




Achieving consensus on the essential knowledge and skills needed by nursing students to promote planetary health and sustainable healthcare: A Delphi study

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Abstract

Aim: To achieve consensus on the knowledge and skills that undergraduate/pre-licensure nursing students require to steward healthcare towards a more sustainable future.

Design: A two-phase real-time Delphi study.

Methods: Phase 1 included the generation of Planetary Health, climate change and sustainability knowledge and skill statements based on a review of relevant literature. Phase 2 consisted of a real-time Delphi survey designed to seek consensus on the proposed statements from a panel of 42 international experts.

Results: Of the 49 survey statements, 44 (90%) achieved $\geq 75\%$ consensus and 26 (53%) achieved $\geq 80\%$ consensus. Three were removed and 32 were modified to improve clarity of language.

Conclusion: The knowledge and skills statements that emerged through this Delphi study can serve as a guide for incorporating Planetary Health, climate change and sustainability into nursing education programs.

Implications for the Profession: Incorporating Planetary Health and climate change education into nursing programs has the potential to produce more environmentally conscious and socially responsible nurses.

Impact: The absence of consensus on the essential knowledge and skills expected of nursing students has hindered the advancement of curricula and impacted educators' confidence in teaching Planetary Health and climate change. This study has resulted in a meticulously crafted framework of knowledge and skill statements that will be beneficial to educators, the future nursing workforce, and, ultimately, the individuals and communities whom nurses serve.

Reporting Method: This paper adheres to the Conducting and REporting DELphi Studies (CREDES) reporting guideline.

Patient or Public Contribution: No patient or public contribution.

KEYWORDS

adaptation, climate change, education, knowledge, mitigation, nursing students, planetary health, real-time Delphi, skills, sustainability

1 | INTRODUCTION

Planetary Health is defined as a 'solutions-oriented, transdisciplinary field and social movement focused on analyzing and addressing the impacts of human disruptions to Earth's natural systems on human health and all life on Earth' (Planetary Health Alliance, 2023). Planetary Health emphasizes the need for sustainable practices and policies that protect the health of current and future generations and that address the three key planetary crises of a changing climate, biodiversity loss and pollution in all of its forms (United Nations, 2023a). Climate change is a significant disruptor of Planetary Health and is described as the most pressing issue facing humanity today (United Nations, 2023a). Escalating global temperatures have resulted in biodiversity loss, shifting disease patterns, food and water scarcity and extreme weather events, impacting both ecosystems and human health (Intergovernmental Panel on Climate Change [IPCC], 2022).

Current and future healthcare professionals must be able to respond effectively to increasing climate change impacts. Nurses are at the forefront of this call to action because they represent the most trusted profession globally and form the largest group of healthcare professionals (Lokmic-Tomkins, Nayna Schwerdtle, & Armstrong, 2023). They also have significant community outreach, especially to marginalised communities who are often disproportionately affected by climate change events and disasters (Atwoli et al., 2021; Thorne, 2021). Integral to nurses' scope of practice are climate change mitigation and adaptation strategies, inclusive of sustainable practices. Behavioural change in these areas could lead to a reduction in pollution and greenhouse gas emissions from healthcare services and a lessening of the threat of surpassing 1.5 degrees Celsius global warming. In turn, this would indirectly impact biodiversity loss.

To enhance the capacity of the nursing profession to respond to climate change effectively, there is an urgent need to integrate Planetary Health into undergraduate curricula. This includes a focus on reducing the health sector's environmental and ecological footprints, practicing sustainably to mitigate greenhouse gas (GHG) emissions and adapting healthcare systems to respond to climate uncertain futures (Best et al., 2023). The Delphi study profiled in this paper was conducted to help address this imperative by seeking expert consensus on the knowledge and skills that would enable undergraduate nursing students to steward healthcare towards a more sustainable future.

2 | BACKGROUND

The planet has undergone significant environmental changes throughout its history. The last 10,000 years, referred to as the

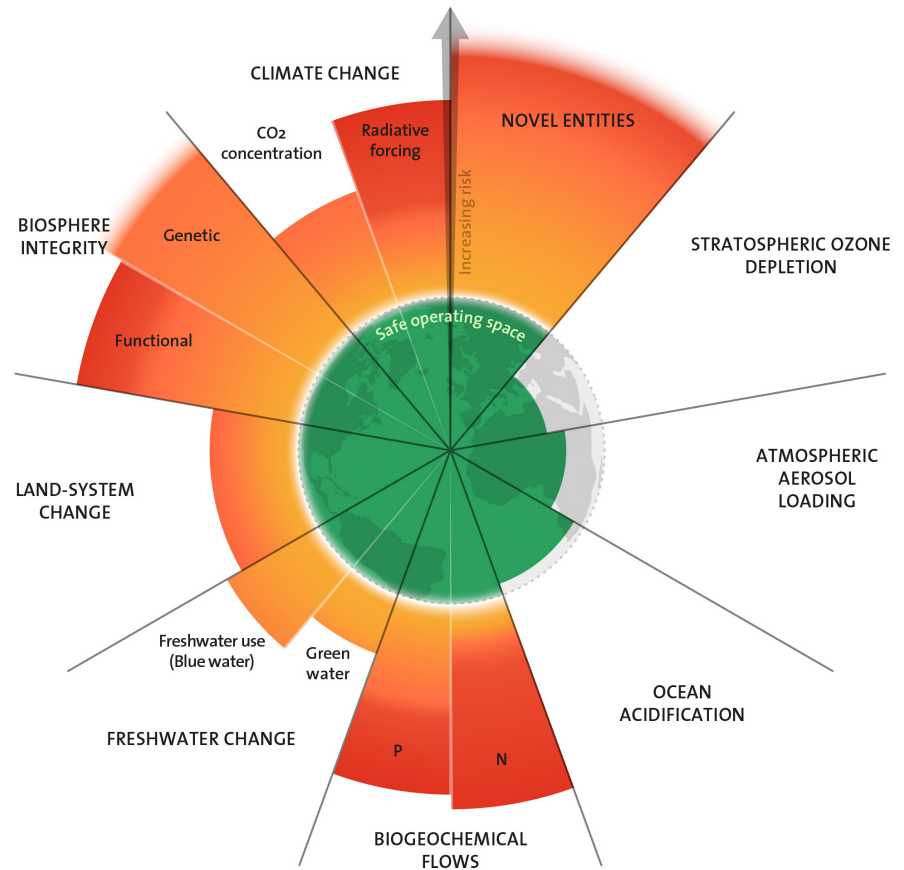
Holocene (Rockström et al., 2009), has been a notably stable period. However, since the onset of the Industrial Revolution and the substantial release of GHGs into the Earth's atmosphere, a new era has emerged. This era, known as the Anthropocene, is characterized by human actions becoming a primary driver of environmental and ecological change, particularly through increasing GHG emissions (Richards et al., 2023). The Anthropocene has brought about significant and detrimental consequences for Planetary Health (Planetary Health Alliance, 2023).

In 2009, Rockström et al. introduced the concept of the planetary boundaries within which humanity and ecosystems can thrive. These boundaries refer to nine interdependent processes that regulate the Earth's stability and resilience; they include climate change, biodiversity loss, land system change, freshwater use, nitrogen and phosphorus cycles, ocean acidification, stratospheric ozone depletion, atmospheric aerosol loading and chemical pollution. In 2023, it was announced that humanity has now transgressed six of these nine boundaries (see Figure 1) (Richardson et al., 2023). Crossing these boundaries elevates the risk of large-scale abrupt and irreversible environmental changes that will impact both ecosystems and human populations.

