Physicians' views of patient–planetary health co-benefit prescribing: a mixed methods systematic review

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Health professionals are increasingly called to become partners in planetary health. Using patient–planetary health (P–PH) co-benefit prescribing framing, we did a mixed methods systematic review to identify barriers and facilitators to adopting P–PH co-benefit prescribing by physicians and mapped these onto the Capability, Opportunity, Motivation, and Behaviour (COM-B) model and Theoretical Domains Framework (TDF). We searched electronic databases from inception until October, 2022, and did a content analysis of the included articles (n=12). Relevant categories were matched to items in the COM-B model and TDF. Nine barriers and eight facilitators were identified. Barriers included an absence of, or little, knowledge of how to change practice and time to implement change; facilitators included having policy statements and guidelines from respected associations. More diverse study designs that include health professionals, patients, and health-care system stakeholders are needed to ensure a more holistic understanding of the individual, system, and policy levers involved in implementing clinical work informed by planetary health.

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Introduction

The UN Secretary-General António Guterres has called climate change "a code red for humanity".[1] With global health-care systems contributing approximately 5% to global greenhouse gas emissions,[2] health professionals (and the medical organisations they work within) have increasingly been called to become partners in climate change mitigation efforts.[3–6] Despite these health system calls to action on climate change, there has been little to no consistency in the development of clear clinical recommendations or guidelines. With expected and continued amplification of climate-related health ailments, physicians and health systems will shoulder the burden of patient care on already stressed health-care systems.[6,7] Health professionals and health systems are currently underprepared for the effects of an increasingly stressed planet, due to a scarcity of clear and ubiquitous clinical recommendations, educational training efforts, and policy guidelines across nation states.

In 2015, WHO's operational framework for building climate-resilient health[8] platformed the need for adaptation measures within health systems globally. Despite this increasing attention on the need for climate adaptation within health systems, clinical practice is still often grounded in climate-reactive medical practice based on acute events (heat events, floods, etc). Few overarching policy, planning, and applied interventions have focused on long-term mitigation activities within the patient-facing clinical examination room.

Most clinically oriented mitigation efforts and activities currently focus on waste reduction and recycling,[9–11] general supply chain decarbonisation and lifecycle assessments,[11–14] the promotion of planet-friendly diets,[15–17] and greater divestment from fossil fuels within health systems;[18–21] all urgently needed changes. There has also been an increase in the reframing of some existing patient-facing efforts, such as the Choosing Wisely initiative,[22] through an environmental stewardship lens (ie, a reduction in inefficient care reduces negative environmental impacts[23,24]). Isolated patient treatment strategies that have a high carbon footprint have also been gaining greater awareness among some physicians, including the use of metered dose inhalers[25,26] and anaesthetic gases (eg, desflurane).[27–29] Despite these initial dialogues on some prescribing practices, there has been little to no focus on day-to-day prescribing considerations for more wide-ranging implementation efforts informed by planetary health, outside of calls for broad transformational change.[23,30–36]

As further movements focus on considering how the clinical advice given to patients can reflect a planetary health perspective,[3,37] new opportunities exist to develop standards of practice that have co-benefits for both patients and the planet.[23] There is consequently the matter of how ongoing and sustainable medical care that considers both the patients' and planet's health can be delivered. With more evidenced-based literature developed in this regard, physicians might be better positioned to adopt clinical approaches that seek to provide benefit to both the patient and the planet. Patient–planetary health (P–PH) co-benefit prescribing is a framing that has been defined to denote all prescribing habits and clinical advice given to patients that explicitly consider both the patients' and the planet's health in the action of prescribing.[37] Yet, despite the framing of P–PH co-benefit prescribing denoting a behaviour engaged by physicians or other medical prescribers, there has been no amalgamated research on the potential application of behavioural theory on this topic.

Behavioural approaches could serve as a leverage point for considering the necessary implementation needs for a clinical practice informed by planetary health. Behavioural frameworks can help to identify and address key determinants of prescribing behaviour across health systems and consider how interventions might be needed at an individual, organisational, or systems level. One behavioural framework of potential interest for climate change mitigation efforts within prescribing practice is the Capability, Opportunity, Motivation, and Behaviour (COM-B) model.[38,39] The COM-B model is made up of

