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Original Article

How much do we throw away in the intensive care unit? An observational point prevalence study of Australian and New Zealand ICUs

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A B S T R A C T

Objective: During the current COVID pandemic, waste generation has been more evident with increased use of single use masks, gowns and other personal protective equipment. We aimed to understand the scale of waste generation, recycling rates and participation in Australian and New Zealand (ANZ) ICUs.
Design: This is a prospective cross-sectional point prevalence study, as part of the 2021 ANZICS Point Prevalence Program. Specific questions related to waste and sustainability practices were asked at the site and patient level.
Setting and participants: ANZ adult ICUs and their patients on the day of the study.
Main outcome measures: Amount of single use items disposed of per shift, as well as the engagement of the site with sustainability and recycling practices.
Results: In total, 712 patients (median number of patients per ICU = 17, IQR 11–30) from 51 ICUs across ANZ were included in our study; 55% of hospitals had a sustainability officer, and recycling paper (86%) and plastics (65%) were frequent, but metal recycling was limited (27%). Per patient bed space per 12-h shift there was recycling of less than 40% paper, glass, intravenous fluid bags, medication cups and metal instruments. A median of 10 gowns (IQR 3–19.5), 10 syringes (4.5–18) and gloves 30 (18–49) were disposed of per bed space, per 12-h shift. These numbers increased significantly when comparing patients with and without infection control precautions in place.
Conclusions: In ANZ ICUs, we found utilisation of common ICU consumables to be high and associated with low recycling rates. Interventions to abate resource utilisation and augment recycling are required to improve environmental sustainability in intensive care units.

1. Introduction and background

We live in the Anthropocene, a time when humanity has an increasingly large environmental footprint that includes climate change, land and water pollution, biodiversity loss, and resource overconsumption.[1] In Australia, 7% of the nation's carbon emissions

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result from the healthcare system.[2,3] There are nascent efforts to reduce healthcare's environmental footprint by advocacy groups,[4–6] the Australian and New Zealand Intensive Care Society (ANZICS),[7] and by governments at a systemic level (e.g. in the UK),[8] and for healthcare to move to a more sustainable planetary health framework.[9] Furthermore, the COVID pandemic has brought the amount of waste generated in healthcare settings to the fore, as exemplified by the millions of single use gowns, gloves and face masks used worldwide to protect healthcare workers and patients.[10,11]

Per patient, the intensive care unit (ICU) consumes considerable amounts of hospital financial and physical resources,[12] energy[13] and waste production. Prior Australian ICU waste audits have indicated that approximately 8 kg of mainly single-use equipment are discarded as waste per day.[14,15] A single Australian ICU was able to recycle 15% of all ICU waste and about half of the potentially recyclable ICU waste.[15] Beyond this single unit, it is unclear how much ICU recycling occurs. Further, despite recent moves by ANZICS to promulgate environmental sustainability in the ICU,[7] current ICU sustainability activities are opaque.

We aimed to understand the scale of waste generated across Australia and New Zealand ICUs and to understand the current levels of recycling and participation in "greening hospital" movements to inform future efforts to improve the environmental sustainability of ICU practices. We included waste specific questions into the 2021 Australian and New Zealand Intensive Care Society Clinical Trials Group (ANZICS CTG) Point Prevalence Program (PPP).

2. Methods

We performed a prospective cross-sectional point prevalence study in Australian and New Zealand adult ICUs, as part of the Point Prevalence Program (PPP; a collaboration between the Australian and New Zealand Intensive Care Society Clinical Trials Group ANZICS CTG and The George Institute for Global Health), on 8 or 23 June, 2021. The authors consulted prior related studies[13,15,16] for relevant questions about ICU waste and environmental sustainability queries.[13,15,16] All sites had ethics approval with the majority of participating sites approved under one National Mutual Acceptance Low or Negligible Risk application approved by the lead ethics committee (Sydney Local Health District – Royal Prince Alfred Zone Ethics Committee; X18-0511 & HREC/18/RPAH/732).

