International Planetary Health Education in Undergraduate and Graduate Medical Curricula: A Scoping Review

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ABSTRACT

Background Climate change is a public health emergency, yet planetary health education is absent for many medical and health professions trainees.

Objective To perform a scoping review exploring the inclusion of planetary health in undergraduate and graduate medical education.

Methods A search strategy was developed with a health sciences librarian and run on 6 databases from their inception to February 2022: MEDLINE, Embase, APA PsycInfo, CINAHL, Global Health, and Scopus. The Arksey and O'Malley framework was employed to broadly select publications that described the implementation of planetary health in undergraduate and postgraduate medical education. Commentaries were included if they outlined a potential curriculum. Extracted data was grouped thematically using an iterative approach based on competencies described, key considerations, and anticipated barriers.

Results After screening 2407 articles, 42 were included. Thirty articles involved medical education at undergraduate or postgraduate levels, while 10 discussed multidisciplinary education including veterinary medicine, public health, and nursing. Two articles discussed planetary heath education for staff physicians. Reported competencies included eco-medical literacy, environmental inequity, and planetary health advocacy. Key considerations for curricular development included longitudinal implementation, interprofessional collaboration, and experiential learning through quality improvement projects. Barriers to implementation included time constraints and the lack of knowledgeable educators and administrative support for curricular change.

Conclusions This scoping review outlines key recommendations and barriers to help facilitate the implementation of planetary health education in medical training.

Introduction

Climate change is a public health emergency, and the health care sector is a major contributor to greenhouse gas emissions. With a trusted voice among their communities, knowledgeable physicians can advocate for the sustainable delivery of health care services to minimize the negative contributions of the health care sector toward the climate crisis.

The effects of climate change are captured within the broader concept of planetary health, which includes the intersection between the health of the environment and the health of the human population.[1] The Planetary Health Report Card (PHRC) initiative highlights the absence of planetary health curricula in undergraduate medical education (UME).[2] There has been no similar evaluation of planetary health education in graduate medical education (GME). There is an urgent need to broadly integrate planetary health into medical education curricula to ensure that future physicians can address the climate crisis.

To address this gap in medical education, we examined the current literature on planetary health curricula in UME and GME through a scoping review with the aim of identifying facilitators and barriers, and summarizing recommendations for implementation.

DOI: http://dx.doi.org/10.4300/JGME-D-24-00027.1

Editor's Note: The online supplementary data contains the search strategy used in the study and further data.

Methods

Study Aim

The aim of this scoping review was to evaluate the extent of current literature on the integration of planetary health within UME and GME curricula. To assist with curricular development, we sought to examine recommended key competencies that should be emphasized along with the major barriers and recommendations for curricular design on planetary

BOX 1 Planetary Health Conceptualization
Recognizing the benefits to health arising from the conservation of natural systems, mitigating greenhouse gases that result from human activities, and developing policies to address the social, economic, and environmental determinants of health.[3]

health education. The conceptualization of planetary health put forth by Whitmee and colleagues was used as our definition in this review (BOX 1).[3] The research questions that guided our review were as follows:

Within undergraduate and postgraduate medical education, what is the extent and method of integration of planetary health? What are perceived barriers and best practices for its integration?

Study Design

A scoping review was selected as the appropriate methodology to answer our research question since we anticipated, from prior examination of the literature, varying article categories, study designs, methods of analysis, and report quality. We utilized the methodology for scoping reviews that was previously described by Arksey and O'Malley, and subsequently refined by Levac and colleagues.[4,5] Our study protocol, which has been previously published, outlines the full details of our methodology.[6] To summarize, 6 databases were searched using a search strategy developed in conjunction with an academic health sciences librarian (L.S.): MEDLINE and MEDLINE In-Process via Ovid, Embase Classic and Embase via Ovid, APA PsycInfo via Ovid, CINAHL via EBSCOHost, Global Health, and Scopus. All databases were searched from their dates of inception to June 22, 2021, with no publication restrictions. The search was updated to February 28, 2022, after publishing our study protocol (online supplementary data Appendix A). All references were entered into an Endnote (Clarivate Analytics) file for processing, and then Covidence systematic review software (Veritas Health Innovation) for deduplication and screening.

The grey literature was searched by reviewing the reference lists of the selected publications and through reports on recent planetary health curricular changes from relevant groups. These additional resources included the Canadian Federation of Medical Students Health and Environment Adaptive Response Task Force (CFMS HEART) National Report on Planetary Health Education, the PHRC, the Association for Medical Education in Europe's Consensus Statement, and recent *Lancet Planetary Health* journal proceedings.[2,6-9]

In anticipation of the heterogeneity of the available literature on planetary health education, our inclusion criteria were kept broad. Articles were included if they discussed the implementation of a planetary health curriculum or course, or if they described what an ideal curriculum would entail. Articles had to discuss planetary health curricula at the UME or GME level. All report designs, including commentaries and opinion pieces, were included. See BOX 2 for inclusion and exclusion criteria.

