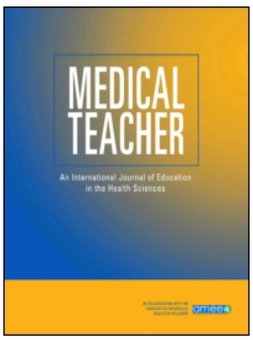

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Education for the Anthropocene: Planetary health, sustainable health care, and the health workforce

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ABSTRACT

Over the past few centuries, human activity has wrought dramatic changes in the natural systems that support human life. Planetary health is a useful concept for health profession education (HPE) teaching and practice because it situates health within a broader understanding of the interdependent socio-ecological drivers of human and planetary health. It facilitates novel ways of protecting both population health and the natural environment on which human health and well-being depends. This paper focuses on the climate crisis as an example of the relationship between environmental change, healthcare, and education. We analyze how HPE can help decarbonize the healthcare sector to address both climate change and inequity in health outcomes. Based on the healthcare practitioner's mandate of beneficence, we propose simple learning objectives to equip HPE graduates with the knowledge, skills, and values to create a sustainable health system, using carbon emission reductions as an example. These learning objectives can be integrated into HPE without adding unduly to the curriculum load.

KEYWORDS

Curriculum; education environment; multiprofessional; public health; ethics/attitudes

The Earth system and its boundaries

The rise of human civilizations since the last major glacial age 11,700 years ago, was enabled by a stable climate and extensive, biodiverse habitats. This geological epoch, called the Holocene, allowed for settled food production and the development of urban societies in almost every part of the world. Over the past few hundred years, the modern world system, based on colonization and industrialization, has transformed human society, extended life expectancy, and 'severely altered' three-quarters of land and two-thirds of marine environments. Over one-third of all land surface and three-quarters all freshwater resources are now used for agriculture (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) 2019). Land clearance and fossil fuel combustion have altered the global carbon cycle, increasing the carbon dioxide in Earth's atmosphere from approximately 280 ppm in preindustrial times to over 400 ppm today, trapping heat and raising the average surface temperature of the planet by about 1.0 °C above pre-industrial levels. Despite international agreements, greenhouse gas emissions have doubled since 1980 and continue to rise, soon ending our ability to stabilize global temperatures at 1.5 °C above pre-industrial levels (Intergovernmental Panel on Climate Change (IPCC) 2018). Anthropogenic changes to land, air, and oceans have produced a rate of species extinction up to hundreds of times faster than the average of the last 10 million years. At least 680 vertebrate species have been lost since 1500 as a result of human activities and a further one million animal and plant species are currently threatened with extinction (IPBES 2019).

Practice points

- Health professional students must be prepared to respond to the health effects of global environmental changes, including climate instability and the mass extinction of species.
- A simple re-framing of the curriculum allows a fresh understanding of professionalism and the integration of socio-ecological determinants of health into clinical practice.

Human activity is now 'putting such strain on the natural functions of Earth that the ability of the planet's ecosystems to sustain future generations can no longer be taken for granted' (Board of the Millennium Ecosystem Assessment 2005). The 'safe space' within which human societies can continue to flourish is built on functioning state of nine essential Earth system processes and we have transgressed the zone of safe certainty of four of these nine planetary boundaries, including climate and biodiversity (Rockström et al. 2009; Steffen et al. 2015).

Some geologists have called for a new name to identify this epoch – 'the Anthropocene'. Other academics have questioned the attribution of responsibility to 'people' generally, when in fact the real culprits – colonialism, capitalism, carbon-based industrialization, economic globalization – have benefitted some people (Haraway 2015; Lewis and

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Maslin 2015; Prescott and Logan 2019), while externalizing harm to the socio-economically marginalized (Raworth 2017; Myers 2018; Watts et al. 2019). The social determinants of the health are brought to life through debate about whether this epoch would better be described as 'the Capitalocene' or 'the Plantationocene' (Vergès 2017; Davis et al. 2019), and an understanding of the links between structural racism and environmental degradation.

Planetary health

The drenching of soils with chemical fertilizers, the re-purposing of air, water, and land as sewers for industrial practices, and the wholesale slaughter of biologically diverse organisms have driven exponential increases in infectious and vector-borne diseases, non-communicable disease, malnutrition, as well as the injury, trauma, displacement, and mental illness associated with extreme weather events and conflicts over natural resources (Myers 2018; Watts et al. 2019) now threaten to roll back the public health gains of the past century.

