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Citation
Visser, E. H., Oosterveld, B., Slootweg, I. A., Vos, H. M. M., Adriaanse, M. A., Schoones, J. W., & Brakema, E. A. (2024). The development and characteristics of planetary health in medical education: a scoping review. *Academic Medicine*, *99*(10), 1155-1166. doi:10.1097/ACM.0000000000005796

Version:	Publisher's Version
License:	Creative Commons CC BY 4.0 license
Downloaded from:	https://hdl.handle.net/1887/4198201

Note: To cite this publication please use the final published version (if applicable).

The Development and Characteristics of Planetary Health in Medical Education: A Scoping Review

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Abstract

Purpose

Climate change, biodiversity loss, and other ecological crises threaten human health globally. The interrelation between human health and ecosystems is addressed in the emerging field of planetary health. Ecological crises have created an urgency to integrate planetary health, including sustainable health care, into medical education. To facilitate integration and guide future research, this review aims to provide an overview of the existing literature about planetary health in medical education.

Method

The authors conducted a scoping review using the conventional methodological framework for scoping studies. They performed a comprehensive search in 7 databases without language restrictions in March 2022. Two researchers independently extracted data. The team analyzed the data using data-driven thematic analysis, content analysis, and qualitative summarizing. Data were structured according to the *Curriculum Development for Medical Education: A Six-Step Approach*.

Results

The authors identified 3,703 unique publications, of which 127 were included. Articles predominantly (71%, n = 90) covered the call to integrate planetary health in medical education (step 1: general needs assessment). Many publications (24%, n = 31) proposed learning objectives (step 3); these mainly concerned raising awareness, while few concerned action perspectives. Publications limitedly reported on the final steps of curriculum development. Only 2 covered a full cycle of curriculum development. Most were published recently, with first authors mainly from Europe and North America.

Conclusions

Planetary health in medical education is an urgent and hot topic. Literature focused predominantly on *why* planetary health should be integrated in medical education and *what* should be covered. The authors recommend future research and education development to shift to *how* to do so, especially in evaluation and feedback. Research and education development needs to be conducted and reported on systematically and underpinned by educational principles. Lastly, it would benefit from perspectives beyond "Western-based" ones.

Our planet is changing at an unprecedented rate, leading to several ecological crises, e.g., climate change, biodiversity loss, and land degradation.[1] This affects not only our living environment but also human health, with, for example, increases in heat-related deaths, vector-borne diseases, and mental health problems.[2–5] In fact, the World Health Organization states that "Climate change is the single biggest health threat facing humanity."[6] Paradoxically, the health care sector not only does experience the consequences of ecological crises but also contributes substantially to these, with, among others, CO_2 emissions (4.4% of net emissions worldwide), material extraction, and waste generation.[7,8] These contributions include microlevel contributions in everyday health care practices. For example, a health professional can reduce greenhouse gas emissions by replacing polluting medication such as metered dose inhalers with more sustainable alternatives such as dry powder inhalers.[9] In contrast to more overarching interventions, such as that of public health, this pragmatic daily approach allows health professionals to easily make a small impact, which add up to a bigger, health-care-wide impact.

To address these challenges concerning ecological crises and health, both current and future health professionals need to be equipped with knowledge, skills, and attitudes about planetary health (PH).[10] PH is a new and rapidly evolving field and defined as "the health of human civilisation and the state of the natural systems on which it depends."[11] Because of the field's novelty, the terminology surrounding PH is not yet clearly defined. For example, it is also referred to as "climate change and health,"[12] "sustainable health care"[10] (SH), or "ecomedicine,"[13] all terms that deal with overlapping fields and definitions. For conciseness and consistency in this review, we will use "planetary health education," by which we mean education about PH,[11] including education about adaptation and mitigation measures such as SH.

Currently, PH is often not yet included in the curriculum of medical schools. A study in 2020 showed that only 15% of 2,817 medical schools in 108 countries

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Acad Med. 2024;99:1155–1166.
First published online July 1, 2024
doi: 10.1097/ACM.0000000000005796

Supplemental digital content for this article is available at http://links.lww.com/ACADMED/B588.

included climate change and health in their curriculum.[12] In recent years, the lack of PH in medical education and the sense of ecological urgency have led to calls for action from medical students, graduated physicians, and medical associations and governments alike to integrate PH into medical education.[14–18]

In response to these calls, guidelines and frameworks have been developed, such as the AMEE consensus statement on PH and education for SH[10] and the framework to guide PH education[19] advanced by Guzmán et al. Besides these frameworks, however, literature about developing and implementing PH into medical education remains fragmented and, to our knowledge, a comprehensive overview is missing. In this scoping review, we aimed to provide such an overview about PH in medical education by qualitatively mapping the existing literature and the characteristics of existing publications. This overview may serve to identify steps in the development of PH education to be further explored, and could serve faculty in development of PH education.