Data Acquisition

The search results were initially screened based on title and abstract by 4 independent reviewers (R.S., N.S., A.L.R., H.M.) using Covidence. Articles were screened according to our inclusion and exclusion criteria, ensuring that each article was screened in duplicate. Any articles that were felt to be equivocal based on their title and abstract alone underwent full-text review. The 4 independent reviewers met at the start, midpoint, and end of the title and abstract screening to discuss any issues with the search strategy and to ensure congruence in the screening process. Selected articles were then reviewed in their full text by 2 independent reviewers (R.S., N.S.) in duplicate based on the predefined inclusion and exclusion criteria. The 2 reviewers met at the start and end of the full-text review process to ensure agreement in the application of the inclusion and exclusion criteria. Reasons for excluding articles following full-text

BOX 2 Inclusion and Exclusion Criteria

Inclusion Criteria (at least one must be met)

- Discusses planetary health curricula at the undergraduate or postgraduate medical education level OR
- Implements formal course curricula, as well as supplemental courses or workshops offered OR
- Describes the components of an ideal curriculum, competencies, or how a curriculum can be implemented OR
- Employs any study design including expert opinion, commentary, and observational or experimental studies OR
- Uses any method of data analysis, including quantitative and qualitative studies OR
- Assesses any outcomes of interest including the components of the planetary health curriculum, how it is implemented, and suggestions for further improvement

Exclusion Criteria (any one will exclude the article)

- Does not describe the nature of planetary health education being taught in their curricula/courses/workshops OR
- Does not involve learners at the undergraduate or postgraduate medical education level OR
- Not published in English or French OR
- Conference abstracts

review were recorded. Discrepancies between the 2 reviewers were reviewed by a third independent reviewer (H.M.) who made the final decision regarding inclusion. The study selection process was documented using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram.[10]

Microsoft Excel was used for data extraction. A standardized data extraction sheet was developed to capture relevant information from the included articles. This data extraction sheet was completed by 2 independent reviewers in duplicate. The data extracted from the first 10 studies were compared between reviewers to ensure congruence in the data extraction process. The data extraction sheet was subsequently modified to capture the range of outcomes reported in the included studies. The updated data extraction sheet was then completed in duplicate for the included articles.

Data Analysis

Article characteristics—including the study design, population of interest, whether a curriculum was implemented, reported objectives/competencies, and assessment strategies—were extracted from included articles. For reports that implemented a curriculum, details on learning objectives, pedagogical approaches, and any outcomes on the evaluation of the effectiveness of the implemented curriculum were recorded. For articles that described what an ideal curriculum would entail, we similarly documented proposed learning objectives and pedagogical approaches. The extracted data were reviewed by 2 independent reviewers who determined codes to describe the data. These codes were categorized in an iterative process through group discussion into themes based on whether they referred to a recommended competency, key recommendation for circular change, or a barrier to curricular development. All members of the study team, which included a medical student, surgical resident, surgical fellow, surgeon, and anesthesiologist, participated in the development of the themes to allow for a range of perspectives during this subjective process. A thematic analysis was chosen as most of the data was derived from commentaries or opinion articles. Outcomes were also categorized within the domains proposed by the Planetary Health Education Framework (PHEF), which outlines 5 domains of planetary health to guide educators and institutions with the development of educational strategies.[10]

Results

Search Results

Our initial search retrieved 2407 articles after duplicates were removed. Following title and abstract review by 4 independent reviewers, 371 articles were selected for full-text review. No changes to the search strategy were required after title and abstract review. Full-text review was completed by 2 independent reviewers after which 39 articles were selected for inclusion. Reasons for exclusion following full-text review included lack of a discussion on planetary health (n=126), commentaries that discussed planetary health but did not describe a specific planetary health curriculum (n=145), and articles that did not involve medical education (n=38). In addition, 7 articles were excluded as they were conference abstracts, 1 article had been retracted, 3 were found to be duplicates of already included articles, and 12 were not able to be retrieved despite attempts through interlibrary loan. Twenty-one articles were reviewed by our third independent reviewer to settle discrepancies from our initial 2 reviewers; none of these articles were included in our review as they did not discuss planetary health or describe a specific planetary health curriculum. The search was updated on February 28, 2022, and an additional 157 articles were screened by 2 independent reviewers. This produced an additional 3 articles that met inclusion criteria after full-text review, for a total of 42 articles included in this scoping review. See FIGURE 1 for a PRISMA flow diagram outlining the article selection process.[11] Main outcomes in terms of curricular design, barriers, and key recommendations for curricular development are outlined in FIGURE 2. A summary of the extracted data from the included articles is provided in online supplementary data Appendix B.

Study Characteristics

Of the 42 published articles that were included in this review, 11 were observational studies, 21 were commentaries, 2 were reviews, and 8 were qualitative studies. Of the 2 reviews, 1 was a scoping review that assessed competencies related to environmental health in existing health care education,[12] while the second was a literature review of existing course offerings on climate change.[13] The target population was UME for 20 of the included articles and GME at the residency level for 5, with an additional 5 articles describing medical education more broadly at UME and GME levels. Of the 5 articles that were specific to GME, one article was focused on family medicine trainees[14] while another was specific to anesthesiology residents.[15] Ten articles discussed planetary health education in a multidisciplinary context including veterinary medicine, nursing, pharmacy, midwifery, dietetics, occupational therapy, physiotherapy, social work, paramedicine, and public health. Two articles discussed planetary heath education for staff physicians, with one of these describing how health care