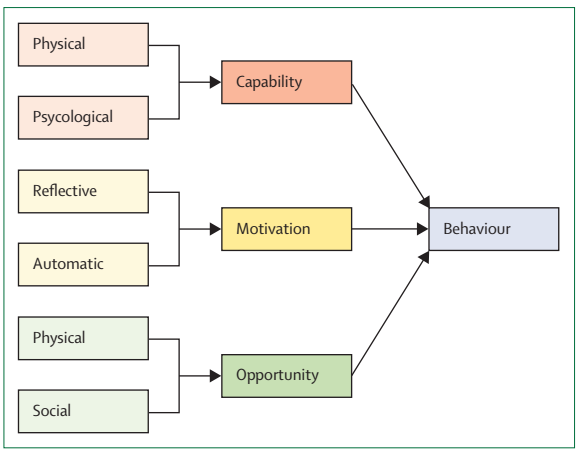

Figure 1: **The Capability, Motivation, Opportunity, and Behaviour model**
Adapted from Michie and colleagues.[38]

three overarching domains that are further subdivided into six key elements thought to influence behaviour (figure 1).[38,39] The COM-B model has been used in other health-care contexts to characterise elements of physician behaviour[40–42] and as a foundation for intervention development.[43]

See Online for appendix

The COM-B model can also be mapped to the detailed Theoretical Domains Framework (TDF) to create a more refined understanding of the behaviours to target in implementation efforts.[44] Together, both the COM-B model and the TDF provide an avenue for framing individual-level behavioural barriers and facilitators in a way that can be easily mapped to inform appropriate intervention design.[39,45]

Due to the current gaps in knowledge, there is a need to collate the existing literature on physicians' views of P–PH co-benefit prescribing and to analyse the findings with input from behavioural theory to better inform clinical practice. Therefore, in this systematic review we aimed to identify the barriers and facilitators to adopting P–PH co-benefit prescribing by physicians, and to map these barriers and facilitators onto the COM-B model and the TDF.

Methods

We used a systematic review methodology and preregistered the review protocol on PROSPERO (number CRD42022301824). In addition, we used the PRISMA 2020 checklist to ensure we followed best practice for reporting results of the review.[46] We used Covidence software for the full management of the systematic review.

For the **Covidence systematic review software** see https://www.covidence.org/

Eligibility criteria, information sources, and search strategy

We included all study designs (ie, qualitative, quantitative, and mixed methods) to ensure we captured all relevant literature. We included any studies related to P–PH co-benefit prescribing that investigated physicians' views on medical advice or prescribing practices that considered both the patients' and the planet's health. We used terminology specific to P–PH co-benefit prescribing; however, we included any studies that considered both the patients' and the planet's health explicitly, regardless of the overarching framing of the research. We excluded publications related to the sustainability of medical supplies outside of direct patient engagement, the Choosing Wisely initiative, educational efforts (eg, curriculum development), or dietary, reproductive, social, and exercise prescribing unless there was an explicit planetary health focus to the analysis (also articulated through a climate change and health lens). We excluded studies in languages other than English due to an absence of translational resources. We included only peer-reviewed papers. Although we did not purposefully exclude conference abstracts, none came through in our final list. Therefore, only full-length articles were included in our final list.

We developed the search strategy (appendix p 1) with advice and guidance from a medical information specialist. Searches were executed in PubMed, Web of Science, PsycINFO, Scopus, Prospero, and Google Scholar, with the latest search conducted on Oct 21, 2022. We manually searched key journals and reference lists of relevant key articles. Additionally, we contacted two expert planetary health researchers for additional knowledge of any key studies in the field of which they might have been aware.

Selection process, data extraction, and quality appraisal

We downloaded search results into the Covidence software and removed duplicate articles. Two reviewers (NR, KW) assessed the titles and abstracts of all articles using the stated inclusion criteria. Papers not meeting the criteria were excluded. Any discrepancies were resolved through discussion with at least one additional author (JH-B, ST-C). Full texts were then reviewed by one author (NR) for possible inclusion, with a second author (KW) reviewing 25% of the articles to ensure consistency. We again resolved any discrepancies through discussion with at least one additional author (JH-B, ST-C). Our reasons for exclusions were documented. One author (NR) performed all data extraction (year of publication, country of study, study aim and design, recruitment and sampling method, number of participants, setting and medical specialty, eligibility, method of analysis, measurement tools or instruments used, key conclusions, and funding source) with a cross-check of 10% of included articles completed by a second author to ensure consistency (KW).

We used the Mixed Methods Appraisal Tool[47] (2018 version) to assess the quality of the included studies. This tool is particularly responsive to the "appraisal stage of systematic mixed studies reviews".[47] Two authors performed the quality appraisal on the included articles as recommended by the Mixed Methods Appraisal Tool (NR, KW).

Data analysis

We carried out content analysis on the included articles using a data-based convergent synthesis design.[48] We chose this design due to its ability to be responsive to both qualitative and quantitative data with included studies being analysed with the same synthesis method.[48] Content analysis categories were then classified into the six subcomponents of the COM-B model and the TDF domains with a best-fit synthesis framework.[49] We used a computer-assisted qualitative data analysis package (NVivo 12) for both content analysis coding and the best-fit synthesis framework mapping.