Method

For this scoping review, we used the methodological framework for scoping studies by Arksey and O'Malley.[20] We supplemented this with relevant recommendations by Levac et al[21] and Peters et al,[22] including holding regular meetings during the screening process[21] and updating the data-charting form during the review process.[21,22] We chose a scoping review as the review type because of the novelty and rapid evolving nature of PH in medical education. We preregistered the review protocol[23] and used a logbook to substantiate choices, and to critically reflect on and document the iterative review process. The protocol, logbook, data, codes, and syntaxes are available on the Open Science Framework (https://osf.io/ptf9r).

Identifying the research question

We defined our research question as: What does the existing literature report about PH (including SH) in medical education?

Identifying relevant articles

Authors E.H.V. and J.W.S. (a research librarian), in consultation with E.A.B., defined a search strategy based on the key terms "planetary health education" or "education for sustainable health care" and "medical education," supplemented by synonyms and related terms. We included all types of literature, from 1987 (the year that the term "sustainability" was defined by the Brundtland Commission[24]) onward, including gray literature, and searched without language restrictions. We conducted the initial search on September 9, 2021, and completed an updated definitive search on March 1, 2022, in 7 databases (PubMed, MEDLINE [OVID], Embase [OVID], Web of Science, Cochrane Library, Emcare [OVID], Academic Search Premier). The searches are available in Supplemental Digital Appendix 1, at http://links.lww.com/ACADMED/B588.

Selecting the articles

We used EndNote (EndNote 20.1; Clarivate Analytics, Philadelphia, PA) as our citation manager and ASReview (v0.19.1; ASReview, Utrecht, the Netherlands) for title and abstract screening. ASReview helps to include relevant publications in a more efficient way by employing an active learning model, while researchers retain control over their own inclusion/exclusion decisions. The model enables researchers to stop screening according to a predetermined stopping rule, when chances of finding a relevant paper afterward are decreasing.[25] We defined the stopping rule as: when at least 33% of the papers are screened AND when ASReview gives 25 consecutive nonrelevant papers.

Two independently working researchers (E.V., B.O.) screened the titles and abstracts for relevance and discussed discrepancies until they reached consensus. We included articles that contained information about PH in medical education. We did not set any exclusion criteria in advance. If disagreements occurred, a third reviewer (E.B.) determined inclusion for full-text screening. We attempted to retrieve the full text for all publications; the details of those articles we were unable to retrieve are available in Supplemental Digital Appendix 2, at http://links.lww.com/ACADMED/B588. E.V. and B.O. both screened full-text publications. After full-text screening, we noticed that too broad a scope had been chosen by including topics related to PH (such as one health, global health, and public health). Although we recognize the importance of the knowledge gained by these adjacent fields, for this review, we chose to include publications exclusively addressing PH to maintain focus within this already broad topic. We therefore excluded articles on related topics; details of these publications are available in Supplemental Digital Appendix 2, at http://links.lww.com/ACADMED/B588.

With a list of the included publications on PH in medical education, J.S. conducted citation searching. In addition, we sent this list to international experts in the field of PH in medical education to obtain as complete a view of the literature as possible. E.V. screened the additional articles from citation searching and expert consultation on title and abstract; B.O. checked 10% of these. After screening these additional publications, we concluded that we had reached data saturation with the previously included papers (meaning no new topics emerged); we therefore chose to not include data from the additional articles from citation searching and expert consultation in the further analyses. Details of the additional publications are available in Supplemental Digital Appendix 2, at http://links.lww.com/ACADMED/B588.

Charting the data

E.H.V. and B.O. entered all data into a data charting form designed by the research team for the purpose of this study. E.H.V. and B.O. then summarized the content per publication and checked each other's work for accuracy. The charted data are available in Supplemental Digital Appendix 2, at http://links.lww.com/ACADMED/B588.

Collating, summarizing, and reporting the results

During regular consensus meetings with the research team, we used data-driven thematic analysis[26] to identify prominent themes. We found that these themes fitted best into the approach advanced in Thomas et al's *Curriculum Development for Medical Education: A Six-Step Approach*.[27] This approach is used to develop medical education and aims to "provide a practical, theoretically sound, evidence-informed approach to developing, implementing, evaluating, and continually improving educational experiences in the health professions."[27] The 6 steps are

1. general needs assessment,
2. targeted needs assessment,
3. goals and objectives,
4. educational strategies,
5. implementation, and
6. evaluation and feedback.

