



Contemporary issue



Promoting sustainability in nursing and midwifery clinical laboratories: Strategies for resource reduction, reuse, and recycling

Tracy Levett-Jones^{a,*}, James Bonnamy^b, Lorraine Fields^c, Jane Maguire^a, Tracey Moroney OAM^d, Jacqueline Pich^a, Laura Sheridan^a, Zerina Lokmic-Tomkins^e

^a University of Technology Sydney, Faculty of Health, 235 Jones St, Ultimo, NSW 2007, Australia

^b Monash University, Faculty of Medicine, Nursing and Health Sciences, School of Nursing and Midwifery, 47-49 Moorooduc Highway, Frankston, VIC 3199, Australia

^c University of Wollongong, Faculty of Science Medicine & Health, Northfields Ave, Wollongong, NSW 2522, Australia

^d Curtin University, Curtin School of Nursing, Building 405, Bentley, 6102, WA, Australia

^e Monash University, Faculty of Medicine, Nursing and Health Sciences, 35 Rainforest Walk, Clayton Campus, Clayton, VIC 3800, Australia

ARTICLE INFO

Keywords:

Planetary health
Sustainability
Climate change
Clinical laboratories
Nursing
Midwifery
Education

ABSTRACT

Background: The impacts of climate change on planetary health are multifaceted and threaten public health gains made since World War II. Healthcare is the fifth largest global emitter of greenhouse gas emissions, demanding significant efforts to transition to an environmentally sustainable future. Addressing these issues will require collective societal action. In this regard, universities have a dual responsibility – (1) to **tackle complex social, economic, and environmental challenges** by championing sustainability initiatives designed to positively impact planetary health; and (2) to ensure that graduates are equipped with the knowledge, attitudes and skills needed to steward planetary health towards a more sustainable future. The future nursing and midwifery workforce must be educated to mitigate the health sector's impact on the environment, advocate for action on climate change, prepare for ongoing health impacts of unpredictable climate and environmental changes, and help communities and healthcare systems become more climate resilient.

What this paper contributes: To help increase nursing and midwifery educators' and students' capacity to support planetary-health related interventions, the overarching purpose of this paper is to provide a series of exemplars that illustrate sustainability initiatives used in four university-based clinical skills laboratories. These initiatives each demonstrate a commitment to the United Nation's Sustainable Development Goals and can be used to help embed the importance of planetary health in student learning.

1. Introduction

Planetary health is an interdisciplinary field that examines and addresses the impact of human activities, such as fossil fuels and plastics pollution, deforestation, depletion of land and natural resources, biodiversity loss, and freshwater scarcity, on the environment and human health. Climate change, one of nine interdependent processes impacting the Earth's stability and resilience, is intricately linked to planetary health. The Earth's climate system disruption, primarily caused by human-generated greenhouse gases (GHG), has led to global temperature shifts, extreme weather, ice sheet alterations and

environmental disturbances. These changes are contributing to intensified wildfires, heatwaves, storms, floods, droughts, famines, social disruptions, ecosystem decline, sea-level rise, and species extinctions (World Health Organization [WHO] Regional Office for Europe, 2017). These crises threaten the achievement of the United Nations (UN) Sustainable Development Goals (SDG) (United Nations, 2015), necessitating collective action for climate mitigation, adaptation, and health resilience at all societal levels (WHO, 2017). The healthcare sector must address its substantial GHG emissions while simultaneously building climate-resilient healthcare systems with a workforce prepared to meet the demands of an uncertain future.

* Corresponding author.

E-mail addresses: tracy.levett-jones@uts.edu.au (T. Levett-Jones), James.Bonnamy@monash.edu (J. Bonnamy), lfields@uow.edu.au (L. Fields), jane.maguire@uts.edu.au (J. Maguire), tracy.moroney@curtin.edu.au (T.M. OAM), Jacqueline.pich@uts.edu.au (J. Pich), laura.sheridan@uts.edu.au (L. Sheridan), zerina.tomkins@monash.edu (Z. Lokmic-Tomkins).