Climate change is defined as 'a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods' (United Nations, 2023b). Human activities, such as the extensive use of fossil fuels, deforestation and animal agriculture, have primarily driven climate change, as well as pollution and biodiversity loss (IPCC, 2022). The increased emissions of GHGs resulting from these activities have led to a rise in the Earth's global temperature, causing significant and, in some cases, irreversible impacts on the atmosphere, freshwater systems, oceans, frozen regions and ecosystems (IPCC, 2022).

The IPCC (2022) report describes profound effects on human health from climate change including rising temperatures that escalate the frequency of heatwaves and lead to heat-related illnesses; altered precipitation patterns that disrupt water supplies and increase the risk of waterborne diseases; changes in vector habitats that extend the range of diseases like malaria and dengue fever; air quality deterioration with more frequent wildfires and dust storms exacerbating respiratory problems; and food security being compromised by altered crop yields, malnutrition, and foodborne diseases. There are also direct impacts from extreme weather events, like hurricanes, wildfires and flooding, resulting in injuries, dislocation, and mental health conditions. Marginalized populations face disproportionate impacts, making climate change a global public health challenge that demands immediate mitigation and adaptation strategies (IPCC, 2022). These current and future impacts have led the World Health Organization (WHO) (World Health Organization, 2023) to

FIGURE 1 The 2023 update to the Planetary boundaries. Azote for Stockholm Resilience Centre, based on analysis in Richardson et al 2023. Attribution: CC BY-NC-ND 3.0. The green zone represents the safe operating space; yellow to red represents the zone of increasing risk.



call for urgent action to address three key objectives: (1) promoting actions that both reduce carbon emissions and improve health, (2) building more climate-resilient and environmentally sustainable healthcare systems and (3) protecting health from the wide range of impacts of climate change. One appropriate response to this call for action is improved education for healthcare providers. Indeed, the International Council of Nurses (2018) advocates that in order to enhance the capacity of the nursing profession to deliver climate-related interventions, the concepts of planetary health, climate change and sustainability must be imbedded into nursing curricula. However, Integrating Planetary Health, inclusive of climate change mitigation and adaptation, along with sustainable practices, into nursing programs, is often considered to be challenging due to existing curriculum constraints.

The nursing profession has traditionally underestimated the significance of environmental issues, only recently starting to recognize the links between health, social justice and the natural world (Lokmic-Tomkins, Strus, et al., 2023). Nonetheless, as climate change poses a severe threat to Planetary Health and the health of individuals and communities, it is essential to equip future nurses with the knowledge and skills needed to address its impacts and to practice in a sustainable manner.

An interdisciplinary framework to guide planetary health education developed by Guzmán et al. (2021) proposes five foundational domains—interconnection with nature, the Anthropocene and health, systems thinking and complexity, equity and justice and

movement building and systems change. However, this framework does not identify the specific knowledge and skills needed by individual disciplines. While nurses are integral to the provision of interdisciplinary care, their scope of practice is carefully defined by accrediting bodies. Thus, Potter (2019) applied the 12 guiding principles of planetary health education proposed by Harvard University's Planetary Health Alliance (Stone et al., 2018) to develop a planetary health education framework for nurses (Potter, 2019). This work was mapped to The American Association of Colleges of Nursing (AACN) The Essentials: Core Competencies for Professional Nursing Education (2021). Again, while this important framework is informative, it does not specify the knowledge or skills needed by nursing graduates that educators could use to plan educational programs. There is therefore a need for clear recommendations regarding the knowledge and skills required by nurses that are both adaptable to local scopes of practice but also reflective of global challenges (López-Medina et al., 2019).

3 | THE STUDY

3.1 | Aim

The aim of this study was to achieve consensus on the knowledge and skills that undergraduate nursing students require to steward healthcare towards a more sustainable future.

3.2 | Design

To address the research aim, a study informed by a recognized Delphi technique (Gnatzy et al., 2011) and aligned with Junger et al.'s Guidance on Conducting and Reporting Delphi Studies (CREDES) (2017) was implemented. Phase 1 of this study included the generation of Planetary Health, climate change and sustainability domains, knowledge and skill statements. Phase 2 consisted of a real-time Delphi survey that sought consensus from a group of international experts on the proposed statements.

In this paper, the term 'Delphi technique' refers to the method, 'Delphi study' describes the research project in which the Delphi technique was employed as the method and the 'Delphi process' includes the approach used to establish consensus of opinion during the study.

The Delphi technique was selected for this study as it provides a flexible, iterative, group facilitation method that systematically elicits expert input and allows for asynchronous participation and anonymity of participants (Linstone & Turoff, 2011). The Delphi technique is particularly useful for exploring differing views as it correlates informed judgements and transforms individual opinions about a given issue into group consensus (Rowe & Wright, 2011).

3.3 | Methods

3.3.1 | Phase 1

Initial domains, knowledge and skill statements were generated following a review of relevant literature, websites, policies and position statements. While informed by Potter's planetary health education framework for nurses (2019), the domains provided a greater focus on climate change adaptation and mitigation, including sustainable practices, that are linked to nurses' scope of practice and actionable in any healthcare setting, as this was identified as an immediate need. Thus, the three overarching domains identified from the review as essential to undergraduate nursing curricula were (1) The science of Planetary Health and climate change, (2) Mitigation of the adverse impacts of healthcare on the environment and (3) Adaptation to the actual and expected impacts of climate change on healthcare and health outcomes. See Table 1 for the definitions of terms used in the survey and in this paper.

For students to comprehend the meaning of Planetary Health and why climate change disrupts planetary and human health, a foundational understanding of climate systems, historical patterns and future scenarios is necessary (Shaman & Knowlton, 2018). This understanding is pivotal for several reasons: it illuminates the causes of climate change, including GHGs and human activities; provides an understanding of potential climate change impacts and disasters, such as rising sea levels and extreme weather events; informs policies related to sustainable healthcare and creates the

shared language or literacy needed to take action, educate the public and advocate for climate action (Climate.Gov, 2023; United Nations, 2023c).

Climate action, especially for nurses, encompasses two main strategies: mitigation and adaptation (Healthcare Without Harm, 2023). Mitigation targets GHG reductions to curb the severity of climate change by addressing its root causes so as to reduce the health sector's environmental and ecological footprint. This is crucial to prevent irreversible and catastrophic consequences and requires global collaboration and locally implemented healthcare initiatives. Adaptation aims to minimize the adverse effects of climate change on human health and the environment, with a particular focus on safeguarding priority populations and marginalized communities. Adaptation strategies also aim to build individual and community resilience against climate change challenges (IPCC, 2022).

The domains, draft statements and survey structure were reviewed and critiqued by the members of research team, which included academics ($n=14$) with expertise in climate science, Planetary Health, sustainability, educational design, nursing education and survey development. In addition to demographic questions and the 49 statements structured within the three overarching domains, there was one open-ended question that asked participants whether they had any further comments to add.

Before making the Delphi survey available to the expert panel, the research team pilot tested the survey portal's accessibility, usability, data collection and analysis methods as well as clarity of instructions. No modifications were deemed necessary.

3.3.2 | Phase 2

While traditional and modified Delphi methods seek feedback from panel members using a series of structured rounds (Hasson et al., 2000), a real-time Delphi survey uses purposively designed software to conduct a 'round-less' survey which facilitates free flow of information between panel members over a defined period of time (Gnatzy et al., 2011). The real-time presentation of results enables panel members to continually review the responses of others and reassess and amend their own responses in order to generate consensus (Varndell et al., 2021). This increases the efficiency of the process, accommodates expert availability and reduces drop-out rates (Gnatzy et al., 2011).

For the purpose of this study, the Surveylet (Calibrium Inc., 2020) software program was used. While there are other commercially available real-time Delphi software programs, Surveylet was selected because of its flexibility, range of question formats, data management and analytics options and user support features (Varndell et al., 2021).