Results

Our systematic search identified 8909 articles for screening. 12 articles met our inclusion criteria and were included for further analysis (figure 2). Most of the included studies were cross-sectional surveys (n=10) with a total combined sample of 10 590 people. Questionnaires had between 14 and 65 items, with some including both closed and open-ended questions. One qualitative study[50] and one mixed-methods study were included. However, for the latter, the mixed-method qualitative arm involved non-physician participants and therefore that portion of the study was not included in the analysis. One of the cross-sectional studies included disaggregated data for non-physicians, which was also not included in the analysis. Six of the studies were based in the USA, and of the 12 included studies, the earliest was published in 2014. Most of the studies were published since 2016 (10 of the 12 studies).

Authorship overlap was noted within some of the included studies, with a few authors being present on several of the included articles (including, in some cases, overlapping funding sources between studies). Five of the included studies had either physician specialists as the population of interest (eg, anaesthesiologists) or key organisational groups. Many of the studies focused on physician specialists used professional organisations to support recruitment efforts by email and used convenience sampling. Table 1 lists all study characteristics and the appendix (pp 2–9) contains the full data extraction sheets.

Our Mixed Methods Appraisal Tool assessments flagged issues with the majority of included studies (table 1; appendix p 10). As most included studies in the review were cross-sectional convenience samples (n=8), the risk of non-response bias and therefore selection bias for all is heightened. Non-response bias was also a potential issue for the cross-sectional random samples (n=3) based on the response rates. Most of the studies reported descriptive statistics; however, a few studies carried out inferential processes on convenience samples without a clear delineation of statistical assumptions, which made us question their validity.

Through content analysis, we identified nine overarching barriers and eight facilitators under the P–PH co-benefit prescribing framing by physicians (panel 1). The most noted barrier across all included articles was a scarcity of resources, with a particular focus on the perceived absence of knowledge and education on the topic (n=12); thus, all 12 included articles supported the need for more education and training of physicians through various mediums. The most cited facilitator across the article base was having policy statements or guidelines (or both) from relevant medical associations available on P–PH co-benefit prescribing parameters (n=10). Barrier 7 (panel 1) was represented within only one US-based study (panel 1). All other barriers and facilitators were represented in more than one country. The barriers and facilitators were cross-cutting across specialty and sample groups with no specific behavioural influences being exclusive to one sample population.

We then mapped the barriers and facilitators to the COM-B model and TDF and identified the most common behavioural influences within the literature base. The most common behavioural influences we identified in terms of TDF domains in the included articles were (panel 2): environmental context and resources (76 mentions); knowledge (57 mentions); beliefs about consequences (49 mentions); and social influences (44 mentions). The TDF domain labelled environmental context and resources included such barriers as an absence of time and financial resources and inability to bill for time, and facilitators included having patient education materials and resources available. A barrier in the TDF domain labelled beliefs about consequences included the concern for patient safety or the perceived absence of well accepted guidelines to make informed and

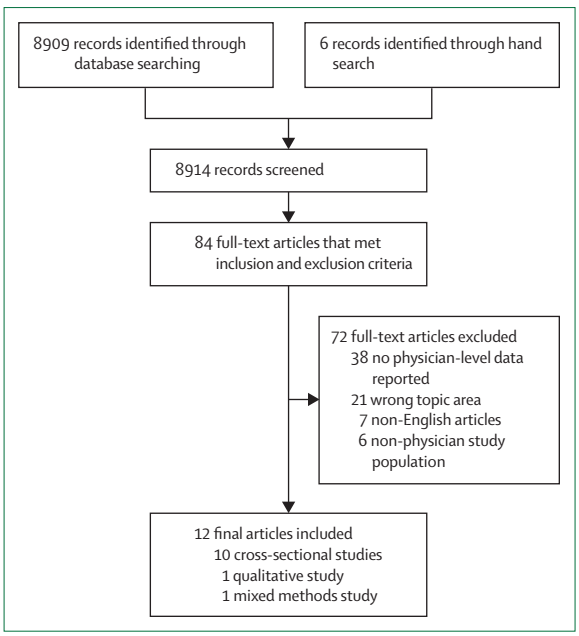

Figure 2: **Adapted PRISMA diagram**

For the **NVivo qualitative data analysis software** see https://lumivero.com/products/nvivo/

