how values which drive the initiation of trajectories of change may actually transform in the process of realizing the envisioned change in practice (i.e., in terms of diverging, aligning or enriching, for example, see [96]). To illustrate: many of the publications discussed above present the reduction of inequalities as an important focus for healthier environments and sustainable healthcare systems, but it remains to be seen to what extent and in what way the reduction of inequality remains a key value in practice when solutions are geared towards optimizing existing ways of working as suggested by, e.g., [47,50,65,67]. Third, and crucially, such knowledge could make explicit what different capacities and responsibilities diverse groups may have, need or be attributed with to realize the changes proposed, and how groups may be affected differently by those changes. Not doing so allows us to present sustainability pathways as inherently desirable for everyone involved, while most suggestions for change, and particularly those that address structural features, may be more desirable for some than for others and raise the question of who is to bear the costs for change. They therefore constitute a source of friction that needs to be rendered explicit if choices are to be made in an inclusive and durable manner [97].

Thirdly, most of the research reviewed in this paper is either directed at the 'global' level, as pointed out in the previous section, or at specific sites (countries, regions, cities, hospitals, etc.). Furthermore, this work is contemporary in nature, or looks towards the future. There is little attention for the ways in which intertwined health and sustainability challenges at different sites are interconnected, and how these challenges have historically emerged. However, we argue that historical trajectories and spatial connections matter: the past has implications for how we experience the present and imagine the future [98], and the movement of people, traded goods and pollutants, amongst others, imply that health and sustainability developments at one site cannot be understood in isolation from other sites [99]. For example, Jameton and Pierce lay out how the ways in which US healthcare is organized is rooted in a historical trajectory that has profound implications for which the future of US healthcare is imagined by most Americans, and that the system's characteristics have consequences for the availability and quality of care far beyond the US, and vice versa [60]. We therefore argue spatial and temporal dimensions of intertwined health and sustainability challenges require more research attention.

4.3. From Universality to Plurality: Opening up to a Wider Diversity of Voices

The third ambition of this paper was to identify voices that have so far remained silent. Given that health and sustainability challenges are pertinent to all living creatures across the world in a wide variety of ways, we argue that it is critical to include a wide variety of voices when addressing the research challenges presented above (Section 4.2),

including those that have so far remained largely silent in scientific debates on health and sustainability intertwinements, despite the calls for more participation, transdisciplinary knowledge production and learning from indigenous people that we identified in Section 3. The silent voices listed in this section are not unique to the literatures on the intertwinement of health and sustainability discussed in this paper: they also feature in wider global and public health literatures as well as sustainability literatures. We argue that the four types of silent voices discussed below taken together emerged from our analysis as particularly pertinent to the literatures reviewed in this paper, and that these voices are required to meaningfully engage with the key research avenues proposed in Section 4.2.

First, and perhaps most crucial, is the silence of non-expert voices, including their diverse priorities and knowledges. The planetary health approach does call for drawing on indigenous knowledge, but primarily to help reach the goals of the planetary health agenda as set out by the Rockefeller Foundation *Lancet* Commission on planetary health. As Myers put it, the indigenous perspective might "have an important role [to play] in reconnecting us with that other important way of knowing that is more consistent with stewardship of our natural systems" [100] (p. 2866). This quote reflects planetary health's unification of non-scientific modes of knowing into a singular alternative mode of knowing (as illustrated by using a singular form of 'the indigenous perspective' rather than 'indigenous perspectives'), and the centrality of an anthropocentric cosmology and the notion of human stewardship over nature. This approach limits the space for interactions between a plurality of knowledges that may emerge from different understandings of *what is*, from different ways of knowing, from different worldviews and from foregrounding different sets of values. In literature on sustainable healthcare systems, we also identified various suggestions to strengthen transdisciplinary research and learning, particularly in terms of combining different disciplines and including staff and patients' perspective in knowledge production and problem-solving. However, when the conventional medical rationality is left unchallenged (as discussed at the end of Section 3.2.3), the inclusion of non-expert voices remains largely instrumental, serving to develop effective solutions to already-defined problems that may not necessarily be the problems of the intended beneficiaries. Sturmberg and Njoroge's people-centred healthcare approach constitutes an inspiring exception, in which non-experts can also play a role in defining what good health and good care constitute to them along with developing care practices to realize good health [92].