The real-time Delphi survey was conducted using the following steps: recruitment of expert panel members, survey implementation, data analysis and reporting.

TABLE 1 Definition of terms.

Term	Definition	Source
Adaptation	'In human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate and its effects'.	https://apps.ipcc.ch/glossary/
Adaptation strategies	An adaptation strategy is a program, project or approach that has been developed to respond to anticipated climate change impacts in a specific area of potential concern.	https://eri.iu.edu/erit/strategies/index.html#:~:text=Strategies%20for%20Climate%20Change%20Adaptation,specific%20area%20of%20potential%20concern
Anthropocene	'A proposed new geological epoch resulting from significant human-driven changes to the structure and functioning of the Earth system, including the climate system'.	https://apps.ipcc.ch/glossary/
Antimicrobial stewardship	An ongoing effort by a health service organizations to optimize antimicrobial use among patients to improve patient outcomes, ensure cost-effective therapy and reduce adverse sequelae of antimicrobial use (including antimicrobial resistance).	https://www.safetyandquality.gov.au/standards/nsqhs-standards/preventing-and-controlling-infections-standard/antimicrobial-stewardship
Autonomy	The right of an organization, country or region to be independent and govern itself.	https://dictionary.cambridge.org/dictionary/english/autonomy
Beneficence	An ethical principle requiring healthcare professionals to engage in behaviours that benefit patients and others.	Cheraghi, R. et al (2023). Clarification of ethical principle of the beneficence in nursing care: an integrative review. BMC Nursing. 22(1):89. doi: 10.1186/s12912-023-01246-4
Change agent	A person that encourages people to change their behaviour or opinions.	https://dictionary.cambridge.org/dictionary/english/change-agent
Climate anxiety	'Distress about climate change and its impacts on the landscape and human existence'.	https://sustainability.yale.edu/explainers/yale-experts-explain-climate-anxiety
Climate change	'A change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods'.	https://unfccc.int/resource/ccsites/zimbabwe/conven/text/art01.htm
Climate-related disasters	Extreme climate-related natural disasters including: (i) hydro-meteorological events (storms, floods, wet mass movements) and (ii) climatological events (extreme temperature, drought, wildfire).	https://indicators.report/indicators/i-6/
Carbon footprint	Measure of the total amount of emissions of carbon dioxide (CO ₂) directly and indirectly caused by an activity over the lifecycle stages of a product.	https://apps.ipcc.ch/glossary/
Climate justice	'Justice that links development and human rights to achieve a human-centred approach to addressing climate change, safeguarding the rights of the most vulnerable people and sharing the burdens and benefits of climate change and its impacts equitably and fairly'.	https://apps.ipcc.ch/glossary/
Carbon neutral	'Condition in which anthropogenic carbon dioxide (CO ₂) emissions associated with a subject are balanced by anthropogenic CO ₂ removals'.	https://apps.ipcc.ch/glossary/
Climate resilience	'Capacity of social, economic and ecosystems to cope with a hazardous event or trend or disturbance'.	Pörtner, H. et al. IPCC, 2022: Summary for Policymakers. doi: 10.1017/9781009325844.001
Disaster	'A serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability and capacity, leading to one or more of the following: human, material, economic, and environmental losses and impacts'.	https://www.preventionweb.net/understanding-disaster-risk/terminology#N

(Continues)

TABLE 1 (Continued)

Term	Definition	Source
Disaster impact	'The total effect, including negative effects (eg, economic losses) and positive effects (e.g., economic gains), of a hazardous event or a disaster. The term includes economic, human, and environmental impacts, and may include death, injuries, disease, and other negative effects on human physical, mental, and social well-being'.	https://www.preventionweb.net/understanding-disaster-risk/terminology#N
Disaster risk	'The potential loss of life, injury, or destroyed or damaged assets which could occur to a system, society, or a community in a specific period of time, determined probabilistically as a function of hazard, exposure, vulnerability, and capacity'.	https://www.preventionweb.net/understanding-disaster-risk/terminology#N
Ecological determinants of health	Interdependent relationships between physical, biological and psychosocial and environment factors that impact human health.	Li, A. Ecological determinants of health: food and environment on human health. <i>Environ Sci Pollut Res Int.</i> 2017 Apr;24(10):9002-9015. doi: 10.1007/s11356-015-5707-9
Environmental determinants of health	'Global, regional, national, and local environmental factors that influence human health, including physical, chemical, and biological factors external to a person, and all related behaviours'.	https://www.paho.org/en/topics/environmental-determinants-health
Environmental sustainability	'The responsibility to conserve natural resources and protect global ecosystems to support health & wellbeing'.	https://spha.com/glossary/what-is-environmental-sustainability/
Environmentally sustainable healthcare	'A health system that improves, maintains or restores health, while minimizing negative impacts on the environment and leveraging opportunities to restore and improve it, to the benefit of the health and well-being of current and future generations'.	https://www.who.int/europe/publications/i/item/WHO-EURO-2017-2241-41996-57723
Fossil fuels	Carbon-based fuels from fossil hydrocarbon deposits, including coal, oil and natural gas.	https://apps.ipcc.ch/glossary/
Global warming	'An increase in global surface temperature relative to a baseline reference period, averaging over a period sufficient to remove interannual variations (e.g., 20 or 30 years)'.	https://apps.ipcc.ch/glossary/
Hazard	'A process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption, or environmental degradation.'	https://www.preventionweb.net/understanding-disaster-risk/terminology#N
Hazardous event	'The manifestation of a hazard in a particular place during a particular period of time'.	https://www.preventionweb.net/understanding-disaster-risk/terminology#N
Health co-benefits	'Implementation of climate policies that lead to both cost savings and improvement in health.'	https://www.who.int/teams/environment-climate-change-and-health/climate-change-and-health/capacity-building/toolkit-on-climate-change-and-health/cobenefits
Indigenous Peoples	'Indigenous Peoples are distinct social and cultural groups that share collective ancestral ties to the lands and natural resources where they live, occupy or from which they have been displaced. The land and natural resources on which they depend are inextricably linked to their identities, cultures, livelihoods, as well as their physical and spiritual wellbeing'.	World Bank. (n.d.). Indigenous peoples. https://www.worldbank.org/en/topic/indigenouspeoples
Mitigation (of climate change)	A human intervention to reduce emissions or enhance the sinks of greenhouse gases.	https://apps.ipcc.ch/glossary/
Net Zero or net Zero CO ₂ emissions	Condition in which anthropogenic carbon dioxide (CO ₂) emissions are balanced by anthropogenic CO ₂ removals over a specified period.	https://apps.ipcc.ch/glossary/
Net zero greenhouse gas emissions	Condition in which metric-weighted anthropogenic greenhouse gas (GHG) emissions are balanced by metric-weighted anthropogenic GHG removals over a specified period.	https://apps.ipcc.ch/glossary/
Net Zero targets	Commitment to 'cutting greenhouse gas emissions to as close to zero as possible, with any remaining emissions re-absorbed from the atmosphere, by oceans and forests for instance.'	https://www.un.org/en/climatechange/net-zero-coalition

TABLE 1 (Continued)