Human societies have traditionally recognised the interdependence of human and ecosystem health, and many Indigenous cultures still do. This recognition re-entered mainstream discourse with the Ottawa Charter for Health Promotion call for a 'socioecological approach to health' (WHO 1986). The concept of planetary health, launched by Lancet-Rockefeller report 'Safeguarding human health in the Anthropocene epoch', recognizes the 'socio-ecological drivers of illness and the unequal and unjust distribution with which different people and ecological entities are affected by them'. It calls for the protection of biological and cultural diversity, promotes funding for interdisciplinary research on threats to human health and ecosystem integrity to improve accountability and decision-making, and aims to redefine growth and prosperity away from GDP toward measures that ensure a better quality of life for all (Whitmee et al. 2015; Lerner and Berg 2017; Prescott and Logan 2019).

The UN sustainable development goals

In ecological terms, sustainability refers to the capacity of a system to maintain essential functions and processes over time. The concept of sustainable development aims to 'meet the needs of the present without compromising the ability of future generations to meet their own needs' (Brundtland et al. 1987). The United Nations Sustainable Development Goals (SDGs) offer a blueprint to improve health, end poverty, and reduce inequality, while simultaneously addressing the climate crisis and restoring the forests and oceans.

Two of the SDGs are of particular relevance to health professions' educators. SDG 4 (quality education) aims to 'ensure that all learners acquire the knowledge and skills needed to promote sustainable development'. SDG 13 (climate action) strengthens 'resilience and adaptive capacity to climate-related hazards and natural disasters in all countries, improves education … and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning, and integrates climate change measures into national policies, strategies and planning' (United Nations 2015).

Climate change and the healthcare carbon footprint

Modern healthcare and medical education have developed in a context of fossil-fuelled economic growth, a stable climate,and an abundance of biological diversity. Yet, today, every part of society–including healthcare–must find ways to operate without producing greenhouse gas emissions or undermining ecosystem function.

An environmentally sustainable healthcare system offers high-quality services in the present without compromising the ability to meet the health needs of the future. It addresses the socio-ecological determinants that undermine population health (primary prevention) and intervenes early in the disease process (secondary prevention) (Parkes et al. 2020). It provides 'lean' healthcare delivery that reduces the environmental and socio-economic costs of healthcare provision, benefitting both patients and the environment (Mortimer et al. 2018). Sustainable healthcare systems can support the implementation of environmental policies that have co-benefits for health, such as reduction in air pollution (Markandya et al. 2018), mental health benefits of increased green spaces (Wood et al. 2017) and active travel (Saunders et al. 2013).

In this article, we will focus on climate change as an example of the challenges of sustainable development in the health sector. There are several reasons for this. First, climate change is one of two 'core' planetary boundaries or 'threat multipliers' with the ability to destabilize other Earth systems. Second, climate change exacerbates existing socio-economic inequalities and injustices that worsen population health outcomes (Islam and Winkel 2017; Hickel 2019). Third, after 50 years of research and advocacy, climate change is supported by a number of national and international policies on greenhouse gas reductions, which other 'core' boundaries such as biodiversity do not. Fourth, beyond regulatory compliance, our professional training and values of *Primum non nocere*, or 'first, do no harm', require us to find a better way to maintain the health of individual patients without undermining the health determinants of the surrounding – and global – communities (Pearson et al. 2015). Fifth, the health sector has begun to quantify its own contribution to the carbon emissions that drive global warming and it is clear that carbon is in some ways the foundation stone of the professional services and technological advances of modern healthcare. If healthcare were a country, it would be the fifth-largest emitter on the planet, producing an astonishing 4.6% of our carbon emissions, 71% of which originate in the produce supply chain (Karliner et al. 2019). Finally, because today's students demand it (International Federation of Medical Students' Associations 2018).

The urgent task ahead is to decarbonize the health sector in the next decade and achieve carbon neutrality by 2050 (United Nations Framework Convention on Climate Change 2016; Intergovernmental Panel on Climate Change (IPCC) 2018). Some health systems have made carbon reduction commitments (National Health Service England 2019) and some education systems have curriculum