We used these steps to code the data (E.H.V., checked by I.A.S.) using Atlas.ti (version 22.2.5.0; Scientific Software Development GmbH, Berlin, Germany). Although we did not set out to develop a curriculum in this review, using this approach allowed us to structure the large amount of information collected and make clear where development of PH in medical education stands and where the gaps in educational development and research lie. With the coded data, we performed content analysis[26] and qualitatively summarized the coded data per step.

Results

We identified 3,703 unique publications, of which 127 were included[10,12–17,19,28–146] (see Figure 1).

Most articles (61%, n = 75) were published in 2020 or later (Figure 2). The majority were written by first authors from Europe (39%, n = 50) and North America (40%, n = 51), and only a few from Africa (1%, n = 1), Asia (6%, n = 7), Australia (12%, n = 15), and South America (2%, n = 3). Of all included publications, 26% (n = 33) had at least one student author on the author list.

A full cycle of curriculum development, as described in the *Curriculum Development for Medical Education: A Six-Step Approach*,[27] was carried out and described in 2% of articles (n = 2).[55,128] The number of unique references per step of the 6-step approach was highest for step 1, general needs assessment (71%, n = 90), and lowest for step 6, evaluation and feedback (6%, n = 8), as shown in Figure 3.

Step 1: General needs assessment

> Identification and critical analysis of a health need or other problem. …
> The difference between the ideal approach and the current approach represents a general needs assessment.[27]

Defining the health care problem. The health care problem addressed in PH education was outlined in the introduction sections of most of the included articles. Although authors phrased the problem differently, they generally emphasized that several ecological crises, including climate change, are currently threatening the health of the planet and thereby human health, leading to increased morbidity and mortality; that health care is a substantial contributor to these crises; and that health care will have to take adaptive and mitigating measures to address these crises.

To position this health care problem (and thereby PH within health care), it was argued in these publications that PH is an extension of existing disciplines such as occupational and environmental health; that the focus currently shifts from global health to PH; and that PH challenges us to rethink the traditional division between individual health and public health.[35,66,67,144] Besides being described as a health care problem, PH was also considered an opportunity for medical education, for example, to improve medical students' literacy about other areas of health care such as public health and to obtain adaptive expertise.[34,86]

The current approach. The publications describing the current status of PH in medical education generally showed that less than half of the analyzed general medical curricula included PH into their education.[12,48,62,63,74,79,83,100,101,106,107,125,126,137,144] These inventories were conducted by educators and researchers, but also by students, using the Planetary Health Report Cards.[17,44,51,52]

Due to the perceived magnitude of the health care problem addressed by PH and the limited inclusion in medical education curricula, there were many publications that posed a call for action to include PH into medical education.[13,14,16,17,28,29,31,38,43–45,47,50,54,58,59,63,71,78,86,87,90,91,93–95,98,99,109,117,119,123,124,137,139,145] Several articles were dedicated exclusively to such a call for action. Authors of these papers were lecturers, physicians, and researchers—but also students, who themselves asked to be educated on this topic. Two student authors stated: "Future health professionals will have to deal

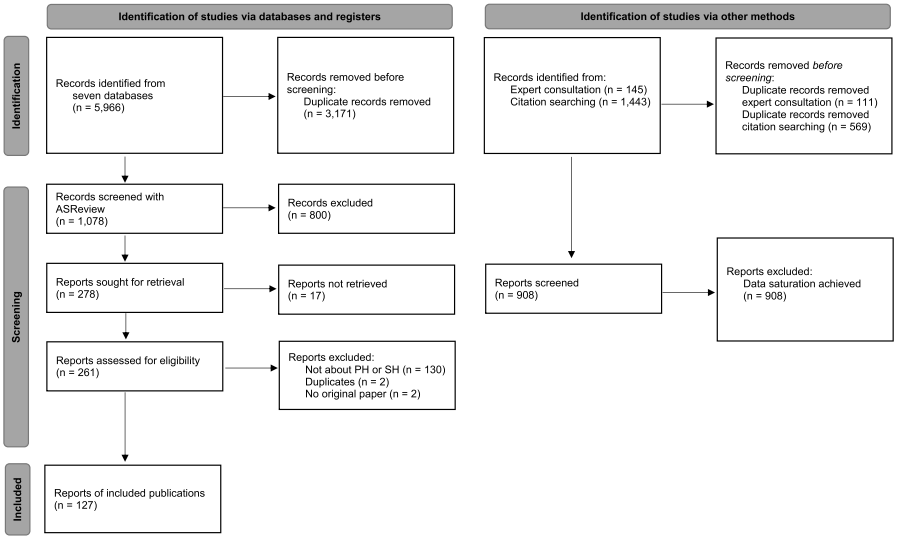

Figure 1 PRISMA flow diagram, from a review on planetary health and education for sustainable health care in medical education, 2022.[149] ASReview is the program chosen to conduct title and abstract review. Abbreviations: PH, planetary health; SH, sustainable health care.

