

Biodiversity and the importance of environmental literacy in medical education

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Doctors have an important role in the protection and promotion of human health, from individual to global scales. As our climate changes and ecosystems are degraded, the protection of nature is becoming increasingly important for public and global health efforts. There is an increasingly large body of evidence highlighting the environment and human health as critically connected – the variety of ecosystems on Earth provide human populations with many necessities for health and wellbeing. Future doctors, the healthcare leaders of tomorrow, should therefore be competent when considering environmental determinants of health in their practice, as these have a huge impact on health at community and population levels. However, there is very little or no environmental teaching in many medical school curricula. In this Perspectives article, I will outline why more should be done to teach medical students about environmental determinants of health and the health benefits of environmental protection, focusing on biodiversity and ecosystem degradation as an example. I will also detail action students can take to promote environmental advocacy and improve the current situation regarding environmental education in medical school curricula.

1. Biodiversity's role in human health

Environmental degradation has adverse effects on human health, with just under one quarter of global deaths being attributed to environmental factors [1]. As damage to the natural environment is continued, this statistic is likely to rise in the future. It is therefore crucial that future medical professionals are equipped with the tools and knowledge to be able to address changing environmental issues [2], both within and outside of their practice. A particularly topical environmental determinant of health is the loss of biodiversity, which underlies various other environmental health determinants.

Biodiversity is defined by the Convention on Biological Diversity (CBD) as “the variability among living organisms from all sources including, inter alia, terrestrial, marine and

other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems” [3]. At first glance, biodiversity may not be regarded as important for human health outcomes. However, biodiversity underpins vital ecosystem services that support human health and livelihoods [4]. These include the provision of food, medicines, energy and clean water. As such, continued damage and unsustainable use of the natural environment could have negative impacts on human health through disruption of the benefits ecosystems provide.

The field of human health and biodiversity is becoming increasingly recognised as important for environmental protection, healthy human populations and the functioning of the planet as a whole [5]. Several institutions are actively investigating these interlinkages, which may have future implications for the way healthcare is delivered, how we plan urban environments and how we utilise resources. As future health professionals, medical students should be made aware of the changing face of environmental health determinants, to secure a better future for the individuals and communities they treat.

A growing body of evidence highlights the important role of biodiversity and associated ecosystem services in promoting healthy human populations [6, 7]. Ecosystems provide nutrition, along with the genetic diversity required to produce diverse, nutritious diets [8, 9]. Additionally, many medicines originate from organisms found in nature. For instance, vincristine and vinblastine, chemotherapy medicines used to treat cancers such as leukaemia and Hodgkin's lymphoma, are derived from the rosy periwinkle (*Catharanthus roseus*) [10], a wild flower native to Madagascar. By protecting the diversity of species on our planet, novel research into new therapeutic agents can continue to improve the treatment of many diseases, as well as furthering our knowledge of pharmacology and pathological processes.

Biodiversity is also important in the regulation of infectious diseases, and can buffer against effective pathogen

transmission. This occurs by providing a greater diversity of species, more of which can act as hosts with a low transmission capacity, thus hindering the ability of a pathogen to propagate effectively (known as the ‘dilution effect’) [11]. A reduction of biodiversity will alter disease ecology, changing the control of infectious disease. For future doctors working in areas of high infectious disease burden, or those with an interest in pursuing infectious disease medicine, understanding the changing face of disease ecology will be paramount for effective practice. However, all practitioners are exposed to infectious diseases in their practice to varying degrees. Therefore, a sound knowledge of how environmental change is likely to affect disease distribution and prevalence is essential, especially when approaching health from a population perspective.

The protection of biodiversity can also provide health benefits for human populations. Natural environments can be beneficial for mental health and wellbeing [12], as well as being valued culturally and recreationally [13]. For example, managed marine environments, such as aquariums, have been shown to have positive effects on mood and stress in visitors, especially as the number of marine species present increases [14]. The strength of such psychological effects has been demonstrated by a study showing a reduction in experienced and recollected pain in participants of a virtual reality (VR) coastal walk [15]. Consequently, nature has potential utility in healthcare, which has not previously been widely recognised. Human health is thus strongly connected with nature – the protection of biodiversity is therefore essential to prevent negative health outcomes. As humanity continues to damage ecosystems and their inhabitants, the benefits and utility of biodiversity will be decreased, and some may disappear.