Next, we note that engagement with the topic by the social sciences and humanities, including but not limited to anthropology, history, geography, and science and technology studies, has been limited so far. The '(un)healthy environments, (un)healthy people' work discussed in this paper is mostly produced by scholars with backgrounds in various environmental and medical sciences. In the case of work on sustainable healthcare systems, scholars in medical sciences, engineering and sometimes management predominate, and a small minority have a background in governance studies. However, the social sciences and humanities are crucial to engage meaningfully with the suggested key research avenues (Section 4.2).

Thirdly, experts and stakeholders from relevant domains beyond the realm of healthcare and (environmental) public health were rarely involved in the scientific work discussed in this paper. Recommendations to improve the health of the planet or to render healthcare systems more socio-economically and/or socio-ecologically sustainable stretched far beyond environmental sciences and healthcare systems themselves: suggestions reviewed in this paper for example included changing the ways in which transportation takes place, how food systems are organized, how cities are planned and how (scientific) knowledge is produced. Research in the latter fields certainly do increasingly engage with questions of simultaneously addressing health and sustainability challenges (see, for example, [101–103] but we have not been able to identify a conversation between such research and the work we reviewed in this paper.

Finally, there is a dearth of voices from the global South, of all of the three types of voices listed above (non-experts, social sciences and humanities, and domains outside the realm of healthcare and (environmental) public health). The planetary health agenda is presented as being applicable globally yet builds on ostensibly universal ideas on what both human and planetary health constitute. This 'One-World World' [104] silences actors' diverse understandings, experiences and agendas with regard to health and sustainability issues (referred to in these terms or otherwise) in different settings across the globe. Indeed, Tandon's recent mapping of the lack of geographical (and gender) diversity in climate change research, and the discussions thereof in a podcast by *The Lancet Voice* brought to the fore that this has sever implications for both the problems that are analysed in research (i.e., predominantly climate changes' health impacts in the global North) and the solutions identified and developed (i.e., predominantly solutions that address global North problems and that are feasible and effective in those settings) [105,106]. This situation features similarly in literature envisioning more sustainable healthcare systems, which is predominantly rooted in modern healthcare systems, particularly those of the US, Australia and a small number of European countries. Mori and Todoka's work on the Japanese healthcare system figures as the only non-global-North literature we identified in this review [44].

To end, and by means of a theoretical contribution to the literature reviewed, we propose that foregrounding, rather than avoiding, plurality is a crucial first step to work towards more inclusive, equitable engagements of today's intertwined health- and sustainability challenges. This implies that knowledge production should move away from doing research to understand 'the problem' and provide 'the solution', approaching both 'the problem and 'the solution' as singular entities that can be clearly defined. Such an approach often comes with a moral imperative to put the solution identified into practice at all costs, while taking other problem statements out of view [107]. Instead, we suggest producing a form of transdisciplinary knowledge in which there is space for multiple understandings of ostensibly the same problem, multiple forms of knowledge thereon, multiple possible solutions, and for rendering the role that values play in the foregoing explicit. Such 'opening up' (cf. [108]) entails pointing out uncertainties and contingencies, and recognizing differences in worldviews, framing and assumptions. Doing so would provide the foundations for more meaningful dialogue between different stakeholders (researchers, citizens and patients, governance actors, etc.), as it allows diverse voices to express themselves and be heard on their own terms, rather than being made to fit a pre-existing and implicit logic a priori [109]. Moreover, foregrounding plurality also invites exploring how possible courses of action presented in the literature reviewed in this paper may intersect: to open up the political and contestable nature of the issues at hand, to create space for dissensus thereon, and to explore alternative solution pathways [110]. As a consequence, traditional governance interventions may need to give way to more pluriform, reflexive and adaptive forms of governance [111–114]. Overall, foregrounding plurality would allow for challenging and transgressing the very ways of thinking and doing that may have played a role in the emergence of the problem(s) at hand in the first place.

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