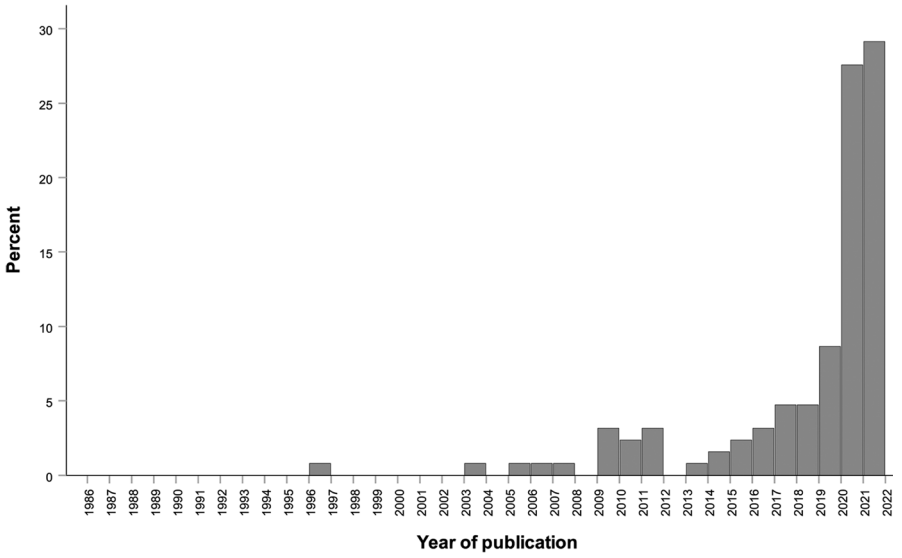

Figure 2 Percentage of articles reviewed per year of publication, from a review on planetary health and education for sustainable health care in medical education, 2022.

with the consequences of the climate crisis. … We therefore urge universities, educators, and students to take up this important task."[137] Besides these "bottom-up" calls, there was also a "top-down" call for action from the American Medical Association (AMA). In 2019, the AMA passed a resolution endorsing teaching climate and health in medical education.[17] Furthermore, many initiatives to teach PH have been described, although mostly have not yet been formally included in a curriculum.[10,17,30,32,37,39,46,49,53,55,56,58–60,64,69,70,73,77,84,85,92,110,112,113,115,126,128,135,140]

The ideal approach. As an important part of the ideal approach, many authors prescribed integrating PH into the already existing curriculum.[10,35,42,47,85,111,115,128,134,137,141,144] Sullivan et al[128] developed a model for this integration. Furthermore, several methods were proposed for the ideal approach for PH education development. The principal methods mentioned were as follows: interdisciplinary/transdisciplinary education development, collaboration, and co-creation.[10,43,120] These methods all cut through the traditional silos of medicine and other fields (e.g., biology and anthropology, acknowledging the inherent transdisciplinary nature of PH) and through various medical professions (e.g., nursing and medicine)[10,43,74,86,115,120]; through the walls around institutions, encouraging collaboration with other institutes nationally and worldwide[81,107,141]; and through hierarchical levels by co-creating the education together with students.[10,17,42,61,83,111,126,128,134,140] More in-depth perspectives on the ideal approach were described by Huss et al[69] and by McKimm et al.[88,89]

Step 2: Targeted needs assessment

> A targeted needs assessment is a process by which curriculum developers apply the knowledge learned from the general needs assessment to their particular learners and learning environment.[27]

Among students, the *awareness* of PH was high,[41,72,75,82,85,102,142] but they also indicated that they experience a lack of *knowledge* about PH.[15,36,79,82,85,116,118,136,142,146] Hence, students indicated that they would like to have more knowledge on PH.[15,36,79,107,118,136,146] Additionally, students indicated to varying degrees that they feel the responsibility to act in relation to climate change and other ecological crises in their professional role.[41,146] A framework to conduct such a learners' needs assessment in continuing medical education was developed by Valois et al.[136]

Educators' knowledge of PH has been studied less frequently, and results are equivocal. Most publications indicated a lack of knowledge and reported this as a barrier to implementation.[83,106,133,134,140,141] However, one survey among educators did suggest strong content knowledge. Meanwhile these educators also frequently reported not knowing *how* best to teach PH.[40]

Step 3: Goals and objectives

> Once the needs of the learners have been clarified, it is desirable to target the curriculum to address these needs by setting goals and objectives.[27]