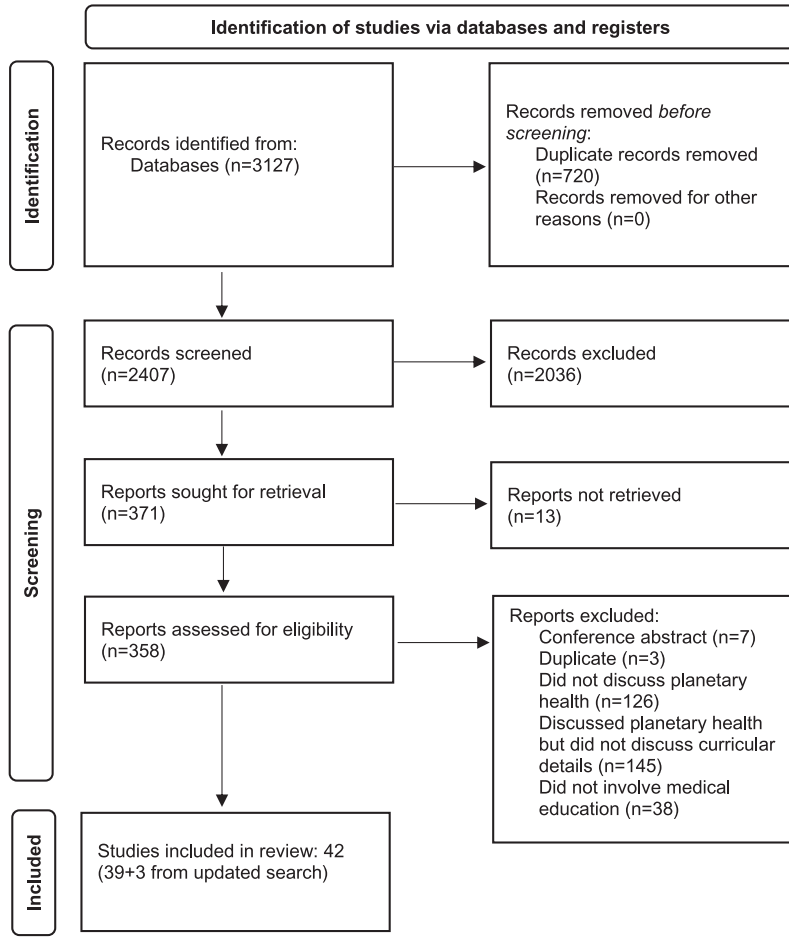

FIGURE 1

PRISMA 2020 Flow Diagram for New Systematic Reviews That Included Searches of Databases and Registers Only

Note: Consider, if feasible to do so, reporting the number of records identified from each database or register searched (rather than the total number across all databases/registers). If automation tools were used, indicate how many records were excluded by a human and how many were excluded by automation tools.[11]

educators can develop their knowledge on environmental sustainability concepts[16] and the other discussing specifically how family physicians can advocate for planetary health education.[17]

Of the included articles, 10 outlined the implementation of a course, workshop, clinical rotation, or case study that prioritized the dissemination of planetary health concepts. Thirty-two articles did not describe a specific course or curriculum that was delivered, but rather outlined what a curriculum on planetary health topics might entail or what learning objectives should be prioritized.

Pedagogical Approach

Planetary health may be taught via a range of teaching strategies, including didactic lectures, small-group learning, and standardized patient cases. Clinical rotations and quality improvement (QI) projects may provide avenues through which knowledge can be further consolidated and applied to make the delivery of health care more sustainable.

The mode of delivery as well the pedagogical approaches used varied across the 10 articles that discussed experiences with implementation of planetary health course material, with multiple articles describing a combination of approaches. These approaches included a didactic lecture component,[18-22] small-group learning activities,[19-23] computer-based learning cases,[20,22,24] and incorporation of problem-based learning into teaching related to planetary health.[21,23,24]

Only 2 articles described an experiential learning approach through clinical rotations.[19,25] Ali outlined a 4- to 6-week elective rotation in a rural community in Indonesia that involved 2 weeks of didactic teaching on community health assessments, biostatistics, and epidemiology followed by participation with the local community assessment team.[18] Sokas and colleagues described incorporation of environmental