In addition to the standard PPP patient demographic and admission data, specific questions relating to the amount of single use items disposed of in a single shift, patient requirement for personal protective equipment (PPE) and whether recycling of paper, glass vials, polyvinyl chloride (PVC) plastic intravenous fluid bags, metal instruments and medication cups occurred. In terms of the items disposed of, we did not distinguish between different types of gowns (such as plastic aprons or full-length PPE gowns), gloves (sterile or non-sterile) or masks (level of protection). Unit level questions included whether the ICU participates in recycling and whether the hospital has a sustainability officer and is a member of an environmental sustainability organisation such as the Global Green and Healthy Hospital network.[6] Given that energy use in ICUs is a significant generator of carbon emissions,[13] and heating and cooling is responsible for much of such energy use, we also asked about the ambient temperature in the ICU and whether it was able to be manipulated. The questions are provided in the Appendix. The research coordinators at each site entered the patient data via an online case report form using REDcap (Research Electronic Data Capture).[17]

Statistical analyses were performed using Stata 17 (StataCorp, Texas, USA). To standardise the number of items disposed of for each patient, as the nurses responding worked different shift lengths at different ICUs, the number of items was divided by the shift length for the responding bedside nurse, and multiplied by 12, to give an approximation for a 12-h daytime shift. Categorical data were summarised using number (percentage), and proportions were compared using the Fisher exact test; continuous data were summarised as mean (standard deviation), or summarised as median (interquartile range [IQR]) and compared with Mann–Whitney (Wilcoxon rank sum) test.

3. Results

Data were available for 712 patients (median number of patients per ICU = 17, IQR 11–30) from 51 ICUs across Australia and New Zealand. Table 1 outlines the characteristics of the participating units and involvement in sustainability activities. Table 1 indicates the characteristics of the ICUs involved. Of the 51 ICUs involved, 49% were members of the Global Green and Healthy Hospitals (GGHH) Initiative, 55% had a hospital sustainability officer and 92% of the ICUs participated in recycling. Recycling paper (86%) and plastics (65%) were frequent, but metal recycling was limited (27%). Staff were unable to alter the temperature set point in 88% of ICUs.

Table 2 displays basic patient characteristics and common items used to care for them. Recycling from individual bed spaces was most common for paper (38%), then intravenous fluid bags (33%), glass (23%) and least for metals (4%), reflecting similar order, but less common frequency for recycling compared to Table 1.

Table 3 indicates differences in the use and quantity of common PPE for patients requiring infection prevention precautions. Importantly, the study did not distinguish between slight plastic aprons and robust, heavier gowns (such as those used for PPE).

4. Discussion

We undertook an observational point prevalence study of environmental sustainability activities in 51 ANZ ICUs, focused upon waste generation/recycling. Per 12-h shift, approximately 30 pairs of gloves, eight aprons/gowns and 10 syringes were used. Treatment of patients requiring infection prevention (1/4 total)

Table 1
Characteristics and sustainability initiatives in the participating Australian and New Zealand intensive care units.

	n = 51 (to nearest %)
CICM Level ICU - Level 1	1/51 (2%)
Level 2	16/51 (31%)
Level 3	34/51 (67%)
New Zealand	11/51 (22%)
Metropolitan	46/51 (90%)
Rural	5/51 (10%)
Public	45/51 (88%)
Private	6/51 (12%)
Hospital part of Global Green and Healthy Hospitals network	25/51 (49%)
Hospital has a sustainability officer	28/51 (55%)
Ambient temperature of unit (degrees Celsius)	22 °C (IQR: 21–22.5 °C)
Ability to alter the temperature of the unit (Y)	6/51 (12%)
ICU participates in recycling (Y)	47/51 (92%)
ICU recycles	
Soft plastics	33/51 (65%)
Hard plastics	33/51 (65%)
Paper	44/51 (86%)
PVC plastic	32/51 (63%)
Metal	14/51 (27%)

CICM Levels equate to the standards for Intensive Care Units (https://cicm.org.au/CICM_Media/CICMSite/CICM-Website/Resources/Professional%20Documents/IC-1-Minimum-Standards-for-Intensive-Care-Units_1.pdf) ranging from smaller (level 1) to level 3 - a tertiary level ICU.