Newly developed goals and/or objectives for PH education were described in 24%

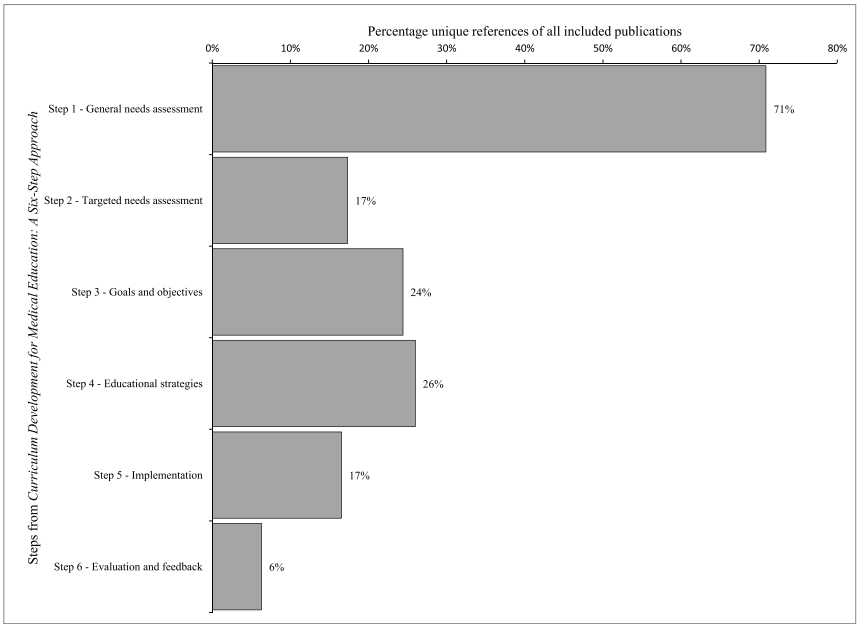

Figure 3 Unique publications per step of *Curriculum Development for Medical Education: A Six-Step Approach*,[27] from a review on planetary health and education for sustainable health care in medical education, 2022.

(n = 31) of the included publications.[10,33,35,55,57,60,68,69,86,88,92,103,105,108,111,114,120,121,125–128,131,132,136–138,140,142–144]

We categorized these goals and/or objectives into 8 themes:

- Ecological crises: general principles of the causes and consequences of various ecological crises;
- PH: relationship between human health and ecosystems;
- Adaptation and diseases related to ecological crises: adaptation of the health care system to the ecological crises and their consequences, including preparation for and knowledge about the change in disease spread and new diseases;
- Mitigation and SH: impact of health care on ecosystems and how this impact can be calculated and reduced, including lifestyle and prevention: the co-benefits of preventive measures for both human health and ecosystems;
- Ethical, social, and legal aspects of PH: ethical aspects of PH, the professional role of the health care professional (within society) regarding PH and the legal and governance frameworks of PH;
- Communication and advocacy: sharing information about PH with patients, colleagues, management and policymakers, and professional advocacy and leadership; and
- Academic attitude and research: development of a critical attitude regarding the health care system and PH; and research on PH.

The themes are presented in Table 1 and plotted against Bloom's taxonomy to facilitate faculty identification of already developed learning objectives. Interestingly, most of the reported learning objectives were "understand" objectives, and only a few focused on "evaluating" and/or "creating" (Figure 4), indicating a literature gap on the topic of the action-oriented learning objectives.

Among 8 themes, 4 subthemes stood out because authors repeatedly highlighted them: first, the emphasis on equity and equality, justice, and the current inequity of the burden of ecological crises on different parts of the world[60,69,86,103,126,127,131,136,142,143]; second, the concept of systems thinking as a way of looking at PH and health care,[10,86,103,127] "an approach which acknowledges the interdependence of all agents in systems"[10]; third, the importance of advocacy and leadership as part of the professional role[10,33,68,88,125,126,128]; and last, the attention for indigenous perspectives on PH.[10,55,69,114,127]

Because the acquisition of knowledge, skills, and attitudes via learning objectives about PH may not be sufficient to cope with the urgency felt, Shaw et al expressed the following consideration: "While it is

Table 1

Publications Categorized Per Theme of Goals and Learning Objectives and Bloom's Taxonomy, From a Review on Planetary Health and Education for Sustainable Health Care in Medical Education, 2022