2. Changing education and attitudes for better future practice

A lack of exposure of medical students to teaching on not only the negative effects of biodiversity loss, but the benefits of environmental protection for health, mean that these key issues are unlikely to be considered in their future careers, whether that is as a medical doctor, policy maker or resource manager. As multi-disciplinary approaches to environmental protection are increasingly required for a more sustainable future, something must be done to address this sparsity of environmental education in medical schools. Emphasis could be placed, for example, on how protecting biodiversity and mitigating negative environmental change also has benefits for human health, rather than only describing negative health impacts of environmental degradation.

Medical students are the doctors and healthcare leaders of tomorrow. As society continues to destroy the environments that support us, it is becoming increasingly important to address environmental issues in all sectors – healthcare is no exception. More attention should thus

be paid to environmental determinants of health, including biodiversity and the vital ecosystem services they provide. A prevention-centred approach to environmental determinants of health is crucial to secure environmental and healthcare sustainability – saving both resources and lives. In our resource-limited planet, the long-term sustainability of all sectors is being scrutinised. The sustainability of healthcare therefore cannot be addressed in isolation from its impact on biodiversity and ecosystems – the wide-reaching effects of the healthcare industry on the environment must be taken into account in order to ensure future sustainability.

A changing world calls for a change in the education of our future doctors. The World Health Organisation (WHO) have contributed towards or authored several devoted publications highlighting how climate change [16] and biodiversity losses [4] are likely to damage the health of human populations in the future. However, this information is often not translated into medical curricula [17]. Due to a lack of environmental education, opportunities to integrate environmental protection with better health outcomes may be missed by future medics.

As the effects of global warming and environmental degradation become progressively more relevant to healthcare practice, more must be done to integrate environmental outcomes into healthcare practice and policy. This could be done through dedicated teaching in core public health curricula or modules in medical school. As doctors are trained to be advocates and leaders of public health efforts, teaching on environmental degradation and climate change as large threats to future public health must be offered in their education [18]. By highlighting the positive impact of biodiversity conservation for both human and environmental health, for example, medical students would hopefully be more mindful of the impact of the healthcare sector on the environment in their future careers. Changing the attitudes of doctors to promote more sustainable practice is key for better health outcomes and generating practical solutions to problems in the face of biodiversity loss and environmental degradation.

Students themselves can take steps to promote and advocate environmental literacy among medical professionals. There are already several organisations working to promote environmental protection and sustainability within the health sector. Examples include the Global Climate and Health Alliance [19] and the Sustainable Healthcare Education Network [20]. Engaging with these organisations (such as attending events or conducting collaborative work) is one constructive method by which medical students can increase their exposure to environmental issues and encourage their colleagues to do the same. Students could also use optional elements of their courses to work with local health providers to audit current services in relation to environmental sustainability, for example. Alternatively, students could conduct research into this interdisciplinary

area. Such work could then be presented at conferences to raise awareness at regional, national and even international levels.

An excellent way for students to gain experience and promote environmental competency of medical students is via university societies. Through societies, such as those focused on global health or environmental health, students can invite academics active in the field to give lectures or discussions at their university relating to the interlinkage between the environment and health. Societies are also a great way to provide suggestions for improvements in the core medical curricula of universities, as well as networking with like-minded students and professionals. As future leaders in their field, medical students should be equipped with environmental competency to improve and foster new practices that protect both the environment and human health. By taking action themselves, students can help change the face of medical education to ensure a better future for the planet as a whole.

A drive towards 'planetary health' (promoting human health alongside ecosystem and animal health [21]) must be realised in the coming decades in order to secure better health outcomes for human populations, in addition to the environment. Practical policy action recognising the connections between ecosystem degradation and human health is required in order to reach national and global targets, including the UN Sustainable Development Goals (SDGs) for 2030 [22]. Collaboration between medical and environmental sectors could raise the profile of environmental protection as a method to protect the health of populations around the world. While this is an anthropocentric reason for conservation, it would hopefully lead to a greater change in public attitude and behaviour in order to prevent further environmental damage. By raising the environmental awareness of medical students through dedicated teaching, these future healthcare practitioners, managers and policy makers are more likely to consider environmental outcomes alongside health and socio-economic goals. This would allow for a more integrated approach to provide a healthier and more sustainable tomorrow for both humans and the planet that supports us.

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