Table 2
Characteristics of the patients, and the items used in their bed space on the day of the Point Prevalence Program survey.

	number
Age in years (mean,sd)	60.4 (16.9)
Gender (female)	264/712 (37%)
APACHE II (mean, sd)	16.9 (7.5)
Requirement for staff to wear PPE (Y)	166/712 (24%)
COVID suspected/positive	3/712 (0.4%)
Number of patients who had items recycled from their bed-space (in a single shift) (n, %)	
Paper	258/712 (38%)
Intravenous fluid bags	235/712 (33%)
Glass	154/712 (23%)
Medication cups	83/712 (12%)
Metal instruments	31/712 (4%)
Number of patients who had any items recycled from their bed space (n, %)	379/712 (53.2%)
Items disposed of, extrapolated to 12 h shift, per patient bed space (median, IQR)	
Aprons/Gowns	10 (3–19.5)
Masks of any sort	0 (0–3)
Syringes	10 (4.5–18)
Pairs of Gloves (non-sterile and sterile)	30 (18–49)

Abbreviations: PPE – personal protective equipment. IQR – interquartile range.

required 20 aprons/gowns, slightly greater numbers of gloves, but similar numbers of syringes. Approximately half of ICU patients had waste associated with their treatment recycled, and recycling rates varied considerably from 4% for metalware to 33% for PVC plastic. Despite these figures, half of the ICUs surveyed were members of the Global Green and Healthy Hospitals movement.

Our study was patient-centric, examining recycling rates at individual ICU bed-spaces. Units reported high rates of overall recycling, but this may reflect recycling items such as packing boxes, and does not estimate the penetration of recycling into daily clinical patient care practices. There was substantial variation between sites and bed spaces in the amount of waste generated. The waste generation and recycling rates of an ICU are nestled within the parent hospital, as well as the health system from within they work. For example, to increase recycling rates at the bed space would require designated recycling bins, and working with the waste provider for the hospital. Changing to recyclable items (such as paper medication cups) requires working with the procurement contracts for the hospital. These are solutions that have been infrequently implemented across Australia and New Zealand ICUs. This may be due to lack of awareness of successful case studies elsewhere, lack of space for adequate well labelled recycling bins, and lack of time in a busy ICU to consider recycling. Almost half of the participating ICUs were in hospitals supporting the Global Green and Healthy Hospitals (GGHH) Initiative, and also had sustainability officers. This suggests that there is willingness within these sites for improved environmental sustainability to occur, but that simply joining such initiatives is not, of itself, enough to lead to such change.

The association between higher waste generation in bed areas of patients with infection control precautions makes sense. However, it does highlight that perhaps these precautions can be carried too far and that strategies to reduce waste are necessary. For instance, ward rounds could limit the number of people entering that bed-space, if they aren't adding extra clinical care to the patient. An analysis of the variability of infection control precautions across sites for the same condition (such as VRE or MRSA colonisation) would be helpful to understanding the benefits and harms of these precautions.

An adjacent issue leading to increased glove use is that the use of non-sterile gloves can create a false sense of protection. Nurses at London's Great Ormond Street hospital realised that healthcare professionals were choosing to use nonsurgical gloves instead of washing their hands, when performing tasks that did not have an infection precaution requirement, such as medication administration or moving beds. When nurses started to remind staff that the gloves weren't intended for these purposes, glove usage went down and the hospital was able to cut its use of plastic gloves, saving 21 tonnes of plastic and £90,000 ($120,000) as a result.[18]

Previous published Australasian studies by McGain et al. in a single ICU reveal similar results.[14] Our study was from a larger, heterogenous population and includes multiple ICU types (tertiary teaching, metropolitan and private ICUs). We could not locate similar studies from elsewhere. Data from the UK NHS includes whole of hospital data only.