	Year	Region	Study design	n	Sampling	Medical specialty or organisational membership	Study aims	Global quality score*
André et al (2022)[51]	2022	Switzerland	Cross-sectional	497	Convenience	Family medicine	To determine the knowledge of general practitioners regarding the health impacts of climate change and of concepts such as planetary health and cobenefit interventions, as well as their willingness to address climate change with patients	3
Ard et al (2016)[52]	2016	USA	Cross-sectional	2189	Random	Anaesthesiologist members of the American Society of Anesthesiologists	To understand the current state of environmental practice, attitudes, and knowledge among anaesthesiologists in the USA	4
den Boer et al (2021)[50]	2021	USA	Qualitative	18	Purposive	Mixed	To determine patients' and physicians' perception of the impact of climate change on patient health in the family-medicine setting	4
Boland and Temte (2019)[53]	2019	USA	Cross-sectional	180	Convenience	Family medicine	To explore the viewpoints among US physicians who are concerned about the health effects of global environmental change	5
Kotcher et al (2021)[54]	2021	Jamaica, UK, Canada, India, Kuwait, New Zealand, Australia, South Africa, Chile, Colombia, Uruguay, and World Medical Association members (countries unknown)	Cross-sectional	3977	Convenience	Mixed	To assess physicians' views about climate change as a human health issue	4
Petre et al (2019)[55]	2019	Canada	Cross-sectional	426	Convenience	The Canadian Anesthesiologists Society	To document Canadian anaesthesiologists' current practice of, attitudes towards, and perceived barriers regarding recycling of operating room waste and environmental sustainability efforts	4
Sarfaty et al (2014)[56]	2014	USA	Cross-sectional	284	Convenience	National Medical Association	To assess physicians' experiences with climate change, particularly whether they were witnessing health effects in their own patients	4
Sarfaty et al (2015)[57]	2015	USA	Cross-sectional	915	Random	Physician members of the American Thoracic Society	To assess the attitudes on the existence and drivers of climate change, their observations of the health effects of climate change in practice, and their suggestions on what actions (if any) should be taken by members of the American Thoracic Society	4
Sarfaty et al (2016)[58]	2016	24% Asia, 25% Europe, 18% South America, 18% North America, 9% Australia or New Zealand, and 6% Africa	Cross-sectional	474	Convenience	International members of the American Thoracic Society	To assess perceptions, clinical experiences, and preferred policy responses related to global climate change of the international members of the American Thoracic Society	4
Sarfaty et al (2016)[59]	2016	USA	Cross-sectional	1184	Convenience	American Academy of Allergy Asthma and Immunology	To assesses the American Academy of Allergy Asthma and Immunology members' knowledge, attitudes, and experiences with climate change and health	3
Völker and Hunchangsith (2018)[60]	2018	Thailand	Mixed Methods	Survey: 184	Survey: convenience	Mixed	To investigate the association between different hypothesised determinants of physicians' engagement in addressing environmental health issues and physicians' likelihood to take their patients' history on environmental exposures and to counsel their patients on environmental health risks	3
Wang et al (2020)[61]	2020	China	Cross-sectional	262	Random	Mixed	To assess the attitudes of physicians prescribing medicines regarding eco-directed sustainable prescribing from the perspective of ecopharmacovigilance	4

*Critical appraisal with the Mixed Methods Appraisal Tool (version 2018) recommends the avoidance of overall global scores for quality appraisal of included articles unless required; we have therefore added the full Mixed Methods Appraisal Tool table with a log of each quality appraisal point to contextualise the study quality assessment in addition to providing the global score here (see appendix p 10 for the full table). A rating of 5 is the highest quality and 1 is the lowest quality.

Table 1: **Characteristics of included studies**

Panel 1: **Physician-specific barriers and facilitators identified in the included articles***

Barriers

(1) Absence or scarcity of resources, including:

- Absence of, or little, knowledge and education: André et al (2022);[51] Ard et al (2016);[52] Boland and Temte (2019);[53] den Boer et al (2021);[50] Kotcher et al (2021);[54] Petre et al (2019);[55] Sarfaty et al (2014); [56] Sarfaty et al (2015);[57] Sarfaty et al (2016);[58] Sarfaty et al (2016);[59] Völker and Hunchangsith (2018);[60] Wang et al (2020)[61]
- Absence of time: André et al (2022);[51] den Boer et al (2021);[50] Kotcher et al (2021);[54] Petre et al (2019);[55] Sarfaty et al (2014); [56] Sarfaty et al (2016);[58] Völker and Hunchangsith (2018)[60]
- Absence of financial resources: Petre et al (2019);[55] Völker and Hunchangsith (2018)[60]

(2) Absence of positive institutional culture and leadership
Ard et al (2016);[52] den Boer et al (2021);[50] Petre et al (2019);[55] Völker and Hunchangsith (2018)[60]

(3) Physicians are uncomfortable, unsure, or do not think it is their role to discuss or address topics related to planetary health in their practices
André et al (2022);[51] Boland and Temte (2019);[53] den Boer et al (2021);[50] Volker and Hunchangsith (2018);[60] Wang et al (2020)[61]

(4) Topic could be too controversial or risky to engage in with patients (eg, due to political differences)
Boland and Temte (2019);[53] den Boer et al (2021);[50] Kotcher et al (2021);[54] Sarfaty et al (2014)[56]

(5) Concerns over patient safety or an absence of well accepted guidelines to make informed and safe decisions
André et al (2022);[51] Petre et al (2019);[55] Wang et al (2020)[61]