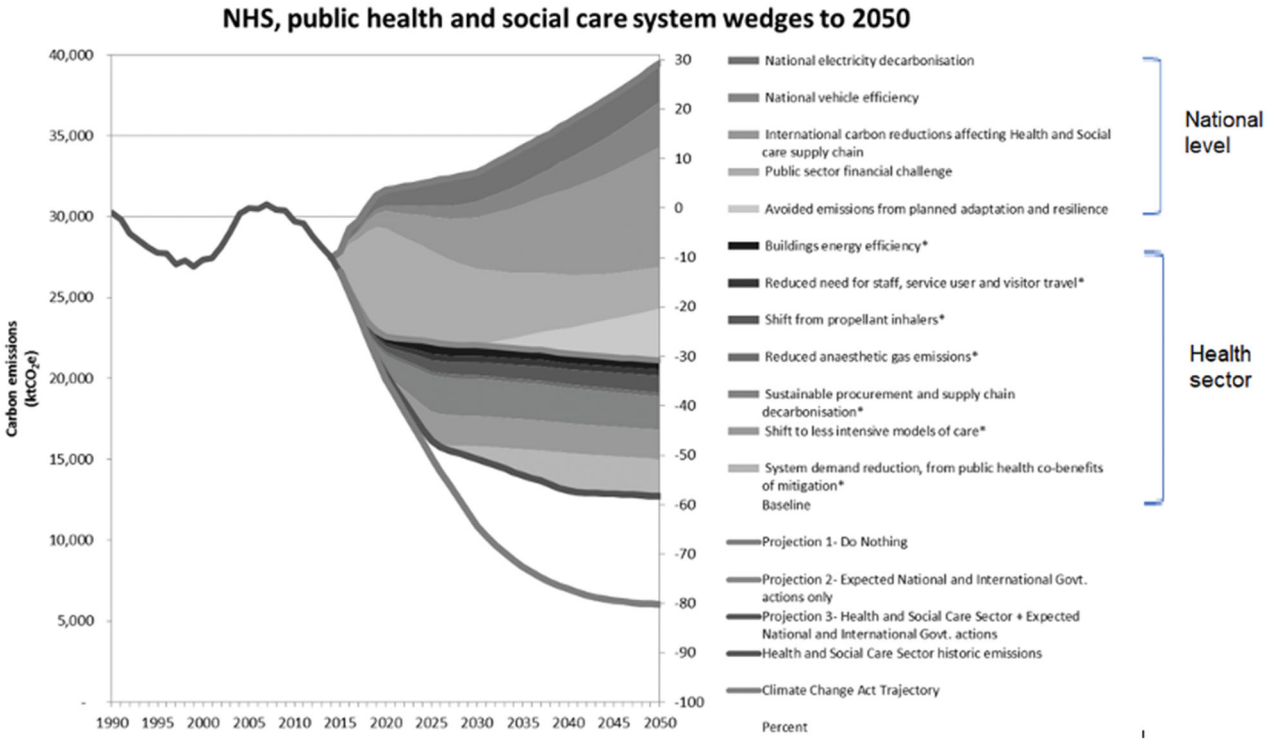

Figure 1. NHS, public health and social care system wedges to 2050 (with permission, Sustainable Development Unit 2016, UK).

sustainability requirements (Swedish Higher Education Authority, UKÄ 2006; General Medical Council 2018), however, these requirements have not been widely implemented.

Figure 1 shows the 'wedges' of activity that together can bring down health sector carbon emissions by 80%. A proportion will be achieved by actions taken at the national level, such as shifting from fossil fuels to renewable energy. Additional gains will come from the work of health system managers to improve building energy efficiency and change procurement policies. Doctors, nurses, and allied health professionals will have to find ways to decarbonize clinical practices. And then another 20% will have to be found to achieve 'net zero' carbon emissions, well before 2050.

In some places, environmental sustainability is recognized as an essential domain of quality in healthcare (Mortimer et al. 2018). Integrating it into quality improvement helps doctors, nurses, and allied health professionals to more accurately define healthcare value, and to measure health outcomes against financial, environmental, and social costs to achieve 'sustainable value' (Figure 2).

An equation for sustainable value extends the numerator beyond simple outputs to more complex outcomes, and beyond individuals to populations and communities. The denominator, traditionally financial cost, is extended to consider inputs such as use of environmental resources and social capital. Applying the sustainable value equation to quality improvement enables health professionals to pioneer systemic changes in practices, procedures, and funding; the COVID-19 pandemic has shown that rapid, system-wide changes are possible when seen as necessary. To meet national Paris Agreement goals, the health sector must reduce carbon use; to meet our equity targets we must improve health outcomes. This can be accomplished

$$\text{Sustainable value} = \frac{\text{Outcomes for patients and populations}}{\text{Environmental + social + financial impacts (the 'triple bottom line')}}$$

Figure 2. Sustainable value in healthcare (with permission from Mortimer et al. 2018).

in two ways: first, by reducing unnecessary activity in the health system and second, by reducing the carbon intensity of health care activities.

Figure 3 describes the kinds of interventions that doctors, nurses, and allied health professionals will need to design and implement (Mortimer et al. 2018). At the bottom of the right-hand column is operational resource use, e.g. energy-efficient buildings and renewable energy sources. These are first interventions that most people think of as underpinning sustainability, yet, as we saw in Figure 1, buildings efficiency will only deliver a tiny wedge of the needed carbon reduction. In the four remaining categories, health professionals play a direct and influential role. Choosing *lower carbon treatments* brings powerful reductions in several 'hotspot' areas. For example, some anesthetic gases have lower global heating effects than others (Charlesworth and Swinton 2017) and dry powder inhalers produce 20 g CO_2 equivalent per dose compared with 500 g CO_2 equivalent for metered-dose inhalers (Hillman et al. 2013). *Leaner care pathways* encourage streamlining care, minimizing low-value activities, and removing unnecessary procedures, and the Covid-19 response has highlighted opportunities to create leaner services through moving information rather than people and by coordinating between primary and secondary care. *Self-care* approaches empower patients to take an active role in co-managing their disease, improving their experiences and