[@ProfTLJ](https://twitter.com/ProfTLJ) (T. Levett-Jones), [@James_Bonnamy](https://twitter.com/James_Bonnamy) (J. Bonnamy), [@Lane_Fields21](https://twitter.com/Lane_Fields21) (L. Fields), [@janemaguire9](https://twitter.com/janemaguire9) (J. Maguire), [@jacqui_pich](https://twitter.com/jacqui_pich) (J. Pich), [@TomkinsZerina](https://twitter.com/TomkinsZerina) (Z. Lokmic-Tomkins)

<https://doi.org/10.1016/j.nedt.2024.106105>

Received 13 September 2023; Received in revised form 31 December 2023; Accepted 18 January 2024

Available online 22 January 2024

0260-6917/© 2024 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

The nursing and midwifery workforce will need to enhance their capacity for managing climate-related interventions to support safe and effective healthcare provision (Lokmic-Tomkins et al., 2023a, 2023b). This requires the adoption of a planetary health approach in education and professional development (Shaw et al., 2021). Key nursing organisations are calling for an urgent and considered response to the impacts of climate change (Rosa et al., 2019) with the WHO global strategic directions for nursing and midwifery 2021–2025 stating that countries should fully enable the contributions of nurses and midwives to “mitigating the health effects of climate change” (p.v). Further, 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 evident in nursing programs. Similarly, the [International Confederation of Midwives \(2014\)](#) emphasises that the importance of climate change for childbearing women should be evident in midwifery education.

Creating authentic learning opportunities to fulfil the professions' responsibility to planetary health can be integrated into clinical laboratories (CLs). Sometimes referred to as clinical teaching classrooms, nursing/midwifery labs or simulation units, CLs replicate authentic healthcare environments, enhancing students' learning experiences with high-fidelity simulation manikins and real clinical equipment. However,

similar to healthcare settings, CLs produce vast quantities of waste, prompting efforts to thoughtfully procure and reuse consumables.

The four exemplars of sustainability outlined in this paper are intended to illustrate the principles most commonly used to underpin waste reduction and NetZero strategies – reduce, reuse, recycle. Importantly, these exemplars provide a way to feasibly role model the principles of sustainable practice to students.

1.1. Simulated electronic medical records in clinical laboratories: Advancing UN SDG 12: Responsible consumption and production; and SDG 15: Life on land

Authentic patient documentation is crucial to fostering relevant learning experiences for students and for facilitating the transfer of clinical skills to practice. Historically, the University of Technology Sydney (UTS), provided simulated patient charts in a hard copy, paper-based format. However, this approach creates unnecessary waste and has adverse environmental implications, as paper production in pulp and paper mills contributes to air, water and land pollution. Further, these patient charts were often laminated to enhance durability and allow for repeated use. This practice supported infection control processes as the laminated charts could be cleaned with alcohol wipes between use. However, the laminated charts had to be discarded in regular



Fig. 1. Use of simulated electronic medical records.

waste bins rather than recycling bins. The issue became particularly problematic for the large student cohorts at UTS (>3000 students) as simulated patient documentation for a single teaching session required several charts, including, for example, vital signs, fluid balance, medication records, and progress notes, resulting in a substantial volume of waste.

To address these environmental and practical concerns and to familiarise nursing and midwifery students with electronic documentation practices, the Electronic Medical Records (EMRs) for Interdisciplinary Simulation Education (eMRISE) program was developed in collaboration with the Australian Catholic University and the University of Sydney.

eMRISE replicates the EMR systems used in Australian public hospitals, and provides thousands of students with clinically relevant learning experiences. Students can document patient care provision on eMRISE using the computers available at each bed space in CLs (Fig. 1) or on personal devices. The simulation experiences and learning activities related to eMRISE use, commence in the first year of the degree program and progressively increase in complexity throughout the second and third years. Students also learn how EMR systems can improve the healthcare industry's environmental footprint (Turley et al., 2011). For example, EMR systems can be optimised to minimise energy consumption, reduce pathology and radiology test duplications, and identify inefficiencies in healthcare models associated with increased GHG emissions (Lokmic-Tomkins et al., 2022).

eMRISE adoption in our CLs has reduced reliance on paper-based and laminated documentation, significantly decreasing our environmental impact by diverting tons of waste from landfill. This approach also serves as an education tool, teaching students a practical strategy for addressing the UN's SDG 12: Responsible Consumption and Production, and SDG 15: Life on Land.

Integrating eMRISE into our curriculum has enhanced students' employability through augmented digital literacy skills and instilled a sense of environmental consciousness, fostering environmentally responsible practitioners. Notably, this strategy simultaneously reduces the environmental footprint of our nursing and midwifery programs. On a more profound level, and in line with SDG13 'Climate Action' which acknowledges the need for equitable and just solutions to climate-related challenges, the use of eMRISE has become a tool that teaches the principles of climate justice and how the nursing workforce can contribute to the design of environmentally responsible digital health interventions that are equitable and just (Lokmic-Tomkins et al., 2023a, 2023b).