(6) Absence of peer support and networks
Kotcher et al (2021);[54] Völker and Hunchangsith (2018)[60]

(7) Patient is seen as a priority in clinical encounter over environmental concerns
den Boer et al (2021)[50]

(8) Perceived patient disinterest
André et al (2022);[51] Sarfaty et al (2014)[56]

(9) Physicians are unable to bill for time
André et al (2022);[51] Sarfaty et al (2014)[56]

Facilitators

(1) Having policy statements and guidelines from associations
André et al (2022);[51] Boland and Temte (2019);[53] den Boer et al (2021);[50] Kotcher et al (2021);[54] Petre et al (2019);[55] Sarfaty et al, (2014)[56] Sarfaty et al (2015);[57] Sarfaty et al (2016);[58] Sarfaty et al (2016)[59]

(2) Belief that the environmental impact is important to consider with patients
André et al (2022);[51] Boland and Temte (2019);[53] den Boer et al (2021);[50] Petre et al (2019);[55] Sarfaty et al (2014);[56] Sarfaty et al (2015);[57] Sarfaty et al (2016);[59] Völker and Hunchangsith (2018);[60] Wang et al (2020)[61]

(3) Available patient education materials and resources
André et al (2022);[51] den Boer et al (2021);[50] Kotcher et al (2021);[54] Sarfaty et al (2014);[56] Sarfaty et al (2016)[58]

(4) Effective leadership, peer support, and collaborations
den Boer et al (2021);[50] Kotcher et al (2021);[54] Petre et al (2019);[55] Völker and Hunchangsith (2018)[60]

(5) Existing knowledge
André et al (2022);[51] Petre et al (2019);[55] Völker and Hunchangsith (2018)[60]

(6) Education and implementation approaches tailored to medical specialities
den Boer et al (2021);[50] Wang et al (2020)[61]

(7) Health system and hospital level environmental metrics, support, funding, and buy-in
Petre et al (2019)[55]

(8) The use of a personalised communication style and approach with patients
den Boer et al (2021)[50]

*Numbered barriers and facilitators are for mapping purposes only and do not denote any hierarchy of presence within the literature in the listed order; subcategories were numbered to allow them to be mapped to the Capability, Opportunity, Motivation, and Behaviour model and Theoretical Domains Framework.

safe decisions. Additionally, one barrier in the TDF domain labelled social influences was that the topic could be too controversial or risky to engage in with patients (eg, due to political differences).

In mapping the barriers and facilitators to the COM-B model and TDF, we were additionally able to identify gaps in the behavioural perspectives focused on by the current literature. The main element of motivation that was identified in the included articles was through the TDF domain labelled belief about consequences (panel 2); however, the COM-B element motivation had overall the least coverage throughout the body of literature. Specifically, reflective motivation (and its mapped TDF domains of goals, intentions, and optimism) and automatic motivation (and its mapped TDF domains of emotion and reinforcement) were not elucidated in the included articles. Behavioural influences that could potentially be of relevance but had no explicit representation in the available included articles are listed in panel 3. It must be noted that some elements of the COM-B and TDF were not relevant to this topic (eg, physical capability in the literal sense), so the scarcity of coverage of this element of the model is not presented as a gap in the literature.

All the included articles made at least some reference to the supported need for more education and training of physicians through various mediums (n=12). Potential mediums recommended included conference lectures;

***Panel 2*: The behavioural influences (mapped to the COM-B model and TDF*) identified in the articles, including example statements**

Capability

Knowledge: an awareness of the existence of something

- Absence of, or little, knowledge and education (Barrier 1a): "Respondents' lack of knowledge about how to approach the issue with their patients (71%)"[56]
- Existing knowledge (Facilitator 5): "Physicians' knowledge can be a key determinant of whether or not physicians give advice to their patients on how to reduce environmental health risks and increase exposure to beneficial environmental influences in their life"[60]

Skills: an ability or proficiency acquired through practice

- The use of a personalised communication style and approach with patients (Facilitator 8): "They were particularly keen to learn conversation skills specifically for discussing this topic so as to tailor the conversation to their patients' interests, values and needs and make the conversation relevant and actionable"[50]

Motivation

Beliefs about consequences: acceptance of the truth, reality, or validity about outcomes of a behaviour in a given situation

- Concerns over patient safety or absence of well accepted guidelines to make informed and safe decisions (Barrier 5): "No data system is currently available to guide medical prescribing decisions in the clinical setting for selection of drugs having a low probability of environmental risks and hazards"[61]
- Belief that the environmental impact is important to consider with patients (Facilitator 2): "Most respondents indicated that the environmental impact of anaesthesia is important and should inform clinical practice when choosing between products and processes that are otherwise equivalent in efficacy and patient outcomes"[55]

Social–professional role and identity: a coherent set of behaviours and displayed personal qualities of an individual in a social or work setting