Term	Definition	Source
Planetary boundaries	Nine interdependent processes that regulate the Earth's stability and resilience; they include climate change, biodiversity loss, land system change, freshwater use, nitrogen and phosphorus cycles, ocean acidification, stratospheric ozone depletion, atmospheric aerosol loading and chemical pollution.	Rockström, J. et al (2009). A safe operating space for humanity. <i>Nature</i> . 461, 472–475. https://doi.org/10.1038/461472a
Planetary Health	Planetary Health is a solutions-oriented, transdisciplinary field and social movement focused on analysing and addressing the impacts of human disruptions to Earth's natural systems on human health and all life on Earth.	https://www.planetaryhealthalliance.org/planetary-health
Planetary Health literacy	Comprised of several parts including concepts of systemic, community and society-orientated literacy approaches such as ecological literacy, ecoliteracy and transformative literacy as well as models of health literacy.	https://www.frontiersin.org/articles/10.3389/fpubh.2022.980779/full
Preparedness	'Preparedness is based on a sound analysis of disaster risks and good linkages with early warning systems, and includes such activities as contingency planning, stockpiling of equipment and supplies, the development of arrangements for coordination, evacuation and public information, and associated training and field exercises'.	https://www.preventionweb.net/under-standing-disaster-risk/terminology#N
Resilience	'The ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management'.	https://www.preventionweb.net/under-standing-disaster-risk/terminology#N
Risk	'The combination of the probability of an event and its negative consequences'.	https://www.preventionweb.net/under-standing-disaster-risk/terminology#N
Risk communication	A process of sharing information and advice about climate-related risks between various knowledge holders and decision-makers, including researchers, technicians, assessors, managers, practitioners, members of the public, authorities, media, interest groups, etc.	https://www.weadapt.org/knowledge-base/governance-institutions-and-policy/risk-communication-in-the-context-of-climate-change#:~:text=Thereby%2C%20in%20the%20context%20of,managers%2C%20practitioners%2C%20members%20of%20the
Social determinants of health	'The social determinants of health (SDH) are the non-medical factors that influence health outcomes. They are the conditions in which people are born, grow, work, live, and age, and the wider set of forces and systems shaping the conditions of daily life.'	https://www.who.int/health-topics/social-determinants-of-health#tab=tab_1:~:text=The%20social%20determinants%20of%20health,the%20conditions%20of%20daily%20life
Sustainable development	Development that meets the needs of the present without compromising the ability of future generations to meet their own needs and that balances social, economic and environmental concerns.	https://apps.ipcc.ch/glossary/
United Nations Sustainable Development Goals	The 17 global goals for development for all countries were established by the UN through a participatory process and elaborated in the 2030 Agenda for Sustainable Development, including ending poverty and hunger; ensuring health and well-being, education, gender equality, clean water and energy and decent work; building and ensuring resilient and sustainable infrastructure, cities and consumption; reducing inequalities; protecting land and water ecosystems; promoting peace, justice and partnerships and taking urgent action on climate change.	https://apps.ipcc.ch/glossary/
Waste segregation	The sorting and separation of waste types to facilitate recycling and correct onward disposal.	https://greensutra.in/waste-segregation-all-you-need-to-know/
Weather extremes	Unusual weather events that are at the extremes of the historical distribution for a given area.	Möller, V. et al. IPCC, 2022: Summary for Policymakers. Annex II: Glossary. doi:10.1017/9781009325844.029

3.3.3 | Recruitment of expert panel members

Selection of appropriate panel members for a Delphi study is crucial and, as Sablatzky (2022) notes, while not needing to be a representative sample, expert panel members must be interested, informed and knowledgeable about the topic area, as their strengths, weaknesses and biases can impact the research outcomes. Although there is no set sample size for a Delphi panel, it is generally agreed that a minimum of 10–18 panel members increases the reliability of group judgements (Stone Fish & Busby, 2005). For this study, we aimed to recruit a minimum of 30 national and international experts on Planetary Health, climate change and sustainability education using purposive sampling. Following ethics approval, email invitations were sent to potential experts who were identified from thought leader groups, professional organizations, university websites, research articles and via professional recommendations.

3.4 | Survey implementation

The survey opened on 1 July 2023 and it remained open for 6 weeks during which time regular reminders were sent to participants. When accessing the survey portal, expert panel members were provided with clear explanations about how to navigate the Delphi software system. For ease of use, one survey statement was presented per page, along with a real-time statistical summary of previous responses and anonymised comments from other experts.

Panel members were asked to rate each knowledge and skill statement according to their level of agreement with its relevance to undergraduate nursing education curricula using a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). They were also asked to comment on the clarity of wording and to identify any statements that were ambiguous, repetitive or unnecessary. Panel members were invited to provide suggestions for rewording of statements and inclusion of additional knowledge or skills statements.

Participation was asynchronous with panel members able to access, review and refine their responses, and respond to the suggestions and modifications made by other participants on multiple occasions. Panel members were also able to view and comment on the consensus rating for each statement as it changed over time. In this way, it was anticipated that the final document would represent the shared views and input of all members of the panel.

3.5 | Data analysis

At the end of the 6-week period, raw survey data and aggregated statistical analysis reports were downloaded from the Surveylet software program. A series of weekly online meetings using MS TEAMS were conducted with the research team to allow for detailed discussion of the results. Free-text comments provided by panel

members were used to assist in interpretation of quantitative responses and to help refine the wording of the knowledge and skills statements where required.

3.6 | Ethical considerations

This study was approved by the University of Technology Sydney ethics committee (ETH23-8253) prior to the recruitment of expert panel members, and ethical processes were maintained throughout the entire study.

4 | RESULTS

4.1 | Demographic characteristics of panel members

Of the 56 potential panel members invited to participate in the real-time Delphi survey, 42 agreed and completed the survey giving an overall response rate of 75% (see Table 2). Hasson et al. (2000) suggest that a response rate of 70% is adequate to ensure the rigour of the Delphi technique. The lowest response rate for any single survey statement was 90% (38 out of 42 participants).

The panel members' ages ranged from 20–≥60 years with most (39%) aged 41–50 years. Although the majority (73%) were working in Australia at the time of the study, others were working in the United Kingdom, United States, Brazil, Canada and Germany. Two thirds of participants were located in metropolitan settings with 19% in regional and 14% in rural settings.

Just over half (53.7%) of the participants had a nursing background, with other panellists representing medical, public health and allied health disciplines. Many of the participants held multiple professional roles including that of researcher, educator and/or clinician. In addition, 29% of the participants held roles such as sustainability managers, Net Zero clinical leads, and climate change/ Planetary Health strategy and policy officers. Most of the participants had high-level academic qualifications including Doctoral (44%) and Masters degrees (34%).

4.2 | Delphi results

For Delphi studies, a priori level of consensus is generally set and this can range from 51 to 100% (Hasson et al., 2000). For this study, the level of consensus was set at ≥80%, meaning that at least 33 of the 42 panel members ranked the statement as a 4 (agree) or 5 (strongly agree) on the 5-point Likert scale. This approach is supported by Paz-Pascual et al. (2019). The secondary measure of consensus was the stability of response, evaluated using the coefficient of quartile variation (<5%) (Koo & Li, 2016).

Of the 49 statements, 26 (53%) achieved ≥80% consensus and 44 (90%) achieved ≥75% consensus. No statements achieved less than 70%, indicating a high level of overall agreement with most of

TABLE 2 Demographic characteristics of expert panel members.