1.2. Renewable energy in clinical laboratories: Advancing UN SDG 7: Affordable and clean energy.

The UN's SDG 7 focusses on ensuring access to affordable, reliable, sustainable, and modern energy. It calls for a rapid transition to decarbonised energy sources and a commitment to achieving a NetZero future. Achieving SDG 7 is instrumental in catalysing action to combat climate change and has far-reaching implications, impacting numerous other SDGs, including those related to health and education.

To keep pace with contemporary clinical environments, CLs have evolved into high-tech teaching and learning spaces, featuring video-conferencing capabilities, touchscreen monitors, and high-fidelity manikins. These manikins connect to various devices, allowing educators to remotely adjust vital signs, communicate through the manikin and modify its physiology. While these technological advancements undeniably enhance the quality of students' learning experiences, there is a drawback – the increased GHG emissions.

Each bed space in the CL draws electricity to power simulated oxygen and suction services, a manikin controlled via a portable device, an adjustable bed, patient monitors, and infusion pumps. Depending on the scenario, additional equipment such as a lifting machine, incubator and high-fidelity infant manikin may be necessary. Electricity is also

required for heating and cooling the CLs and for the equipment used to reuse and recycle consumables and resources.

Monash University's CL building has a roof covered in solar panels (Fig. 2), supplying 55 % of the building's energy requirements. The remaining energy needs are primarily purchased from wind farms (R. Oliver, personal communication, June 19, 2023) in line with the University's ambition to achieve 100 % clean and renewable energy usage by 2030 (Monash University, 2017).

Alongside transitioning to cleaner and more sustainable energy sources, other measures to reduce CL's GHG emissions include simple actions such as turning off lights, using motion sensors and implementing sleep timers for equipment such as manikins, monitors and infusion pumps to conserve energy when these devices are not in use. Discussing the strategies with students emphasises the University's commitment to sustainability and alignment with the UN's SDGs.

1.3. Drugs down the drain: Advancing UN SDG 6: Clean water and sanitation; and SDG 14: Life below water

Globally, the incorrect disposal of medications is having a detrimental impact on our natural environment. Pharmaceuticals have been detected in marine environments and drinking water, posing potential threats to human and planetary health (Ebele et al., 2017). Ensuring the safe disposal of medications is an integral responsibility of registered nurses. However, a recent study found that almost 70 % of nursing students had not received education on safe medication disposal (Al Rawwad et al., 2021). Within the clinical practice setting, medications continue to be disposed of in ways that endanger the environment, such as being discarded down the drain (Ebele et al., 2017). To ensure that nursing and midwifery students receive appropriate education on the correct methods for disposing of medications, educators must emphasise the significance of practices that promote planetary health (Al Rawwad et al., 2021).

At the University of Wollongong, educational initiatives emphasise practical actions that nurses can take towards environmental sustainability. One such example is the inclusion of education on appropriate disposal of medications and the detrimental effects of the improper practice of disposing of drugs down the drain on marine life and groundwater contamination. While various guidelines concerning medication disposal exist, students are instructed to adhere to local policies and procedures, including the use of pharmaceutical bins. They are also informed that, in many States, medication waste must undergo high temperature incineration as the final disposal step. To further support this education, visual reminders (Fig. 3) are placed above each sink within the CLs, aiming to raise awareness, support behaviour change, and encourage students to transform practice in the clinical setting.

This simple but practical initiative aligns with the theoretical subjects that students study related to planetary health and the role of nurses in contributing to the achievement of the UN's SDGs. Incorporating visual reminders within the CLs facilitates a connection between theory and practice, particularly regarding SDG 6: Clean Water and Sanitation, and SDG 14: Life Below Water. Additionally, these posters encourage students to pause and reflect on their practices and consider the importance of sustainable medication disposal for planetary health.

1.4. Single use plastic segregation and recycling: Advancing UN SDG 12: Sustainable consumption and production patterns

The COVID-19 pandemic illuminated a pressing issue in healthcare: the generation and disposal of vast quantities of healthcare waste. Every year, tons of masks, gowns, and gloves end up in landfill. While this revelation has shocked some, there is a shared understanding that using single-use plastics is a crucial component of infection control policies aimed at preventing the transmission of contagious pathogens. Nonetheless, environmental concerns have triggered increasing demands for



Fig. 2. Solar panels for renewable clean energy on the Monash paramedicine building (left) and nursing and midwifery building (right).