- Patient seen as a priority in the clinical encounter over environmental concerns (Barrier 7): "It's always been about your health and illness needs and not about situating you as a human being in the larger health of the planet"[50]
- Physicians are uncomfortable, unsure, or do not think it is their role to discuss or address topics related to planetary health in their practices (Barrier 3): "Although >70% of family physicians in this study agree that climate change is relevant to patient care, two thirds do not think that physicians should take an active role in addressing this with patients"[53]

Opportunity

Environmental context and resources: any circumstances of a person's situation or environment that discourages or encourages the development of skills and abilities, independence, social competence, and adaptive behaviour

- Absence of financial resources (Barrier 1c): "In terms of the availability of resources needed to adequately address linkages between ecosystem health and human health, more than two-thirds of all physicians perceived a lack of [financial and material] resources"[60]

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formal curriculum during student training, residency, or fellowship training; online e-modules; workshops for existing staff; requirements for continuing medical education on the topic; and communication training. Several articles (n=8) supported the need for physicians to be advocates and educators of patients and the public (eg, a "majority of participants said they felt that health professionals have a responsibility to bring the health effects of climate change to the attention of the public [86% somewhat or strongly agreed] and policy makers [90% somewhat or strongly agreed]"[54]). Advocacy support was also noted to extend to professional associations and physician organisations throughout several articles (eg, "For advocacy, responders suggested a greater presence of local professional associations involved in the issues and working to influence policy, community advocacy, public service announcements, and use of social media").[56]

Discussion

Our systematic search resulted in 12 articles being included in this Review. We identified nine main barriers and eight facilitators within the context of P–PH co-benefit prescribing by physicians. The most noted barrier across all included articles was the perceived absence of knowledge (which might or might not represent actual knowledge) and education on the topic. Additionally, the most cited facilitator across the article base was having policy statements or guidelines (or both) from relevant medical associations available on P–PH co-benefit prescribing parameters. Our mapping of the identified barriers and facilitators to the COM-B model and TDF also identified key gaps in the behavioural perspectives focused on by the current literature. Gaps included little to no coverage of specific behavioural influences, including reflective and automatic motivation.

There has been some question within the literature on the usefulness of behavioural theories for implementation efforts such as those we have highlighted in this systematic review.[62] The Behaviour Change Wheel, in which the COM-B model is embedded, could provide a clear pathway for connecting individual sources of behaviour to wider policy implementation categories.[38] For example, the Behaviour Change Wheel has premapped behavioural influences on intervention

(Panel 2 continued from previous page)

- Scarcity of time (Barrier 1b): "An important barrier that was mentioned frequently was the short amount of time that physicians are allowed to spend per patient […] This discourages physicians to bring up issues beyond what is strictly required"[50]
- Physcians are unable to bill for time (Barrier 9): "Barriers included non-billability of time spent speaking with patients about it"[56]
- Available patient education materials and resources (Facilitator 3): "Patient education materials would be helpful"[54]
- Education and implementation approaches tailored to medical specialities (Facilitator 6): "Participants suggested developing tools and resources with information on the health effects of GEC [global environmental changes] together with both professionals and patients, and tailored for different specialties"[50]
- Having policy statements and guidelines from associations (Facilitator 1): "Health professional societies should develop, or update, their policy statement on climate and health, and should explicitly encourage climate and health advocacy"[54]
- Health system and hospital level environmental metrics, support, funding, and buy-in (Facilitator 7): "Gaining support from hospital and OR [operating room] leadership might be encouraged at levels above the hospital administration, as some respondents suggested, by including sustainability efforts in hospital accreditation processes"[55]

Social influences: those interpersonal processes that can cause individuals to change their thoughts, feelings, or behaviours

- Absence of peer support and networks (Barrier 6): "Only 15% of the medical doctors know colleagues, co-workers, other persons or institutions which address these links, most of which are other medical doctors, followed by members of the senior hospital management, nurses and others"[60]
- Absence of positive institutional culture and leadership (Barrier 2): "Only 12·6% reported that hospital leadership encouraged sustainability practices, and only 18·0% reported there was a sustainability or green task force in their institution"[52]
- Perceived patient disinterest (Barrier 8): "barriers included […] patient disinterest (27%)"[56]
- Topic may be too controversial or risky to engage in with patients—eg, due to political differences (Barrier 4): "some participants for example said they talk about environmental topics and do not use the word climate change explicitly to avoid friction with patients who do not believe in CC [climate change]"[50]
- Effective leadership, peer support, and collaborations (Faciltator 4): "physicians who discuss with their peers about environment-health linkages are more likely to address these linkages in their work with patients"[60]

COM-B=Capability, Opportunity, Motivation, and Behaviour. TDF=Theoretical Domains Framework. *Barrier subcategories were mapped to the COM-B model and TDF independently (facilitators did not have any subcategories); descriptions of the TDF are from Michie and colleagues;[39] barriers and facilitators were numbered according to listings in panel 1 for mapping purposes only.