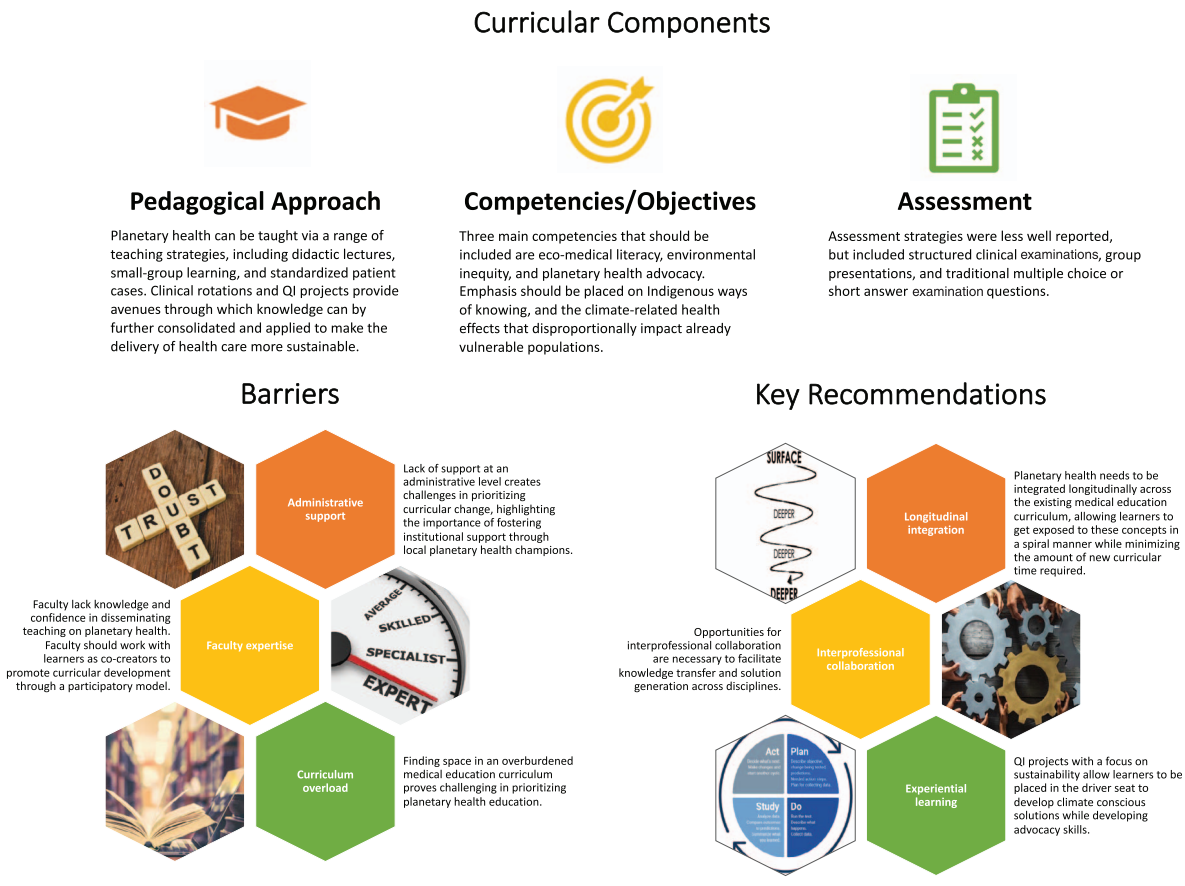

FIGURE 2
Curricular Components
Abbreviation: QI, quality improvement.

health knowledge through a medical student 6-week primary care rotation, which included distribution of an instructional booklet followed by computer-assisted and problem-based cases.[24] While not delivered during a formal clinical rotation, Subramanium and Gopichandran also described a method of experiential learning through a field visit to a local thermal power plant for medical students to identify environmental hazards and reflect on social accountability.[25]

Two articles described the use of standardized patients, either during an objective structured clinical examination (OSCE) that involved climate change material[26] or to enhance their small-group learning exercise on the interaction between human and environmental health.[23] Two articles highlighted the value of student-led initiatives: Bajgoric and colleagues outlined the work by medical students to make existing clinical skills such as intravenous cannulation more sustainable,[27] while Walpole and Mortimer described their experience with a 9-month collaborative project where medical students were tasked with developing teaching sessions on sustainability.[21] The triple bottom line approach that incorporates sustainability in quality improvement (SusQI) was described by 2 articles as a way to reframe thinking and foster engagement in sustainability practices.[22,27]

Proposals for curriculum development and delivery within descriptive articles were similarly varied, with the use of didactic and small-group sessions for case-based or problem-based learning.[13-16,28-45] A few articles also suggested integrating topics related to planetary health into clinical skills learning where standardized patient cases can be used to highlight climate-related health effects.[28,37,46] Creating opportunities for learners to get involved with clinical rotations, research or quality improvement projects related to climate change were also proposed to integrate planetary health concepts into existing curricula in an experiential manner.[14,33,36,38-40,42,44,46-48]

Competencies/Objectives

Three main competencies that should be considered are eco-medical literacy, environmental inequity, and planetary health advocacy. These can include highlighting Indigenous ways of knowing and the climate-related

health effects that disproportionally impact already vulnerable populations.

Important objectives or competencies for consideration were described in the 32 articles that did not implement a particular curriculum or course. Multiple articles emphasized the importance of developing foundational knowledge of climate change and its impact on health, referred to as a sense of eco-medical literacy.[13,15,16,28,29,31,33,36-39,41,43,46,48-50] Three articles highlighted the importance of teaching learners, while developing this eco-medical literacy, how the health effects of climate change disproportionately burden vulnerable populations.[31,38,41] In discussing different approaches to integrating planetary health concepts into existing curricula, many articles also emphasized competencies or objectives that instill a sense of advocacy in learners, to understand their role in developing initiatives and policies that address inequities that may arise from it.[12-14,28,34,36,41,43,48,50]

Among articles that disseminated some form of course material, their description of specific competencies or objectives were varied. Key themes included characterizing the link between climate change and health outcomes,[18-22,24,26] and emphasizing the role that physicians and the health care sector play in the climate crisis.[21,22,26] Two articles highlighted the importance of teaching learners how to identify more information on the topic,[23,24] while another 3 articles emphasized the importance of promoting student-directed initiatives as a collaborative approach to curricular development.[21,22,29]

Four articles discussed the importance of integrating other ways of knowing, specifically Indigenous teachings, within planetary health education.[30,32,46,51] Bell emphasized that understanding climate change–related effects on health requires understanding the relationships that Indigenous Peoples have with their planet, and teaching both the clinical and nonclinical competencies required to care for this population.[28] Burch and colleagues described their experience with a First Nations health team which included Indigenous-led content within their planetary health-organ system map.[45]

Assessment

Assessment strategies were not as well reported but included structured clinical examinations, ratings of group presentations, and traditional multiple choice or short answer examination questions.

The assessment of learners on planetary health concepts was less well described. Methods of assessment included practical skills stations and focused OSCEs,[36,44,48] group presentations or debates,[36,38,40,50] reflective essays,[36,46,48] and traditional multiple-choice or short-answer questions.[17,36,42,46,48] For example, one article described the use of a summative presentation based on sustainability in health care at the end of the rotation,[48] while another report described organizing an in-class debate on issues specific to climate change, such as divestment in fossil fuels, as a way to assess planetary health knowledge.[36] Schwerdtle and colleagues described the use of a skills station to evaluate learners' ability to conduct a clinical consultation that integrates health promotion with respect to a low carbon lifestyle.[34]

Barriers to Implementation

Administrative Support: Lack of support at an administrative level creates challenges in prioritizing curricular change, highlighting the importance of fostering institutional support through local planetary health champions.