PLEASE DON'T PUT DRUGS DOWN THE DRAIN

Drugs disposed of down the drain enter waterways impacting marine life & the water table potentially affecting humans & animals.

6 CLEAN WATER AND SANITATION

14 LIFE BELOW WATER

Fig. 3. 'Don't put drugs down the drain' poster.

more sustainable practices, with a shift towards recycling programs that mitigate the environmental impact while upholding effective healthcare practices (Hockenberry and Clark, 2019; Marsack et al., 2024).

The imperative to provide nursing and midwifery students with authentic learning experiences, particularly with skills such as aseptic technique, often results in the generation of significant waste as students

practice opening sterile packages to gain familiarity and competence. Education providers committed to sustainable practices sometimes repack and reuse some of these single-use items.

At Curtin University, a team of committed academics looked for new and original ways to repurpose single-use plastics and other items that cannot be reused. These items are segregated and donated to community

groups such as recycling centres or sent to low-resource countries (Fig. 4). This process is carried out thoughtfully, recognising that not all single-use plastic items will be of benefit and that transferring the recycling or waste management responsibility to countries with limited resources is inappropriate. It is also important to note that while various single-use plastics, including frequently used items such as masks and gloves, can be outsourced to third parties for commercial recycling, this incurs a cost. Universities committed to sustainability must weigh this short-term expenditure against broader planetary health imperatives.

The UN SDG 12: Sustainable Consumption and Production emphasises the need to minimise the generation of hazardous wastes. Developing more sustainable practices in CLs will only occur with collaboration between higher education and other stakeholders. Challenges of this magnitude need solutions that reduce waste and align with societal expectations. Fostering a culture of resource consciousness and investing in new methods for recycling and reusing can collectively and significantly reduce the environmental impact of CLs.

2. Discussion and conclusion

Little is known about global sustainability practices being used in CLs. A broader understanding of contemporary practices can promote sharing of ideas and initiatives, potentially improving sustainability practices internationally (Marsack et al., 2024). This paper illustrates how integration of sustainable practices in CLs can help to address GHG emissions and mitigate the impact of climate change on planetary health. We have emphasised how nursing and midwifery clinical education can be undertaken in an ecologically-sound and fiscally responsible manner with practical well thought out educational solutions (Connor and McAlister, 2023). This paper showcases both opportunities and challenges for clinical education and that success relies on active student and staff engagement, clear signage, and sustainability orientation. The leadership and commitment of dedicated staff members who champion sustainability and address resistance are instrumental in driving meaningful change. Moreover, the approach to costing sustainability interventions needs a paradigm shift. We must look beyond immediate monetary costs and consider the long-term environmental and planetary health benefits. Emphasising sustainability initiatives like well-structured reuse and recycling programs, resource conservation, and renewable energy adoption can yield lasting savings (Hockenberry and Clark, 2019). The costs associated with financial risks linked to climate change, such as infrastructure damage, rising insurance expenses, or supply chain disruptions, also need to be considered.

The ultimate objective of integrating sustainable practices in CLs is to reduce environmental impact, and align with societal expectations. The path to a sustainable, resilient future will require a strategic and holistic approach involving collaboration, commitment, and continuous improvement.

CRedit authorship contribution statement

Tracy Levett-Jones: Conceptualization, Supervision, Writing – original draft, Writing – review & editing. **James Bonnamy:** Conceptualization, Writing – original draft, Writing – review & editing. **Lorraine Fields:** Conceptualization, Writing – original draft, Writing – review & editing. **Jane Maguire:** Conceptualization, Writing – original draft, Writing – review & editing. **Tracey Moroney OAM:** Conceptualization, Writing – original draft, Writing – review & editing. **Jacqueline Pich:** Conceptualization, Writing – original draft, Writing – review & editing. **Laura Sheridan:** Conceptualization, Writing – original draft, Writing – review & editing. **Zerina Lokmic-Tomkins:** Conceptualization, Writing – original draft, Writing – review & editing.

Funding

No funding was awarded to support this study.



Fig. 4. Segregating single-use plastic items for recycling.

Declaration of competing interest

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.