functions, which then relate to policy categories to support greater system change. Given that several of the barriers and facilitators identified in our systematic review cross into the physical (eg, resources) and social (eg, institutional culture) opportunity category of the COM-B model and TDF, having guided pathways towards policy change levers could be helpful (table 2). More nuanced interventions aimed at prescribing behaviours could still be supported by implementation guides currently available.[44]

Despite a number of the included articles referring specifically to behaviour change or behavioural influences,[50,54,61] mostly in the context of their discussions, none of the articles noted any inclusion of or framing of their study design or questionnaire tools around or including behavioural theories or frameworks. It also became apparent throughout our review that the sole qualitative research study[50] was able to elucidate a greater range of barriers and facilitators than many of the cross-sectional studies (panel 1). There were a few cross-sectional studies that were also able to elucidate a large number of barriers and facilitators,[51,55,56] including one study[56] that included a few open-ended questions. Regardless, varied formats of investigation, including qualitative and mixed methods studies, are recommended to better contextualise the range of potential barriers and facilitators that can exist in a respective health system to better inform intervention development.

Qualitative and mixed-methods studies might also be able to elucidate a greater range of behavioural influences than quantitative studies alone, including the behavioural gaps identified here in the COM-B model and TDF (panel 3). Elucidating a great range of behavioural influences can also support further development of focused survey tools for use within the topic area. There have been several research studies published (both quantitative and qualitative) examining physician behaviour through the COM-B model in other fields that could be considered for potential further application within the patient–planetary health space.[40,63,64] Additionally, cross-analysis with other physician-specific studies into the behavioural determinants of prescribing could be helpful within the patient–planetary health space.[65] For example, despite long-standing guidelines surrounding the overprescription of antibiotics, there is still a state of overprescribing of antibiotics.[66,67] Leveraging lessons learned from other fields could create efficiencies for moving towards intervention scale-up within the planetary health clinical space.

Panel 3: **COM-B model and TDF behavioural influences not represented in the included articles**

Capability—psychological

Behavioural regulation

Anything aimed at managing or changing objectively observed or measured actions

Memory, attention, and decision processes

Anything aimed at managing or changing objectively observed or measured actions

Motivation—automatic

Emotion

A complex reaction pattern involving experiential, behavioural, and physiological elements, through which the individual attempts to deal with a personally important matter or event

Reinforcement

Increasing the probability of a response by arranging a dependent relationship, or contingency, between the response and a given stimulus.

Motivation—reflective

Beliefs about capabilities

Acceptance of the truth, reality, or validity about an ability, talent, or facility that a person can put to constructive use

Goals

Mental representations of outcomes or end states that an individual wants to achieve

Intentions

A conscious decision to perform a behaviour or a resolve to act in a certain way

Optimism

The confidence that things will happen for the best or that desired goals will be attained

COM-B=Capability, Opportunity, Motivation, and Behaviour. TDF=Theoretical Domains Framework. Descriptions from Michie and colleagues.[39]

Although the results of our systematic review highlighted some common barriers and facilitators identified in other types of prescribing-related behavioural literature (eg, time and knowledge), there were also potentially unique factors that were more specific to P–PH co-benefit prescribing (eg, that the topic might be too controversial or risky to discuss with patients). Therefore, the unique geopolitical landscape of countries surrounding the discourse on climate change might play a part in the perceived barriers of physicians within the clinical exam room. For example, in a Ipsos broad scope opinion study published in 2020, the USA was the most climate-skeptic country in the world with 52% of Americans not believing in climate change caused by human activity.[68] The USA was closely followed by Saudi Arabia (51%), Norway (50%), and Australia (43%).[68] By contrast, the EU shows "relatively homogeneous scores, with Italy and Spain being the most convinced of the human origin of climate change" with 75% people believing this.[68] The political orientation of physicians could also be relevant. Physician respondents with a right-wing political orientation tended to address climate change less with their patients and were more likely to believe that addressing climate change was not their role, as reported in the study by André and colleagues[51] in Switzerland.

Despite differing views on the causes of climate change in general polls, there is little research examining how patients might perceive or respond to clinical care delivery that brings in planetary health-oriented care elements within varied contexts.[53] In a study by Boland and Temte[53] that reported auxiliary patient data, only 10% of patients reported speaking to their physician about an environmental issue and its health effects. Without further inquiry into patient perceptions towards planetary health-oriented care, concerns for patient response to this approach might be minimised or exaggerated by physicians and other health-care providers. As nurses and physicians have been consistently rated the most trusted members of society,[69] they could play a substantial role in helping to educate patients on climate-related and health-related impacts as it relates to their local context. By physicians having a better appreciation of patient perceptions in this topic area, coupled with access to tools on shared decision making expanded from existing efforts (see Metting and colleagues[70]), a shared-decision-making communication skillset,[71] and planetary health-informed knowledge base,[36,72] a climate-forward reflective positioning (panel 3) within physician populations could be more easily enabled.