	Bloom's taxonomy level, reference no.[a]					
Theme	Remember	Understand	Apply	Analyze	Evaluate	Create
Ecological crises	60, 103, 125, 128, 131, 136, 142, 143	55, 69, 92, 121, 126, 128, 131, 136, 142, 143	35	86	131	—
Planetary health	10, 86, 92, 111, 125, 126, 131, 143	10, 33, 55, 60, 120, 127, 128, 131, 132, 142, 143	35, 120, 127	10, 127, 136	—	127
Adaptation and diseases related to ecological crises	136	10, 55, 60, 92, 108, 111, 121, 131, 136–138, 143	68, 86, 108, 125, 131, 136	125	—	55
Mitigation: sustainable health care	—	10, 55, 57, 60, 108, 111, 121, 131, 137, 142, 143	10, 35, 68, 120, 131, 132, 138, 140, 143	126, 131, 143	10	—
Lifestyle and prevention	60, 121, 137	10, 57, 86, 120, 127, 131, 132, 140, 143	—	33, 131, 143	—	—
Ethical, social, and legal aspects	142	10, 33, 55, 60, 69, 86, 105, 111, 114, 120, 126–128, 131, 136, 142, 143	10, 35, 69, 103, 114, 125, 128, 131, 136, 143	10, 114, 120, 125, 127	10	—
Communication and advocacy	—	10, 126, 127, 144	10, 33, 35, 57, 68, 88, 108, 111, 120, 125, 127, 128, 138, 142	—	—	—
Academic attitude and research	—	86, 120, 127	10, 69, 103, 120, 127	33, 86, 127	—	144

[a]Please see the list of references at the end of this article.

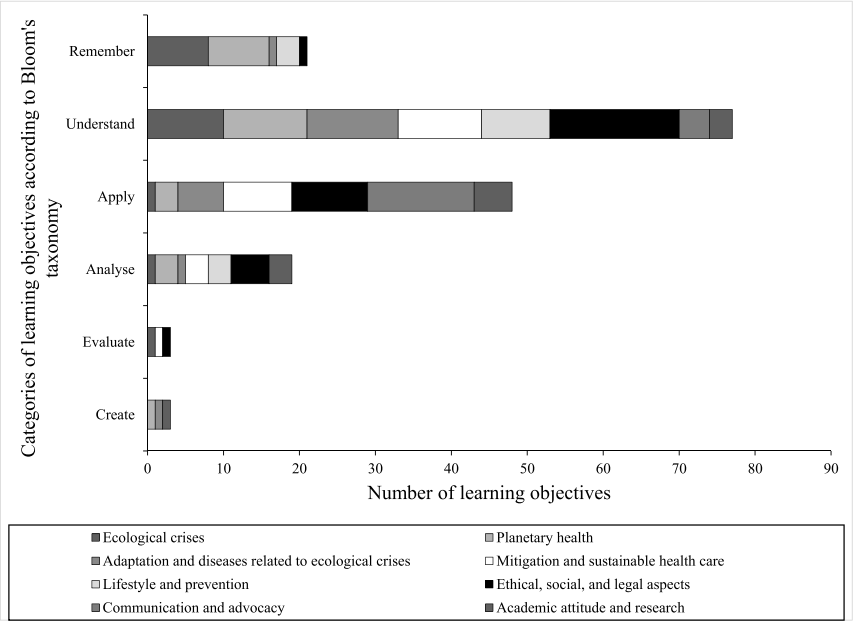

Figure 4 Learning objectives per theme and category of Bloom's taxonomy, from a review on planetary health and education for sustainable health care in medical education, 2022.

important for health professionals to acquire and apply knowledge and learn skills and appropriate professional behaviors, it is equally important that educators consider the role of values and emotions."[10]

Step 4: Educational strategies

> The next step is to develop the educational strategies by which the curricular objectives will be achieved. Educational strategies include both content and methods.[27]

In the sections above on the ideal approach and learning objectives, we described the recommended content for PH education. A way to structure this content was reported by Guzman et al.[19] This task force of thought leaders in PH education described a framework for PH education.

To convey the content to students, many different methods have been used or suggested (see Supplemental Digital Appendix 3, at http://links.lww.com/ACADMED/B588).[30,32,39,46,49,53,55,60,61,65,73,74,76,84,85,92,104,112,113,115,122,124,126,128–130,135,136,140,144]

PH education has been offered both as mandatory and elective education.[48,97] Rabin et al argued that elective education can be unfavorable; they state: "An elective would … signal to students that the implications of climate change on health are non-essential content rather than critical knowledge for every physician—a message that undermines the educational mobilization required at this moment."[111]

Step 5: Implementation

> The curriculum developer must ensure that sufficient resources, political and financial support, and administrative structures have been developed to successfully implement the curriculum.[27]

Resources. For the implementation of PH education, several required resources were identified. Most frequently mentioned was faculty development.[10,134,144] As Tun et al stated: "To deliver this new learning, faculty themselves need to be prepared, to bring capacity and confidence to this new paradigm."[134] An identified enabler for faculty development was personal motivation of the educator for PH.[74,125,134] It was suggested that learning materials on PH, as a resource, could be collated in a repository.[40,144]