Variables	(n = 42) n (%)
Age group (years old)	
20–30	3 (7.3%)
31–40	7 (17.1%)
41–50	16 (39.0%)
51–60	8 (19.5%)
>60	7 (17.1%)
No response	1
Professional background	
Nursing	22 (53.7%)
Medicine	10 (24.4%)
Public health	2 (4.9%)
Allied health	1 (2.4%)
Other ^a	6 (14.6%)
No response	1
Current professional role—multiple responses permitted^b	
Clinician	18 (42.7%)
Researcher	24 (57.1%)
Educator	24 (57.1%)
Other ^c	12 (28.6%)
Years worked in current role	
1–5 years	18 (42.9%)
6–10 years	10 (23.8%)
11–15 years	6 (14.3%)
16–20 years	4 (9.5%)
>20 years	4 (9.5%)
Highest educational qualification	
PhD	18 (43.9%)
Masters degree	14 (34.2%)
Graduate diploma	1 (2.4%)
Bachelor degree	3 (7.3%)
Other ^d	5 (12.2%)
No response	1
Current country of work	
Australia	31 (73.7%)
United Kingdom	1 (2.4%)
United States of America	7 (16.7%)
Brazil	1 (2.4%)
Canada	1 (2.4%)
Germany	1 (2.4%)
Current work location	
Metropolitan	28 (66.6%)
Regional	8 (19.1%)
Rural	6 (14.3%)

^aSustainability, engineer, climate science, environmental science.

^bResponses do not add up to 100% as multiple responses were permitted for this question.

^cSustainability manager, strategy and policy officer, Net Zero clinical lead.

^dGraduate certificate, Doctor of Nursing Practice, Doctor of Medicine.

the knowledge and skill statements. Figure 2 provides an example of a review screen that panel members were able to view while participating in the study. It shows that for the statement 'Provides a nursing perspective in interdisciplinary discussions related to the challenges associated with climate change', consensus was achieved with a group stability of 86%. This screen also indicates that 15 revisions were made by participants to their initial responses over the 6 weeks that the survey was open. It should be noted that for each of the statements, the number of amendments made by the expert panel members varied. In general, where there was a higher level of overall agreement, there were fewer amendments made by the experts.

Based on the level of consensus and the written feedback provided by panel members, three of the statements were deleted and 32 were modified to improve clarity of language. No additional statements were suggested by the panel members to improve survey breadth. At the conclusion of the real-time Delphi survey, there were 46 knowledge and skill statements remaining. Table 3 provides the consensus ratings for each knowledge and skill statement, interquartile ranges (the range of values that reside in the middle of the scores), and amendments made to improve clarity of wording. Table 4 lists the final version of the knowledge and skills statements.

4.2.1 | Domain 1. The science of planetary health and climate change

Ten of the 16 statements (63%) in this domain achieved a consensus rating of $\geq 80\%$, seven of the 12 knowledge statements and three out of four skill statements. The two statements that scored 71% ('Discusses how climate change is linked to environmental changes including habitat and biodiversity loss, deforestation, ocean acidification, and pollution of air, water, and soil' and 'Outlines the key goals of international policies and agreements related to climate change, including the UN Sustainable Development Goals, the UN Framework Convention on Climate Change and the Paris Agreement') were deleted. Panel members felt that the first of these repeated, to some extent, other statements in this domain. Panellists also indicated that with the exception of the United Nations Sustainable Development Goals, which are addressed in Domain 2, the international policies and agreements related to climate change are not directly relevant to undergraduate nursing students.

4.2.2 | Domain 2. Mitigation of the adverse impacts of health care on the environment

In this domain, 11 of the 18 statements (61%) achieved a consensus rating of $\geq 80\%$, including four of the 10 knowledge statements and seven of the eight skill statements. Based on feedback from the expert panel, minor amendments were made to improve clarity of some of the statements but none were deemed worthy of deletion.

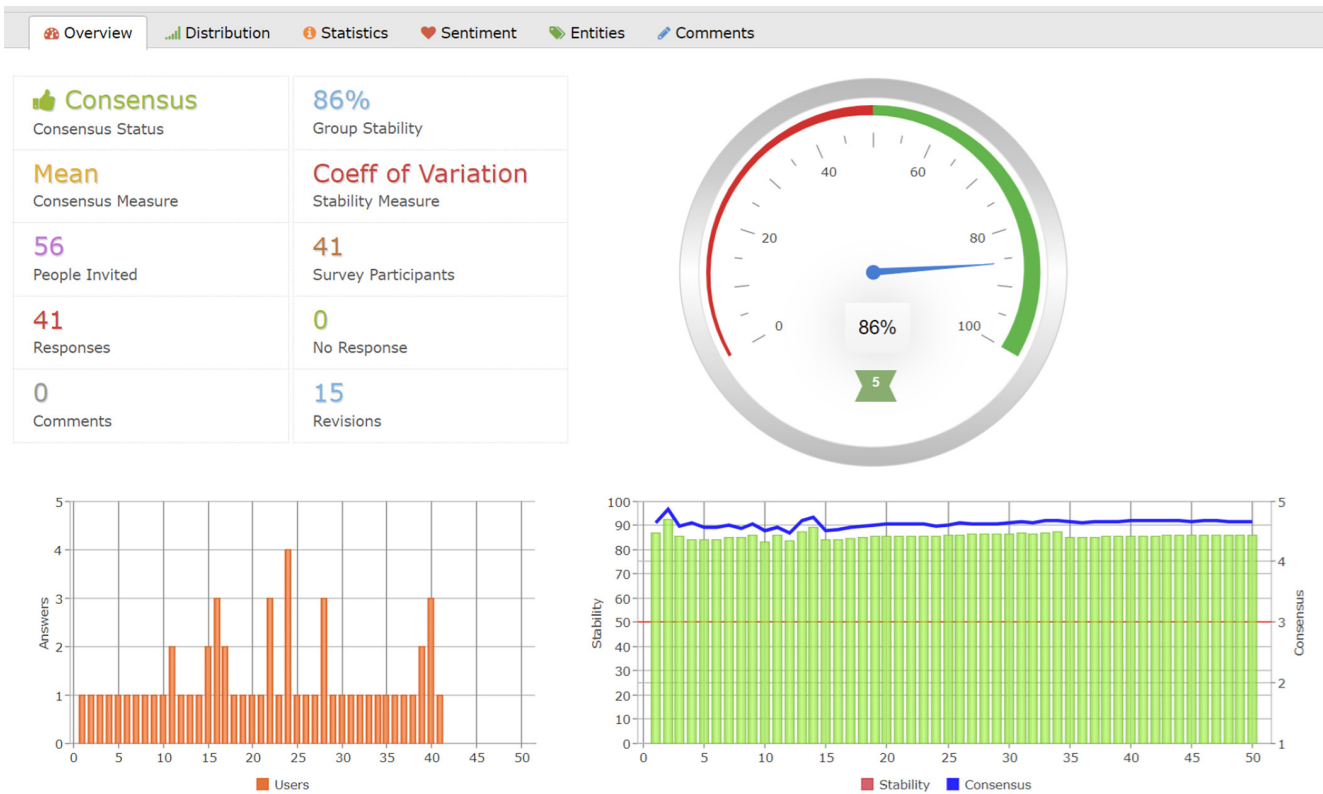


FIGURE 2 Example of review screen (Domain 1. Statement: Provides a nursing perspective in interdisciplinary discussions related to the challenges associated with climate change).

4.2.3 | Domain 3. Adaptation to the actual and expected impacts of climate change on health care and health outcomes

In Domain 3, five of the 15 statements (33%) achieved a consensus rating of $\geq 80\%$, three of the eight knowledge statements and two out of seven skill statements. One statement ('Explains the principles of climate justice and the need to systemically address climate justice issues in the context of healthcare') was deleted based on the expert panel members' feedback and because it is referred to in the key terms related to adaptation to climate change. Amendments were made to improve the clarity of language for eight of the other statements.

4.3 | Free text comments

Twelve participants provided free text comments at the end of the survey. Ten comments indicated that achieving consensus on Planetary Health, climate change and sustainability knowledge and skills statements is critical for addressing the significant gap in contemporary nursing education. Two panel members emphasized the importance of hope in the face of the negative discourse about climate change and that there is a need for students to understand that they can have a positive impact on Planetary Health by engaging in mitigation and adaptation activities designed to improve individual,

community and global health. Two participants also referred to the importance of nursing curricula focusing on concepts such as anthropocentric thinking and interconnectedness with nature. In light of the free text comments, the statements were again reviewed with amendments made where appropriate.