References

- Al Rawwad, T., Schrader, P., Brooks, A., Duong, L., Thornton, D., 2021. Do nursing and pharmacy students practice what they preach on safe drug storage and disposal? A cross-sectional study. *Nurse Educ. Today* 107, 105143. <https://doi.org/10.1016/j.nedt.2021.105143>.
- Connor, J., McAlister, M., 2023. The recycling, reusing, and repurposing of nursing and medical equipment in nursing education. *Australian Nursing & Midwifery Journal*. (Accessed December 2023 at: [The recycling, reusing, and repurposing of nursing and medical equipment in nursing education – ANMJ](https://doi.org/10.1016/j.anmj.2023.105143)).
- Ebele, A., Abdallah, M., Harrad, S., 2017. Pharmaceuticals and personal care products (PPCPs) in the freshwater aquatic environment. *Emerging Contaminants* 3 (1), 1–16. <https://doi.org/10.1016/j.emcon.2016.12.004>.
- Hockenberry, K., Clark, D., 2019. Supporting sustainability in a nursing simulation lab. *Pennsylvania Nurse*. 74 (3), 14–18.
- International Confederation of Midwives, 2014. Position statement – impact of climate change. Accessed December 2023 at: <https://www.internationalmidwives.org/assets/files/statement-files/2019/06/impact-of-climate-change-eng-letterhead.pdf>.
- International Council of Nurses, 2018. Position statement - Nurses, climate change and health. Accessed December 2023 at: <https://www.icn.ch/sites/default/files/inline-files/ICN%20PS%20Nurses%252c%20climate%20change%20and%20health%20FINAL%20.pdf>.
- Lokmic-Tomkins, Z., Davies, S., Block, L.J., Cochrane, L., Dorin, A., von Gerich, H., Lozada-Perezmitre, E., Reid, L., Peltonen, L.-M., 2022. Assessing the carbon footprint of digital health interventions: a scoping review. *J. Am. Med. Inform. Assoc.* 29 (12), 2128–2139. <https://doi.org/10.1093/jamia/ocac196>.
- Lokmic-Tomkins, Z., Borda, A., Humphrey, K., 2023a. Designing digital health applications for climate change mitigation and adaptation. *Med. J. Aust.* 218 (3), 106–110. <https://doi.org/10.5694/mja2.51826>.
- Lokmic-Tomkins, Z., Schwerdtle, P., Armstrong, F., 2023b. Engaging with our responsibility to protect health from climate change. *J. Adv. Nurs.* 79 (6), e41–e44. <https://doi.org/10.1111/jan.15508>.
- Marsack, J., Bathish, M., Lee, D., 2024. Sustainability efforts in healthcare simulation and clinical learning: an international survey. *Nurse Educ. Today* 132, 105990. <https://doi.org/10.1016/j.nedt.2023.105990>.
- Monash University, 2017. Monash to become Australia's first 100 per cent renewable energy powered university. <https://www.monash.edu/news/articles/monash-to-become-australias-first-100-per-cent-renewable-energy-powered-university>.
- Rosa, W., Kurth, A., Sullivan-Marx, E., Shamian, J., Shaw, H., Wilson, L., Crisp, N., 2019. Nursing and midwifery advocacy to lead the United Nations sustainable development agenda. *Nurs. Outlook* 67 (6), 628–641. <https://doi.org/10.1016/j.outlook.2019.06.013>.
- Shaw, E., Walpole, S., McLean, M., Alvarez-Nieto, C., Barna, S., Bazin, K., Behrens, G., Chase, H., Duane, B., El Omrani, O., Elf, M., Faerron Guzmán, C., Falceto de Barros, E., Gibbs, T., Groome, J., Hackett, F., Harden, J., Hothersall, E., Hourihane, M., Woollard, R., 2021. AMEE consensus statement: planetary health and education for sustainable healthcare. *Med. Teach.* 43 (3), 272–286. <https://doi.org/10.1080/0142159x.2020.1860207>.
- Turley, M., Porter, C., Garrido, T., Gerwig, K., Young, S., Radler, L., Shaber, R., 2011. Use of electronic health records can improve the health care industry's environmental

footprint. *Health Aff (Millwood)* 30 (5), 938–946. <https://doi.org/10.1377/hlthaff.2010.1215>.
United Nations, 2015. The sustainable development agenda. Accessed September 2023 at: <https://sustainabledevelopment.un.org/post2015/transformingourworld/publication>.

World Health Organization Regional Office for Europe, 2017. Environmentally sustainable health systems: a strategic document. Accessed December 2023 at: http://www.euro.who.int/_data/assets/pdf_file/0004/341239/ESHS_Revised_WHO_web.pdf?ua=1.