Many articles noted a lack of administrative support when external policies promoting curricular development on planetary health were lacking.[15,16,32,39,41,48,51] Without support at the institutional or university level, faculty found it challenging to get adequate funding for planetary health curricular development and to find time in their practice to work on curricular changes.[15,41,51] To address this problem, many authors emphasized the value of having a local champion or faculty planetary health chair to foster engagement in universities and hospitals, as well as from accreditation bodies.[14,15,36,39,48] Wicklum and colleagues further discussed the importance of support from accreditation bodies such as the Licentiate of the Medical Council of Canada, with the recent addition of questions on planetary health on their eligibility examination.[17]

Faculty Expertise: Faculty lack knowledge and confidence in disseminating curricula on planetary health. Faculty should work with learners as co-creators to promote curricular development through a participatory model.

Many articles highlighted that the lack of faculty with expertise is an important barrier.[15,16,30,33,36,42,44–46,51] Without available training, faculty lack confidence in teaching planetary health concepts, which limits broad curricular change.[16,21,51] Emphasis was placed on organizing education for faculty themselves through continuing medical education workshops.[17,23,29,52] To further address the lack of faculty expertise, a few articles discussed the value in recruiting students with climate health expertise as teachers within student-faculty partnerships.[16,33,42,45,53] For instance, Tun and colleagues outlined their experience at Georgetown University School of Medicine, in which third-year medical students created a Climate Health and

Medical Sustainability Group. The group's agenda was to expand curricular content on sustainability in preclinical courses through working with course directors and developing extracurricular programing.[16]

Curriculum Overload: Finding space in an overburdened medical education curriculum proves challenging in prioritizing planetary health education. Articles reported that the major barrier to implementation of curricula or course material on planetary health concepts was reported to be the already overburdened medical education curriculum.[15,18,21,24,33,36,38,40-44,50,51]

Key Considerations

Longitudinal Integration: Planetary health concepts may be integrated longitudinally across the existing medical education curriculum, allowing learners exposure to these concepts in a spiral manner while minimizing the amount of new curricular time required.

Many articles described a key principle that can be summarized as longitudinal integration, or the addition of planetary health concepts within the existing biomedical curriculum rather than new stand-alone courses focused on planetary health.[12,13,16,22,28-32,34,36,38,41,42,44,45,48-51] This idea of longitudinal integration was offered as a solution to concerns about the already overloaded medical education curriculum. Rabin and colleagues specifically highlighted that the modules proposed in their article would account for less than 0.2% of total curricular time.[38] Through this longitudinal approach, some articles highlighted that planetary health concepts can be taught in a spiral manner, with key concepts being repeated throughout the curriculum with deepening layers of complexity or in different applications.[34,45]

Interprofessional Collaboration: Opportunities for interprofessional collaboration are necessary to facilitate knowledge transfer and solution generation across disciplines.

A theme of interprofessional collaboration came across in many articles that highlighted the multifactorial health effects of climate change.[23,29,31,33,39,40,44,49] Thus, this education needs an interprofessional format. The concept of "One Health" was described as a transdisciplinary framework to address zoonotic spillovers between animal and human populations.[39] Using this conceptualization, Wilkes and colleagues outlined their implementation of a small-group learning activity involving medical students and veterinary students, as they worked through a case of toxoplasmosis with a standardized patient.[23]

Experiential Learning: QI projects with a focus on sustainability allow learners to be placed in the driver seat to develop climate conscious solutions while developing advocacy skills.

Many articles emphasized developing student advocacy and highlighted the role of climate-related QI projects[12,22,29,30,47] or research projects.[14,27,39,40,44] Clery and colleagues specifically reported on their experience with teaching students the SusQI framework which includes environmental impact in QI initiatives.[22] Empowering students to take an active role when it comes to addressing climate-related health care effects was considered valuable for developing critical thinking skills and activism.[31,51]

Planetary Health Education Framework

The PHEF was used to evaluate the breadth of planetary health education in the existing literature. Of our 42 included articles, the domains of The Anthropocene and Health, and Equity and Social Justice were discussed the most, in 30 (71%) and 19 (45%) articles, respectively. Concepts falling under the movement building and systems change umbrella were discussed in 16 (38%) articles, systems thinking and complexity in 12 (29%) articles, and interconnection within nature in 10 (24%) articles.

Discussion

This scoping review examining the landscape of planetary health education curricula in UME and GME training found that this critical area is substantially understudied, particularly for GME. Through the end of February 2022, most reports were proposals or descriptions of individual initiatives, with little assessment of learning or competencies. However, information, primarily from UME, provides useful suggestions for high-priority competencies and objectives, barriers to curricular change, and strategies to drive meaningful curricular development. These include longitudinally integrating planetary health into the existing curricula, using experiential learning, and leveraging support from institutions and accreditation bodies.

The 3 main competency areas identified through our thematic grouping—eco-medical literacy, environmental inequity, and planetary health advocacy—are in line with the 11 curricular competencies put forth by the CFMS HEART report.[7] In a 2020 scoping review, Parker and colleagues also identified planetary health concepts that relate to the competencies identified in our review, which suggests the feasibility of integrating planetary health concepts into the current biomedical student curricula.[12] Additional work on learning objectives and competencies is required, as well as assessment strategies for an integrated planetary health curriculum.[28,38,47,50]

Of these competencies, environmental inequity stood out as a crucial aspect in planetary health education. As highlighted by the Intergovernmental Panel on Climate Change and PHEF, the effects of climate change intersect with social determinants of health, such as gender, age, socioeconomic status, and Indigenous identity, which compounds the effects of climate change on these vulnerable populations.[10,54] Of the articles included in our review, only a few addressed the incorporation of Indigenous ways of knowing into planetary health curricula, and none involved other community-based approaches.