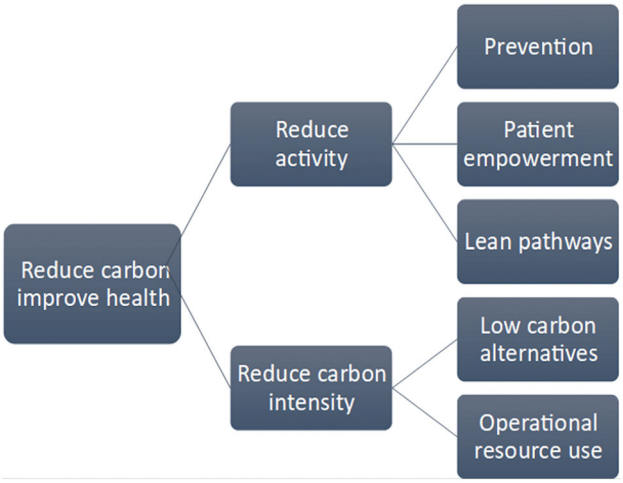

Figure 3. Sustainable quality improvement framework (with permission from Mortimer et al. 2018).

outcomes and potentially reducing future healthcare demand. And finally *preventing illness* reduces the need for health care, and the futility of releasing patients back into the conditions that made them ill in the first place. Healthcare is after all at its most sustainable levels when it is not required at all.

Preparing the health workforce: integrating planetary health principles into health profession education (HPE)

Medical, nursing, and other health educators must find a way to produce graduates who can ensure safe, environmentally sustainable and equitable healthcare, within planetary limits, under increasingly difficult circumstances. Few educators currently possess the requisite knowledge, experience or skills to do this.

In 2014, an international collaboration of doctors attempted to address this gap by identifying three simple learning objectives for planetary health and healthcare sustainability in medical education (Walpole et al 2015). The first is a knowledge-based objective with planetary health as a frame, which asks students to 'describe the relationship between the natural environment and human health'. The second is a values-clarification objective that aligns environmental stewardship with preventive medicine and the principle of *primum non nocere* (first, do no harm). It asks students to 'discuss the duty of a doctor to protect health in a time of global environmental change' and classroom debates often circle around the tension between resource-intensive models of healthcare provision and the need to mitigate and adapt to the climate crisis in order to protect health in the future. The third outcome asks students to 'demonstrate skills for a sustainable health system', and this is easily put into practice through quality improvement projects, in all specialties.

These learning objectives have since been piloted in medical and nursing education without adding significant weight to the curricular load (Thompson et al. 2014; Pearson et al. 2015; Walpole et al. 2016, 2017, 2019). They are extensions of the core disciplinary knowledge, skills, and values structured around a systems-understanding of the body, a systems-understanding of social determinants, and a systems-understanding of the professional values that underpin medicine, nursing and the allied health professions. There are other useful curricular frameworks (Catton 2020; CFMS 2019; Wellbery et al. 2018) which provide more specific content on planetary health knowledge and quality management skills to enable graduates to protect health for all in a time of global environmental change.

Over the past 10 years, pioneering health professions' educators, spurred in many places by student demand, have begun to equip their graduates with planetary health knowledge and quality management skills which will enable them to protect health for all in a time of global environmental change.

Recommendations

Three simple learning outcomes can achieve planetary health literacy, across all health professional education.

- *Values*: Recognize our professional duty for environmental stewardship as part of the ethical principle of beneficence; support national and professional bodies to set guidance on healthcare practices 'fit for the Anthropocene'; and commit to practices which simultaneously addresses equity and sustainability in health.
- *Knowledge*: Integrate planetary health concepts (i.e. socio-ecological determinants of health) across the curriculum; identify how to prevent the harmful effects of global environmental changes at primary, secondary, and tertiary levels, in ways that integrate culturally relevant knowledge practices.
- *Skills*: Demonstrate clinical, leadership, and advocacy competencies for environmental stewardship of the health system; identify research questions which address both equity and sustainability in mitigation and adaptation.

Disclosure statement

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the article.

Glossary

Planetary health: Is an emerging concept in healthcare research, practice and education which seeks to understand the interconnection between the function and disruption of global ecosystems and human health. It also prioritizes solutions that simultaneously benefit human health and advance environmental sustainability.

Sustainable healthcare: Provides high-quality healthcare for all, without compromising the ability to meet the health needs of the next generation. This includes the prevention of illness, leaner care pathways, treatments with a lower carbon footprint where they exist, and an energy-efficient infrastructure.

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