5 | DISCUSSION

Despite overwhelming evidence, the global response to climate change has been mired in bureaucracy and political intransigence. Nurses are being increasingly looked to for leadership, education, research, advocacy and practical solutions to mitigate the health sector's impact on the environment and to prepare for current and future health impacts of climate, ecological and environmental change on health outcomes. Accordingly, universities have the responsibility to address this imperative by ensuring that graduates are equipped to address Planetary Health concerns. However, to date, there have been limited examples of curricula integration of these topics (Best et al., 2023; Potter, 2019). This is despite studies indicating that nursing students expect Planetary Health, climate change and sustainability to be included in undergraduate programs (Alvarez-Nieto et al., 2021).

One of the key challenges to curricula integration is that there have been 'no skills available to guide curricula development' (Portela Dos Santos et al., 2023, p. 5), and consequently, many nurses have

TABLE 3 Real-time Delphi results with amended knowledge and skill statements, ranked highest to lowest in levels of consensus.

Domain 1. The science of planetary health and climate change			
Original statements	Consensus	IQR	Amended statements
Knowledge statements			
Explains how the health of ecosystems is interconnected with human health	82%	0	Explains the interdependence of human health and the health of the natural environment
Describes how climate change impacts the environmental determinants of health including food security and ecosystem services (water, air, soil)	82%	1	Describes how climate change impacts the environmental determinants of health, including air quality and food and water security
Outlines the impact of climate change on environmental disasters such as extreme weather, droughts, floods, fires, dust storms, extreme heat and sea level rises, locally, nationally and internationally	81%	1	No change
Describes how climate change influences the prevalence and intensity of infectious diseases	81%	1	Describes how environmental conditions and climate change influences the prevalence of infectious and vector-borne diseases
Explains how and why socioeconomically disadvantaged, vulnerable and marginalized communities locally, nationally and internationally, are most impacted by climate change	81%	0	Explains how and why socioeconomically disadvantaged and marginalized communities locally, nationally and internationally, are most impacted by climate change
Defines climate change and related terms such as Global warming Ecological footprint Greenhouse gas effect Carbon footprint Carbon sink Anthropocene	80%	1	Discusses the meaning of Planetary Health, climate change and related terms such as <ul style="list-style-type: none"> • Global warming • Greenhouse gas emissions • Carbon footprint • Anthropocene
Describes how human activities, including the use of fossil fuels, are exacerbating climate change	80%	1	No change
Discusses how First Nations peoples' cultural knowledge, land management and conservation practices are critical to informing the global climate action agenda	77%	1	Discusses how First Nations peoples' connection with Country, cultural knowledges, land management and conservation practices, inform the agenda for a sustainable future.
Outlines the carbon footprint of the Australian healthcare system on Australia's total greenhouse gas emissions	76%	1	Outlines the contribution of the healthcare system to greenhouse gas emissions
Explains the scientific basis of climate change	72%	2	Describes, in simple terms, the basic scientific principles of climate change
Discusses how climate change is linked to environmental changes including habitat and biodiversity loss, deforestation, ocean acidification and pollution of air, water and soil	71%	1	Deleted
Outlines the key goals of international polices and agreements related to climate change, including the UN Sustainable Development Goals, the UN Framework Convention on Climate Change and the Paris Agreement.	71%	2	Deleted
Skill statements			
Provides a nursing perspective in interdisciplinary discussions related to the challenges associated with climate change	86%	1	No change
Communicates effectively using plain English language with various stakeholders, including colleagues, healthcare consumers and policymakers, about the causes and consequences of climate change, in order to promote informed decision-making	83%	1	Communicates effectively with various stakeholders, including colleagues, healthcare consumers and policymakers, about the consequences of climate change for human health, in order to promote informed decision-making in healthcare
Advocates for those most impacted by the short and long-term impacts of climate change.	82%	1	Advocates for and works with those most impacted by the short- and long-term impacts of climate change

(Continues)

TABLE 3 (Continued)

Domain 1. The science of planetary health and climate change			
Original statements	Consensus	IQR	Amended statements
Responds appropriately to misconceptions related to climate change as well as climate scepticism, denial and hopelessness	77%	1	Disseminates scientific evidence related to Planetary Health and climate change
Domain 2. Mitigation of the adverse impacts of health care on the environment			
Original statements	Consensus	IQR	Amended statements
Knowledge statements			
Discusses the roles of nurses as change agents and advocates for environmentally sustainable healthcare practices	86%	0	No change
Provides examples of direct and indirect health co-benefits of mitigation measures	82%	1	No change
Discusses the environmental impact of healthcare delivery and nursing practice with particular attention to energy and water use, waste production, and pollution from harmful chemicals	81%	1	Discusses examples of the environmental impact of healthcare delivery and nursing practice
Discusses personal, interpersonal, organizational and political enablers and barriers to nurses' ecological behaviours	81%	1	Discusses personal, interpersonal, organizational and political enablers and barriers to nurses' sustainable behaviours
Explains how nurses uphold the ethical principles of beneficence, nonmaleficence and justice by practicing in an environmentally sustainable manner	79%	1	Explains how nurses uphold the ethical principles of beneficence, nonmaleficence, autonomy and justice by practicing in an environmentally sustainable manner
Describes the roles and responsibilities of staff involved in healthcare sustainability initiatives	79%	1	Identifies healthcare staff involved in sustainability initiatives and describes their roles and responsibilities
Describes local healthcare initiatives for reducing greenhouse gas emissions and their impact	79%	1	No change
Defines mitigation of climate change and related terms such as	78%	2	Discusses the meaning of mitigation of climate change and related terms such as
<ul style="list-style-type: none"> • Environmental sustainability • Net Zero targets • Carbon neutral • Tipping point • Ecological behaviours 			<ul style="list-style-type: none"> • Environmental sustainability • Net Zero targets • Carbon neutral • Planetary boundaries
Explains the relevance of Net Zero plans and policies to the work of nurses	78%	1	Explains the relevance of Net Zero plans to the work of nurses
Outlines legislative and organizational requirements for segregating and managing waste disposal	75%	2	Investigates legislative and organizational requirements for segregating and managing waste disposal
Skill statements			
Accurately segregates and disposes of bio-hazardous, chemical, pharmaceutical and nuclear waste according to legislative and organizational requirements	88%	0	No change
Contributes to organizational initiatives and quality improvement projects related to environmental sustainability	87%	1	No change
Advocates for appropriate antimicrobial stewardship	84%	1	No change
Educates colleagues and provides rationales for waste segregation and management practices	83%	1	Educates colleagues and consumers on rationales for waste segregation and management practices
Uses risk communication strategies to advocate for proactive action to ameliorate the negative impacts of climate change	82%	1	Uses risk communication strategies to advocate for proactive action to address the impacts of climate change
Advocates for minimization of chemical waste and for its environmentally sustainable disposal	80%	1	Advocates for minimization and environmentally sustainable disposal of waste

TABLE 3 (Continued)