Lack of funding and competing institutional priorities were reported as barriers for meaningful curricular development on planetary health.[15,41] Through surveys and focus groups carried out with a multidisciplinary group of health professionals, Brand and colleagues highlighted the importance of addressing regulatory drivers for curricular change, whereby planetary health can be included in accreditation and competency standards.[51] The importance of departmental leadership was also reported to play a pivotal role in knowledge dissemination and translation through the allocation of appropriate funding and enforcing policies.[15] These findings from our review are in line with recommendations from the CFMS HEART report and the PHRC, which highlight the importance of fostering support from faculty and institutions for planetary health research and student-led initiatives.[2,7] Fortunately, recent support from accreditation bodies such as the Association of Faculties of Medicine of Canada, through their declaration on planetary health, provides momentum for the implementation of planetary health education and research across Canadian medical schools.[55]

A second major barrier that was identified was a lack of expertise and confidence in faculty to teach planetary health topics. To address this, a participatory model for curricular development was proposed by some authors.[16,42,43] In participatory learning models, learners transition from passive to active roles within educational settings and are asked to share their perspectives and experiences in order to promote engagement and deeper learning.[56,57] While continuing medical education for faculty is an option, a model expanding learner roles in curricular development supports mutual learning.

The benefit of longitudinally integrating planetary health within existing curricula was favored in multiple articles in our review. Jowell and colleagues outlined the longitudinal integration of climate-related health effects on reproductive health and obstetrics and gynecology across the entire length of medical education, from preclinical years, to clerkship, to early residency.[8] Blom and colleagues also described a longitudinal approach across the medical education curriculum in Amsterdam, with both theoretical sections and clinical rotations.[9]

A key recommendation in multiple articles was to harness experiential learning through QI projects. Cleary and colleagues outlined their experience with disseminating a SusQI workshop to medical students, a model through which sustainability is integrated into traditional quality improvement frameworks.[22,58] By incorporating sustainability into existing domains of quality, learners use practical tools to address environmental harms of health care delivery. This approach may also increase learners' motivation and engagement as agents for change.[22,59]

This scoping review is limited by the quality of the included articles, of which the majority were commentaries or opinion pieces. The low number of GME articles found during a 2022 search means that any conclusions regarding planetary health education within GME should be considered tentative. In addition, the exclusion of non-English and non-French language articles may leave out key planetary health education initiatives underway throughout the world. As this field is evolving rapidly, the article inclusion end date of early 2022 suggests that follow-up reviews will be needed to summarize new developments and best practices in planetary health education. Another critical step will be to determine the results of the proposals and early interventions reported in this scoping review, including how they have evolved or been sustained.

Conclusions

This scoping review maps the international planetary health education literature in UME and GME through February 2022. While the existing literature is heterogeneous and primarily in the form of commentaries, our review highlights the main competency areas to prioritize, barriers to address, and key recommendations to drive curricular development. The most important curricular strategies appear to be longitudinally integrating planetary health into existing curricula, using experiential learning, and leveraging support from institutions and accreditation bodies.

References

1. Seguin N, Selvam R, Moloo H. Contextually relevant healthcare professional education: why planetary health is essential in every curriculum now. *J Climate Change Health*. 2021;4:100044. doi:10.1016/j.joclim.2021.100044