Support. In line with the 6-step approach, support for the curriculum was identified by many authors as a precondition to successful implementation.[10,40,74,111,125,133,141,144] This included support from students[40,74,125,133,141] and from the institutional board,[10,74,96,125] but also support from national politics[74] and accrediting bodies.[40] An example came from the United Kingdom, where the General Medical Council has placed an obligation on medical education for doctors "to understand and apply the principles of sustainable health care."[133] To increase support, it was suggested that a PH education champion is appointed.[74,86]

Barriers. Several barriers were identified to implementing PH education. The 3 most frequently mentioned were as follows: an overpacked curriculum,[74,83,86,106,107,116,120,125,133,137,140] a lack of faculty knowledge,[83,86,106,107,125,133,134,140,141] and difficulty in gaining support.[106,107,133,140]

Implementation strategies, roadmaps, and recommendations to implementation were described in more detail by McKimm et al,[89] Shaw et al,[10] Sullivan et al,[128] Tun et al,[133] and Van Bree et al.[137] These roadmaps and frameworks provide practical guidance for integration[10,128,133,137] as well as substantive considerations.[89]

Step 6: Evaluation and feedback

> Assessment and evaluation provide information that can be used to guide individuals and the curriculum in cycles of ongoing improvement.[27]

Individual assessment of PH was described in 3 publications (2%)[10,74,108] and was considered a difficult task.[133] Interestingly, students themselves did ask to be examined on PH.[61]

Only 2 publications (2%) reported whether knowledge had improved after implementing PH education; both showed an increase in knowledge.[73,126] A recommended method to establish indicators for program evaluation and assessment is to use the Sustainable Development Goals, specifically goals 4, 12, and 13.[80]

Discussion

With this scoping review, we aimed to provide an overview of the literature on PH in medical education. We found that the literature predominantly focused on the first steps of *Curriculum Development for Medical Education: A Six-Step Approach*[27] (general needs assessment, targeted needs assessment, goals and objectives, educational strategies), while the final steps (implementation, evaluation and feedback) were relatively

limitedly covered. A systematic approach in education development was frequently lacking. Learning objectives were mostly devoted to increasing awareness of PH, rather than equipping students with action perspectives. Lastly, most articles were published after 2020, and the vast majority were written from a "Western-based" perspective. Below, we discuss these key findings and provide practical implications and research recommendations.

From an urgent problem to a mature part of education

First, the publications we found predominantly focused on the problem that ecological crises pose on health, and urged the integration of PH in medical education (steps 1 and 2). Many publications also reported on learning objectives (step 3). However, the final steps of educational development (steps 4–6) were less studied, especially the last step, evaluation and feedback. Hence, we recommend now shifting the focus from *why* PH should be integrated in medical education and *what* should be done, to the next development steps on *how* to do so. As a 2023 review already studied different types of education, i.e., educational strategies,[147] future research should focus on *how* to evaluate the programs and the students. As such, PH can mature in the curriculum.

In very few of the included publications was education development systematic and underpinned by a full cycle of curriculum development. Possibly, the sense of urgency to integrate PH in medical education resulted in rapid educational development that lacked a systematic approach. Therefore, in line with the recommended transdisciplinary approach, there is a role for education developers to join current PH initiatives and add their expertise to facilitate orderly completion of the steps of educational development.

Learning objectives with an action perspective

Second, almost one-quarter of publications proposed newly developed learning objectives. These were categorized into 8 themes: ecological crises; planetary health; adaptation and diseases related to the crises; mitigation and sustainable health care; lifestyle and prevention; ethical, social, and legal aspects; communication and advocacy; and academic attitude and research. Following Bloom's taxonomy, most learning objectives addressed objectives related to understanding; few concerned evaluating and creating. However, to move beyond awareness and knowledge about PH and to provide an action perspective, more learning objectives in the last categories should be developed. This would not only make students aware of the problem but also give them tools to address the problems they became aware of.

A rapidly evolving field, students calling to be educated, and a predominantly "Western" perspective

Third, several overarching literature observations stood out. Most articles were published in 2020 or later; this demonstrates that PH in medical education is a recent and rapidly evolving field. Of note, one-quarter of publications were authored or coauthored by students. Many of these were call-for-action statements from students' perspectives, including requests to be educated and assessed on PH. The remarkably high representation of students among the authors demonstrates their involvement in PH education and the responsibility they are willing to take up. Last, first authors originated predominantly from Europe or North America; the voices of those in regions most affected remain underrepresented. This is not an exception in English academic literature. However, especially in PH, this may signify a missed opportunity. On the one hand, from an equity perspective, historically most pollution has been emitted by the Global North, while the burden of climate change is mostly felt in the Global South.[148] On the other hand, indigenous cultures are much more used to living in harmony and balance with their environment and could share this wisdom in PH education.[114] PH education research and development therefore would benefit greatly from perspectives from across the planet.