Domain 2. Mitigation of the adverse impacts of health care on the environment			
Original statements	Consensus	IQR	Amended statements
Identifies strategies to reduce waste through reusing, recycling and repurposing products as appropriate	80%	1	Identifies strategies for waste reduction, reuse and recycling
Judiciously and prudently selects and uses disposable healthcare products	77%	1	Responsibly and sustainably selects and uses healthcare products
Domain 3. Adaptation to the actual and expected impacts of climate change on health care and health outcomes			
Original statements	Consensus	IQR	Amended statements
Knowledge statements			
Discusses how climate change affects the social and environmental determinants of health such as clean air, safe drinking water, food security and safe housing, especially for people in low-resource settings and with weak health infrastructure	83%	1	Discusses how climate change affects the social and environmental determinants of health such as clean air, safe drinking water, food security and safe housing, especially for priority populations
Describes strategies nurses can use to support individuals and groups most at risk of climate impacts (such as air pollution, extreme temperatures, floods and fires), with particular attention to frail and elderly people, young children, pregnant women and those with pre-existing comorbidities and/or disabilities	82%	1	No change
Describes the health impacts of climate change on cardiovascular, respiratory, renal, gastrointestinal, neurological and reproductive systems across the lifespan	81%	0	Describes the health impacts of climate change on cardiovascular, respiratory, renal, gastrointestinal, neurological, integumentary, endocrine and reproductive systems across the lifespan
Outlines potential emotional and mental responses to climate change, including anxiety, stress, hopelessness and despair	77%	1	Outlines potential psychological responses and mental health impacts of climate change, including anxiety and stress
Explains the interconnected nature of climate change adaptation measures and the UN Sustainable Development Goals	76%	2	No change
Defines key terms related to adaptation to climate change, such as	75%	2	Discusses the meaning of adaptation to climate change and related terms, such as
<ul style="list-style-type: none"> • Climate-related disasters • UN Sustainable Development Goals • Sustainable development • Adaptive capacity • Critical threshold • Climate justice 			<ul style="list-style-type: none"> • Climate-driven disasters • UN Sustainable Development Goals • Sustainable development • Climate resilience • Climate justice
Explains the principles of climate justice and the need to systemically address climate justice issues in the context of health care	73%	2	Deleted
Discusses how healthcare organizations adapt staffing and resourcing strategies to manage the impact of climate change and related environmental disasters.	72%	2	Discusses how healthcare settings can adapt models of care and resourcing to prepare for and manage climate-driven disasters.
Skill statements			
Works collaboratively and within interprofessional teams to respond to climate-related health issues and disasters	88%	0	No change
Provides effective and person-centred care to individuals whose health is impacted by climate change and/or climate-related disasters	81%	0	No change
Responds appropriately to the emotional and mental toll of climate change impacts on healthcare consumers', colleagues' and own well-being	79%	1	Responds appropriately to the emotional and mental toll of climate change impacts on colleagues' and own well-being

(Continues)

TABLE 3 (Continued)

Domain 3. Adaptation to the actual and expected impacts of climate change on health care and health outcomes			
Original statements	Consensus	IQR	Amended statements
Applies knowledge and expertise to influence environmental policies and to advocate for solutions that build resilience and decrease the health impacts of climate change	79%	1	Applies knowledge and expertise to influence environmental policies and to advocate for solutions that build climate resilience
Provides evidence-based information and education to healthcare consumers and colleagues about preparing for, responding to, and recovering from the effects of climate change	76%	1	No change
Engages with community members to promote and protect health in the context of weather extremes and environmental disasters	75%	1	Engages with community members to promote and protect health in the context of weather extremes and climate-driven disasters
Discusses positive examples of adaptation strategies and, in particular, those that have impacted vulnerable patients and communities	74%	1	Discusses examples of successful adaptation strategies and, in particular, those that have impacted priority patients and marginalized communities

a limited awareness of environmental issues. Portela Dos Santos et al. (2023) suggest that this has led to feelings of demotivation and overwhelm as well as the profession's lack of commitment and knowledge about what to do and how. This Delphi study is the first known study to identify the specific Planetary Health and climate change knowledge and skills required in undergraduate programs that would enable graduate nurses to take action in their clinical practice. Embedding Planetary Health and climate change knowledge and skills into nursing curricula will directly address the objectives of the WHO (2023) by increasing the capacity of nurses to steward healthcare towards a more sustainable future.

Jochem et al. (2023) suggest that Planetary Health education could be one of the key levers for improving a sustainable and healthy future. These authors further advocate that integral to this education is a holistic approach informed by increased Planetary Health literacy that would allow for the transfer of knowledge and skills to decision-making and actions. The Delphi study profiled in this paper sought to provide a better understanding of the explicit knowledge, skills and literacies required of nursing students to enable them to engage in climate action that directly benefits human and Planetary Health. By so doing, we sought to contribute to other emergent perspectives and form part of a growing understanding of the critical need for education that improves Planetary Health and sustainable healthcare.

Concerns are often expressed about nursing curricula being 'overfull'. Apprehension because of perceived curriculum crowding necessitates a renewed recognition of the reality of climate change and re-evaluation of educational priorities (Shaw et al., 2021), and clarity about the foundational Planetary Health knowledge and skills that nursing graduates require to respond to the health impacts of climate change, regardless of their context of practice (Lokmic-Tomkins, Nayna Schwerdtle, & Armstrong, 2023). This is critical because healthcare professionals, especially nurses, need to be cognisant of these issues as they have a direct impact on public health. Universities are uniquely positioned to contribute to a more sustainable future by promoting interconnections with

nature and incorporating Planetary Health and climate change in curricula. This has the potential to foster a sense of optimism, agency and empowerment in the face of challenging global issues so that graduates are enabled to have a positive impact on Planetary Health.

The results of this study have the potential to impact the global challenges related to Planetary Health and climate change as well-educated nurses are better equipped to play a significant role in promoting environmental sustainability. The evidence-based knowledge and skills statements that emerged from this study provide a foundational language and blueprint for competent nursing practice. As such, they can be used to develop competency statements and inform accreditation standards, nursing curricula, continuing professional development programs, and the design of learning resources. The knowledge and skills statements may also be useful in designing public health and disaster nursing courses.

5.1 | Strengths and limitations

When used appropriately, the Delphi technique can contribute to broadening knowledge within a discipline by allowing researchers to arrive at justifiable conclusions based on a consensus of opinions from expert panel members. The strength of the Delphi technique is based on the understanding that several people are less likely to arrive at a wrong decision than a single individual (Hasson et al., 2000). In this study, the inclusion of an appropriate number of informed, high-calibre and interested panel members with a diverse range of professional backgrounds helped to increase the content validity of the knowledge and skills statements. In addition, the provision of multiple opportunities for panel members to amend their responses and provide feedback, ensured consensual and concurrent validity (Davies et al., 2011). However, determining the reliability of a Delphi study remains difficult as there is no way of knowing whether a different group of panel members would produce the same, similar or different results. Further, it should also be noted that the

TABLE 4 Final knowledge and skill statements.

Domain 1. The science of Planetary Health and climate change**Knowledge statements**

Discusses the meaning of Planetary Health, climate change and related terms such as

- Global warming
- Greenhouse gas emissions
- Carbon footprint
- Anthropocene

Explains the interdependence of human health and the health of the natural environment

Describes, in simple terms, the basic scientific principles of climate change

Describes how human activities, including the use of fossil fuels, are exacerbating climate change

Outlines the contribution of the healthcare system to greenhouse gas emissions

Outlines the impact of climate change on environmental disasters such as extreme weather, droughts, floods, fires, dust storms, extreme heat and sea level rises, locally, nationally and internationally

Describes how environmental conditions and climate change influence the prevalence of infectious and vector-borne diseases

Describes how climate change impacts the environmental determinants of health, including air quality and food and water security

Explains how and why socioeconomically disadvantaged and marginalized communities locally, nationally and internationally, are most impacted by climate change

Discusses how First Nations peoples' connection with Country, cultural knowledges, land management and conservation practices, inform the agenda for a sustainable future.