2. Hampshire K, Islam N, Kissel B, Chase H, Gundling K. The Planetary Health Report Card: a student-led initiative to inspire planetary health in medical schools. *Lancet Planetary Health*. 2022;6(5):e449-e454. doi:10.1016/S2542-5196(22)00045-6
3. Whitmee S, Haines A, Beyrer C, et al. Safeguarding human health in the Anthropocene epoch: report of The Rockefeller Foundation–Lancet Commission on planetary health. *Lancet*. 2015;386(10007):1973-2028. doi:10.1016/S0140-6736(15)60901-1
4. Arksey H, O'Malley L. Scoping studies: towards a methodological framework. *Int J Soc Res Methodol*. 2005;8(1):19-32. doi:10.1080/1364557032000119616
5. Levac D, Colquhoun H, O'Brien KK. Scoping studies: advancing the methodology. *Implement Sci*. 2010;5:69. doi:10.1186/1748-5908-5-69
6. Moloo H, Selvam R, Seguin N, et al. Integration of planetary health in undergraduate and postgraduate medical education: protocol for a scoping review. *BMJ Open*. 2022;12(6):e057207. doi:10.1136/bmjopen-2021-057207
7. Affleck Z, Roshan A, Stroshein S, Walker C, Luo O. CFMS HEART National Report on Planetary Health Education 2021. Canadian Federation of Medical Students Health and Environment Committee. Published August 2021. Accessed September 4, 2024. https://www.cfms.org/files/HEART/CFMSHEART NationalReportonPlanetaryHealthEducation2021.pdf
8. Jowell A, Lachenauer A, Lu J, et al. A model for comprehensive climate and medical education. *Lancet Planetary Health*. 2023;7(1):e2-e3. doi:10.1016/S2542-5196(22)00215-7
9. Blom IM, Rupp I, de Graaf IM, Kapitein B, Timmermans A, Weiland NHS. Putting planetary health at the core of the medical curriculum in Amsterdam. *Lancet Planetary Health*. 2023;7(1):e15-e17. doi:10.1016/S2542-5196(22)00316-3
10. Guzmán CA, Aguirre AA, Astle B, et al. A framework to guide planetary health education. *Lancet Planetary Health*. 2021;5(5):e253-e255. doi:10.1016/S2542-5196(21)00110-8
11. Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*. 2021;372:n71. doi:10.1136/bmj.n71
12. Parker G, Berta W, Shea C, Miller F. Environmental competencies for healthcare educators and trainees: a scoping review. *Health Educ J*. 2020;79(3):327-345. doi:10.1177/0017896919886599
13. Goshua A, Gomez J, Erny B, et al. Addressing climate change and its effects on human health: a call to action for medical schools. *Acad Med*. 2021;96(3):324-328. doi:10.1097/ACM.0000000000003861
14. Gillam S, Barna S. Sustainable general practice: another challenge for trainers. *Educ Prim Care*. 2011;22(1):7-10.
15. Petre MA, Bahrey L, Levine M, Crawford M, Matava CT. Anesthesia environmental sustainability programs—a survey of Canadian department chiefs and residency program directors. *Can J Anesth*. 2020;67(9):1190-1200. doi:10.1007/s12630-020-01738-w
16. Tun S, Wellbery C, Teherani A. Faculty development and partnership with students to integrate sustainable healthcare into health professions education. *Med Teach*. 2020;42(10):1112-1118. doi:10.1080/0142159X.2020.1796950
17. Wicklum SC, Svrcek C, Kelly MA. Advocating for planetary health in medical education. *Can Fam Physician*. 2020;66(4):235-238.
18. Ali R. Introducing Indonesian medical students to rainforest conservation and community health in the field: a practicum experience in East Kalimantan. *EcoHealth*. 2006;3:195-203. doi:10.1007/s10393-006-0034-8
19. Kligler B, Pinto Zipp G, Rocchetti C, Secic M, Ihde ES. The impact of integrating environmental health into medical school curricula: a survey-based study. *BMC Med Educ*. 2021;21(1):40. doi:10.1186/s12909-020-02458-x
20. Sudharsanam MB. Making environmental health interesting for medical students-internet assisted facilitated collaborative learning approach. *J Educ Health Promot*. 2014;3:46. doi:10.4103/2277-9531.131934
21. Walpole SC, Mortimer F. Evaluation of a collaborative project to develop sustainable healthcare education in eight UK medical schools. *Public Health*. 2017;150:134-148. doi:10.1016/j.puhe.2017.05.014
22. Clery P, d'Arch Smith S, Marsden O, Leedham-Green K. Sustainability in quality improvement (SusQI): a case-study in undergraduate medical education. *BMC Med Educ*. 2021;21(1):425. doi:10.1186/s12909-021-02817-2
23. Wilkes MS, Conrad PA, Winer JN. One health—one education: medical and veterinary inter-professional training. *J Vet Med Educ*. 2019;46(1):14-20. doi:10.3138/jvme.1116-171r
24. Sokas RK, Fenton B, Foran J, et al. Environmental medicine: its introduction into a medical school primary care requirement. *Med Educ*. 1993;27(5):410-415. doi:10.1111/j.1365-2923.1993.tb00294.x
25. Subramaniam S, Gopichandran V. A picture speaks a thousand words: using participant photography in environmental pedagogy for medical students. *Educ Health (Abingdon)*. 2018;31(3):178-183. doi:10.4103/efh.EfH_124_17
26. Ramkumar J, Rosencranz H, Herzog L. Asthma exacerbation triggered by wildfire: a standardized patient case to integrate climate change into medical curricula. *MedEdPORTAL*. 2021;17:11063. doi:10.15766/mep_2374-8265.11063
27. Bajgoric S, Appiah J, Wass V, Shelton C. Sustainability in clinical skills teaching. *Clin Teach*. 2014;11(4):243-246. doi:10.1111/tct.12141