Implications for education development and research

Our findings can be translated into the following practical recommendations to guide future education development and research.

Widespread application of a general needs assessment demonstrates clear consensus on the problem definition: Many ecological crises, including climate change, are currently threatening ecosystems and thereby human health, leading to increased human morbidity and mortality. Health care is a contributor to these crises and has to take adaptive and mitigating measures to address these crises. We suggest that the focus should now be moved to the next steps. Although a targeted needs assessment has been repeatedly conducted in the general population of students and teachers, we recommend to repeat the step locally to determine the local entry level of education on PH. Education developers can subsequently use this information to define learning objectives, which can be supported by our findings (Table 1) and objectives as reported in a review on environmental literacy.[103] In addition to the already developed learning objectives addressing awareness, action-oriented learning objectives should be developed and included. As educational strategies, we recommend combining separate curricular components, such as lectures exclusively dedicated to PH (as shown in Supplemental Digital Appendix 3, at http://links.lww.com/ACADMED/B588), with PH integrally woven into the existing education (as recommended in the Ideal Approach). The type of education may be adapted to local preferences, as a 2023 review showed that the type of education did not affect the level of improvement of knowledge, attitudes, and skills, indicating that all types of education may be equally adequate in conveying PH education.[147] Given the urgency felt of implementing PH in medical education, mandatory education seems to be preferable to elective education.[111] For the implementation of PH education, support at all levels of the organization is needed. One important facilitator is engaging with influential stakeholders. Students in Florida, for example, successfully accelerated implementation of PH by co-creating education with their teachers.[17] Lastly, given the limited studies published on evaluation and feedback, we recommend future research and education development to focus on this step.

Strengths and limitations

We wrote this review with a transdisciplinary team consisting of an educationalist, physicians (including physicians involved in the development of PH as a

discipline nationally), an experienced scientist with a background in health sciences, and a librarian, combining the expertise of these disciplines. In this way, the review is underpinned by educational principles such as the 6-step approach and Bloom's Taxonomy, as well as relevant to practice. Another strength is the structured approach with which we conducted this review, reflexively reviewing and transparently documenting our decisions in the review process, and presenting the results in an organized manner.

Although this review was comprehensive, we recognize limitations. First, we chose to focus on medical education to keep the review manageable. Information from other health professions education literature may have therefore been missed. However, this focus does provide a comprehensive picture for medical education, and the review may serve as inspiration for other health professions educators. Second, publication and reporting bias may have skewed the results of this review, as opponents of inclusion of the topic may not have published similarly. This may have led to an overly positive presentation of the support for integrating PH in medical education. Furthermore, we conducted the search in 2022, possibly making the search less up-to-date. However, we did achieve data saturation, reducing the likelihood of missing insights. In addition, we chose not to perform a quality assessment of the publications we included. This may make the findings more difficult to interpret because each article we included was counted proportionally. We chose this approach as we aimed to provide a broad overview of the available literature. Moreover, we did not search for gray literature outside of the chosen databases. We may, therefore, have missed informal forms of educational development. We pragmatically did not perform the optional stage 6 of the review process, the consultation exercise.[21] This may reduce the ease of translation and dissemination of the results. By including a section specifically dedicated to the implications of the review, we aim to perform this step of translation and dissemination as yet. Lastly, we acknowledge that we have only included "Western" authors in our team. We have realized this limitation too late and cordially invite reflections from "non-Western" authors on this review.

Conclusions

In conclusion, literature on PH in medical education is rapidly evolving, with the current focus on why PH in medical education is important and what content should be covered. Now we should move beyond the *why* and the *what* and focus on *how* to do so, especially in the domain of evaluation and feedback. Future development of PH in medical education should be systematically conducted and concern all steps of curriculum development; it should be co-created with students and consider inclusion of perspectives from across the planet, especially outside of the "Western-based" ones.

Acknowledgments: The authors wish to thank the international experts who provided additional publications for review: Egid van Bree, Kay Leedham-Green, Michelle McLean, Hans Ossebaard, Simran Shedev, and Sarah Walpole; the team of ASReview for their support and guidance in using the software and development of the stopping rule; and Nienke Boogaard, educationalist, for sharing her knowledge on education during the analysis process.

Funding/support: This review was funded by the innovation fund of the General Practitioner Specialty Training (Innovatiefonds Huisartsopleiding Nederland) (7020).

Other disclosures: The authors used ASReview (v0.19.1; ASReview, Utrecht, the Netherlands) for title and abstract screening.

Ethical approval: Reported as not applicable.

Data: Data and syntaxes can be accessed via the Open Science Framework at https://osf.io/ptf9r.

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