Skill statements

Communicates effectively with various stakeholders, including colleagues, healthcare consumers and policymakers, about the consequences of climate change for human health, in order to promote informed decision-making in healthcare

Disseminates scientific evidence related to Planetary Health and climate change

Provides a nursing perspective in interdisciplinary discussions related to the challenges associated with climate change

Advocates for and works with those most impacted by the short- and long-term impacts of climate change

Domain 2. Mitigation of the adverse impacts of healthcare on the environment**Knowledge statements**

Discusses the meaning of mitigation of climate change and related terms, such as

- Environmental sustainability
- Net Zero targets
- Carbon neutral
- Planetary boundaries

Discusses examples of the environmental impact of healthcare delivery and nursing practice

Explains the relevance of Net Zero plans to the work of nurses

Provides examples of direct and indirect health co-benefits of mitigation measures

Discusses personal, interpersonal, organizational and political enablers and barriers to nurses' sustainable behaviours

Discusses the roles of nurses as change agents and advocates for environmentally sustainable healthcare practices

Explains how nurses uphold the ethical principles of beneficence, nonmaleficence, autonomy and justice by practicing in an environmentally sustainable manner

Identifies healthcare staff involved in sustainability initiatives and describes their roles and responsibilities

Describes local healthcare initiatives for reducing greenhouse gas emissions and their impact

Investigates legislative and organizational requirements for segregating and managing waste disposal

Skill statements

Responsibly and sustainably selects and uses healthcare products

Accurately segregates and disposes of bio-hazardous, chemical, pharmaceutical and nuclear waste according to legislative and organizational requirements

Educates colleagues and consumers on rationales for waste segregation and management practices

Advocates for minimization and environmentally sustainable disposal of waste

Identifies strategies for waste reduction, reuse and recycling

(Continues)

TABLE 4 (Continued)

Domain 2. Mitigation of the adverse impacts of healthcare on the environment
Advocates for appropriate antimicrobial stewardship
Contributes to organizational initiatives and quality improvement projects related to environmental sustainability
Uses risk communication strategies to advocate for proactive action to address the impacts of climate change
Domain 3. Adaptation to the actual and expected impacts of climate change on healthcare and health outcomes
Knowledge statements
Discusses the meaning of adaptation to climate change and related terms, such as
<ul style="list-style-type: none"> • Climate-driven disasters • UN Sustainable Development Goals • Sustainable development • Climate resilience • Climate justice
Discusses how climate change affects the social and environmental determinants of health such as clean air, safe drinking water, food security and safe housing, especially for priority populations
Explains the interconnected nature of climate change adaptation measures and the UN Sustainable Development Goals
Describes strategies nurses can use to support individuals and groups most at risk of climate impacts (such as air pollution, extreme temperatures, floods and fires), with particular attention to frail and elderly people, young children, pregnant women and those with pre-existing co-morbidities and/or disabilities
Describes the health impacts of climate change on cardiovascular, respiratory, renal, gastrointestinal, neurological, integumentary, endocrine and reproductive systems across the lifespan
Outlines potential psychological responses and mental health impacts of climate change, including anxiety and stress
Discusses how healthcare settings can adapt models of care and resources to prepare for and manage climate-driven disasters.
Skill statements
Provides effective and person-centred care to individuals whose health is impacted by climate change and/or climate-related disasters
Engages with community members to promote and protect health in the context of weather extremes and climate-driven disasters
Works collaboratively and within interprofessional teams to respond to climate-related health issues and disasters
Responds appropriately to the emotional and mental toll of climate change impacts on colleagues' and own well-being
Provides evidence-based information and education to healthcare consumers and colleagues about preparing for, responding to and recovering from the effects of climate change
Applies knowledge and expertise to influence environmental policies and to advocate for solutions that build climate resilience
Discusses examples of successful adaptation strategies and, in particular, those that have impacted priority patients and marginalized communities

participants represented six countries only and no participants were from Asian or African countries. We also acknowledge that this study was informed by the researchers' Western epistemology and that future studies would benefit from a greater focus on Indigenous perspectives.

In order to address potential limitations of the Delphi technique and any threats to trustworthiness, we employed the criteria of transferability, credibility, dependability and confirmability (Lincoln & Guba, 1985) in this study. Prior to initiating the real-time Delphi process, the survey was critiqued and piloted by the 14-member research team to address the criteria of transferability. To ensure credibility and confirmability, consensus was achieved by recruiting expert panel members who were knowledgeable about Planetary Health, climate change and substantiality. Dependability was addressed by using a documented and auditable approach to make decisions on development, refinement and inclusion of knowledge and skills statements. Further, the anonymity and iterative nature of the real-time Delphi approach allowed for honest responses and

ongoing 'member checking' which promoted dependability and credibility.

5.2 | Recommendations for further research

We recognize that consensus of opinion is only one form of evidence and that ongoing discussion and debate on the integration of Planetary Health and climate change content into nursing curricula is warranted. Future studies could consider using the findings from our study as the basis for examining if and to what extent essential knowledge and skills related to Planetary Health, climate change and sustainability are evident in contemporary nursing programs. Further, the knowledge and skill statements may be used to develop professional standards and design and evaluate educational resources. Lastly, consensus-based approaches such as the nominal group technique could be used to explore the relevance of the knowledge and skills statements to other healthcare disciplines.

6 | CONCLUSION

Nurses are charged with the responsibility for contributing to Planetary Health by advocating for environmental and social determinants of health, such as a clean environment, poverty alleviation, healthcare access and social support networks. Many nurses engage in community-wide climate mitigation plans, adapting to changing circumstances and integrating local knowledge, including First Nations' knowledge into their practice. Such collective efforts promote sustainable health care, bolster resilience and diminish community vulnerability to climate change. These real-world learnings need to be translated into nursing curricula so that future generations of nurses can actively develop solutions and support individuals and communities through practice, research, advocacy, policy development, education and climate mitigation and adaptation initiatives.

Until now, the absence of consensus on the essential knowledge and skills expected of nursing students has hindered the advancement of curricula and impacted educators' confidence in teaching Planetary Health and climate change. This study has resulted in a meticulously crafted framework of knowledge and skill statements categorized under the domains of 1. The science of Planetary Health and climate change. 2. Mitigation of the adverse impacts of healthcare on the environment and 3. Adaptation to the actual and expected impacts of climate change on health care and health outcomes. This framework, and the knowledge and skill statements derived from this study, will be beneficial to educators, the future nursing workforce and, ultimately, the individuals and communities whom nurses serve.

However, we note that given the rapidly evolving body of research related to Planetary Health and climate change, these statements will need to be reviewed regularly to ensure they remain contemporaneous, contextually appropriate and aligned to emerging science and best practice in this field.

AUTHOR CONTRIBUTIONS

Levett-Jones: Conceptualisation and survey design, data analysis and interpretation, writing and finalizing manuscript for submission. Catling: Survey design, data analysis and interpretation, reviewing and editing manuscript for submission. Cheer: Survey design, data analysis, reviewing and editing manuscript for submission. Fields: Data analysis, reviewing and editing manuscript for submission. Foster: Survey design, data analysis and interpretation, reviewing and editing manuscript for submission. Maguire: Data analysis, reviewing and editing manuscript for submission. McIntyre: Survey design, data analysis and interpretation, reviewing and editing manuscript for submission. Moroney: Data analysis, reviewing and editing manuscript for submission. Pich: Data analysis, reviewing and editing manuscript for submission. Pitt: Survey design, data analysis and interpretation, reviewing and editing manuscript for submission. Whiteing: Survey design, data analysis and interpretation, reviewing and editing manuscript for submission. Lokmic-Tomkins: Conceptualisation and survey design, data analysis and interpretation, writing and finalizing manuscript for submission.

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The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

PEER REVIEW

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DATA AVAILABILITY STATEMENT

Data available on request from the authors.

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