Due to the differences in health-system structures that exist around the world, some barriers and facilitators might be more relevant in specific health systems. For example, being unable to bill for time was an identified barrier that came from health systems in which physician billing parameters are a consideration.[51,56] Although not all health systems have physicians formally billing under International Classification of Diseases codes, physicians who do not might still not be able to log appropriate planetary health related codes into already-structured electronic medical record systems as relevant codes might not exist. Further work should then consider how and in what way International Classification of Diseases codes, private insurance billing, and electronic medical record systems can influence planetary health-informed clinical work in varying contexts. Additionally, more research and educational work is needed to better clarify existing ways for physicians to ensure organisational responsibilities and patient quality-care metrics are met while carrying out planetary health-informed clinical work.

The Mixed Methods Appraisal Tool assessment identified specific quality parameters, including a high risk of non-response bias across the included articles. Efforts should be made in future study designs to reduce

	COM-B model	Clinical intervention targets	Potential policy levers
Absence of, or little, knowledge and education	Capability—psychological	Training	Guidelines, fiscal, regulation, legislation, service provision
Concerns over patient safety or absence of well accepted guidelines to make informed and safe decisions	Motivation—reflective	Education	Communication or marketing, guidelines, regulation, legislation, service provision
Unable to bill for time	Opportunity—physical	Environmental restructuring	Guidelines, fiscal, regulation, legislation, environmental and social planning
Absence of peer support and networks	Opportunity—social	Enablement	Guidelines, fiscal, regulation, legislation, environmental and social planning, service provision

See table 2 and table 3 in Michie and colleagues[38] for more details. COM-B=Capability, Opportunity, Motivation, and Behaviour.

Table 2: **Some example linkages between the identified barriers in this paper to the COM-B model, a COM-B mapped intervention target, and example COM-B mapped policy levers**

non-response and selection bias to better ensure that subsequent intervention design is informed by the most accurate data. Although all health professional perspectives are needed on the P–PH co-benefit prescribing topic, we chose to focus on the physician population specifically for this systematic review as they are often the main overarching prescribers within high-carbon health systems. Future investigations, however, should expand out to other health professional groups, patients, and other stakeholders in the health-care system (including leadership), while also being mindful of the potential for cross-pollinating initiatives across often siloed areas of care delivery. Additionally, due to a high proportion of studies being based solely in high-income countries, a greater scope of research within low-income and middle-income countries is needed to ensure implementation guidelines are context specific. Further consideration and exploration into the reduction of inefficient care through a planetary health research and practice lens is also warranted.

Limitations

P–PH co-benefit prescribing is an umbrella framing that covers many potential prescribing and clinical practices that considers both the patients' and planet's health. As there is no set list of prescribing terms within the P–PH co-benefit prescribing space available, it is possible that we missed a prescribing term that is new, was not in English, or is not well represented in the current literature. Therefore, this systematic review might not be inclusive of all relevant studies. Despite this, we made strong efforts to prescan the literature and speak to experts in the field to ensure as many relevant terms were included within the search strategy.

We sought to gain a clearer perspective on the type and spread of available literature regarding physicians' perspectives on prescribing habits and the clinical advice given in the P–PH co-benefit prescribing context. However, some of the barriers and facilitators that were identified in the review that had lower presence across the included articles could have been affected by the types of questions that were asked in the original study. Given this, although the barriers and facilitators in panel 1 are listed in hierarchal order of presence within the content analysis, this might be due only to the number of times a specific type of question was asked across the survey tools. Therefore, judgements should not be made based on the frequency that a specified barrier or facilitator was identified. Due to this, we reported all results in this systematic review, even if their mention was only across a few papers, to get a better picture of the spread of factors that have been identified in the literature as barriers and facilitators across varied contexts.

Conclusion

This systematic review identified key behavioural influences under the P–PH co-benefit prescribing framing that were similar across countries and clinical specialties. Behavioural influences related to knowledge, environmental context and resources, and social influences were commonly identified in the included articles. These influences should be targets for future clinical interventions such as education and training, environmental restructuring, and enablement. We additionally found gaps where studies did not report other potential behavioural influences; the use of behavioural frameworks could serve to improve future study and survey tool design. We recommend the continued development and use of more diverse study designs with health professionals, patients, and stakeholders in the health-care system to ensure a more holistic understanding of the individual, system, and policy levers involved in implementing planetary health-informed clinical work and guidelines.

Contributors

NR, JH-B, and ST-C conceptualised this study and designed the methodology; NR and KW did the data curation; NR wrote the original draft; and all authors reviewed and edited subsequent drafts.

Declaration of interests

We declare no competing interests.

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