28. Bell EJ. Climate change: what competencies and which medical education and training approaches? *BMC Med Educ*. 2010;10:31. doi:10.1186/1472-6920-10-31
29. Fadadu RP, Jayaraman T, Teherani A. Climate and health education for medical students. *Clin Teach*. 2020;18(4):362-364. doi:10.1111/tct.13317
30. Gandhi V, Al-Hadithy N, Göpfert A, Knight K, van Hove M, Hockey P. Integrating sustainability into postgraduate medical education. *Future Healthc J*. 2020;7(2):102-104. doi:10.7861/fhj.2020-0042
31. Green EI, Blashki G, Berry HL, Harley D, Horton G, Hall G. Preparing Australian medical students for climate change. *Aust Fam Physician*. 2009;38(9):726-729.
32. Hackett F, Got T, Kitching GT, MacQueen K, Cohen A. Training Canadian doctors for the health challenges of climate change. *Lancet Planetary Health*. 2020;4(1): e2-e3. doi:10.1016/S2542-5196(19)30242-6
33. Huss N, Ikiugu MN, Hackett F, Sheffield PE, Palipane N, Groome J. Education for sustainable health care: from learning to professional practice. *Med Teach*. 2020;42(10): 1097-1101. doi:10.1080/0142159X.2020.1797998
34. Schwerdtle PN, Maxwell J, Horton G, Bonnamy J. 12 tips for teaching environmental sustainability to health professionals. *Med Teach*. 2020;42(2):150-155. doi:10.1080/0142159X.2018.1551994
35. Machalaba C, Raufman J, Anyamba A, et al. Applying a one health approach in global health and medicine: enhancing involvement of medical schools and global health centers. *Ann Glob Health*. 2021;87(1):30. doi:10.5334/aogh.2647
36. Maxwell J, Blashki G. Teaching about climate change in medical education: an opportunity. *J Public Health Res*. 2016;5(1):673. doi:10.4081/jphr.2016.673
37. Philipp R. Problem-management questionnaires as a student learning tool in environmental medicine. *Public Health*. 1992;106(4):289-299. doi:10.1016/s0033-3506(05)80422-6
38. Rabin BM, Laney EB, Philipsborn RP. The unique role of medical students in catalyzing climate change education. *J Med Educ Curric Dev*. 2020;7: 2382120520957653. doi:10.1177/2382120520957653
39. Roopnarine R, Regan JA. Faculty perceptions: a qualitative study of the perceived need, opportunities, and challenges of developing "One Health-One Medicine" in the medical, veterinary, and public health curricula. *J Contin Educ Health Prof*. 2021;41(1): 16-23. doi:10.1097/CEH.0000000000000332
40. Shah S, Owusu-Addo A. Envisioning planetary health in every medical curriculum: a medical student's perspective. *Med Teach*. 2020;43(4):484-485. doi:10.1080/0142159X.2020.1817352
41. Shea B, Knowlton K, Shaman J. Assessment of climate-health curricula at international health professions schools. *JAMA Netw Open*. 2020;3(5):e206609. doi:10.1001/jamanetworkopen.2020.6609
42. Tun S. Fulfilling a new obligation: teaching and learning of sustainable healthcare in the medical education curriculum. *Med Teach*. 2019;41(10):1168-1177. doi:10.1080/0142159X.2019.1623870
43. Walpole SC, Mortimer F, Inman A, Braithwaite I, Thompson T. Exploring emerging learning needs: a UK-wide consultation on environmental sustainability learning objectives for medical education. *Int J Med Educ*. 2015;6:191-200. doi:10.5116/ijme.5643.62cd
44. Wellbery C, Sheffield P, Timmireddy K, Sarfaty M, Teherani A, Fallar R. It's time for medical schools to introduce climate change into their curricula. *Acad Med*. 2018;93(12):1774-1777. doi:10.1097/ACM.0000000000002368
45. Burch H, Beaton LJ, Simpson G, Watson B, Maxwell J, Winkel KD. A planetary health-organ system map to integrate climate change and health content into medical curricula. *Med J Aust*. 2022;217(9):469-473. doi:10.5694/ mja2.51737
46. Philipsborn RP, Sheffield P, White A, Osta A, Anderson MS, Bernstein A. Climate change and the practice of medicine: essentials for resident education. *Acad Med*. 2021;96(3): 355-367. doi:10.1097/ACM.0000000000003719
47. Patel A, Joshi A. Teaching sustainable healthcare in the medical education curricula: student perspectives. *Med Teach*. 2020;42(5):593-594. doi:10.1080/0142159X.2019.1641190
48. Walpole SC, Vyas A, Maxwell J, et al. Building an environmentally accountable medical curriculum through international collaboration. *Med Teach*. 2017;39(10): 1040-1050. doi:10.1080/0142159X.2017.1342031
49. Colbert CY, French JC, Brateanu A, et al. An examination of the intersection of climate change, the physician specialty workforce, and graduate medical education in the US. *Teach Learn Med*. 2022;34(3): 329-340. doi:10.1080/10401334.2021.1913417
50. Teherani A, Nishimura H, Apatira L, Newman T, Ryan S. Identification of core objectives for teaching sustainable healthcare education. *Med Educ Online*. 2017;22(1): 1386042. doi:10.1080/10872981.2017.1386042
51. Brand G, Collins J, Bedi G, et al. "I teach it because it is the biggest threat to health": integrating sustainable healthcare into health professions education. *Med Teach*. 2021;43(3):325-333. doi:10.1080/0142159X.2020.1844876
52. McCurdy LE, Roberts J, Rogers B, et al. Incorporating environmental health into pediatric medical and nursing education. *Environ Health Perspect*. 2004;112(17): 1755-1760. doi:10.1289/ehp.7166
53. Moore A. A planetary health curriculum for medicine. *BMJ*. 2021;375:n2385. doi:10.1136/bmj.n2385
54. Intergovernmental Panel on Climate Change (IPCC). *Climate Change 2022: Impacts, Adaptation, and Vulnerability*. Cambridge University Press; 2022.
55. The Association of Faculties of Medicine of Canada. Academic Health Institutions' Declaration on Planetary

Health. Accessed September 4, 2024. https://www.afmc.ca/initiatives/planetaryhealthdeclaration/
56. Bovill C, Cook-Sather A, Felten P. Students as co-creators of teaching approaches, course design, and curricula: implications for academic developers. *Int J Acad Dev*. 2011;16(2):133-145. doi:10.1080/1360144X.2011.568690
57. Hattie J. *Visible Learning: A Synthesis of Over 800 Meta-Analyses Relating to Achievement*. Routledge; 2008.
58. Mortimer F, Isherwood J, Wilkinson A, Vaux E. Sustainability in quality improvement: redefining value. *Future Healthc J*. 2018;5(2):88-93. doi:10.7861/futurehosp.5-2-88
59. Stanford V, Barna S, Gupta D, Mortimer F. Teaching skills for sustainable health care. *Lancet Planetary Health*. 2023;7(1):e64-e67. doi:10.1016/S2542-5196(22)00330-8

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Funding: The authors report no external funding source for this study.

Conflict of interest: The authors declare they have no competing interests.

This work was previously presented at the International Conference on Residency Education, October 17-21, 2023, Halifax, Nova Scotia, Canada, and the American College of Surgeons Quality and Safety Conference, July 10-13, 2023, Minneapolis, Minnesota, USA.

The authors would like to thank S. Visintini for their assistance with peer reviewing the search strategy.

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Received January 4, 2024; revision received April 6, 2024, and August 31, 2024; accepted September 3, 2024.