Our study was conducted during the COVID-19 pandemic period and the low recycling rates seen in our results may have been affected by COVID-19 protocols for waste disposal. Nevertheless, the 2021 point prevalence program days missed the COVID-19 pandemic peaks, with less than 1% of ICU patients diagnosed with COVID-19. Thus, we cannot adequately comment upon waste generated from treating patients with COVID-19. Almost one fourth of our patients had non-COVID infection control precautions in place, showing that there are high rates of colonisation or contact with resistant organisms in our ICUs. Hu et al. reported on the rise in use of single use plastics during COVID-19, and their findings are relevant in our patient group.[10] It is clear that some waste produced is considered hazardous (potentially infectious), but estimates suggest that this only accounts for about 15% of waste in hospitals, and the nonhazardous waste is where many of the reductions could occur.[19] COVID-19 also illustrated that supply chain disruptions can cause problems when hospitals rely on single use disposable items in lieu of reusable equipment such as gowns.[11] Furthermore, when waste itself cannot be completely reduced, it is increasingly possible to look for other waste solutions, such as using biodegradable single use items (such as gowns, kidney dishes or medication cups).

Ambient temperature control forms the vast majority of the ICU's energy consumption.[13] Reducing or increasing the set temperature by 0.5–1.0° is unlikely to have any significant effect on patients or staff but can reduce the energy consumption of ICUs significantly. Almost 90% of ICU staff surveyed were unable to alter the temperature of their own units, but perhaps they could collaborate with hospital engineers to undertake such changes.

Our prospective, observational study has limitations. The audit was performed over two calendar days, for a single 24-h period. Data were collected for each nursing shift, regardless of shift

Table 3
Items disposed of, comparing patients with and without the need for infection control precautions.

Numbers of items disposed of over 12 h shift	No precautions[a] (n = 525)	Infection prevention precautions[a] (n = 165)	*P* value
Aprons/gowns	7.5 (0–79.5)	19.5 (0–100)	0.000
Pairs of gloves	30 (0–198)	35 (0–208)	0.0065
Syringes	10 (0–112)	9 (0–90)	0.616
Masks	0 (0–24)	3 (0–49.5)	0.000

[a] Median, IQR.

length (8–12 h), and we extrapolated all data out to 12 h. Unlike prior ICU studies,[14,15] we did not quantify the mass of waste produced. We relied upon ICU staff completing the forms accurately and entirely. That is, there was no oversight of data collection accuracy nor did we obtain information about the proportion of staff who did/did not attempt the data forms. We did not distinguish between lightweight aprons and more robust, fully sleeved gowns, nor between different types of masks (N95 versus surgical). We also did not collect data on waste from food preparation. We did not ask about what are barriers to recycling at the bed space, and whether waste was being placed in the appropriate bin, as disposal of contaminated waste through incineration generates much a higher carbon footprint.[20,21] Finally, we did not collect data on the barriers and enablers of recycling in the various units.

5. Conclusions

This point prevalence survey across 51 Australian and New Zealand ICUs the first step in describing the opportunities to improve the environmental sustainability of healthcare in Australian and New Zealand ICUs. The next is collaboration to improve our ICU sustainability practices.

Author contribution statement

MA: Conceptualization, Investigation, Methodology, Analysis, Writing-original. **LT/DB/FM:** Conceptualization, Methodology, Investigation, Writing-reviewing and editing. **SK/NH:** Investigation, Data curation, Methodology, Writing- Reviewing and Editing.

Conflicts of interest

Dr Anstey, McGain are members of the Doctors for the Environment Australia.

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Appendix. Questions asked in the point prevalence survey

Sustainability

16 |__ __ . __| °C Ambient temperature in the ICU during study day

17 |__ __ . __| °C Maximum outside temperature during study day

18 Y N Staff in ICU can adjust the temperature within the ICU/unit

19 Y N ICU participates in recycling

- If No, *(go to question 21)*
- If Yes, *(go to question 20)*

20 Items recycled in your ICU *(select all that apply)*

- Y Soft plastics
- Y Hard plastics
- Y Paper
- Y PVC
- Y Metal

21 Y N Does your hospital have a sustainability officer?

22 Y N Is your hospital part of the Global Green and Healthy Hospitals Network or similar network of hospitals working on sustainability?

23 Y N Does your ICU have a documented protocol, policy or guideline for the replacement of CVC infusion tubing sets?

- If No, *(go to question 25)*
- If Yes, *(go to question 24)*

24 When is replacement of CVC infusion tubing sets as documented in the protocol, policy or guideline *(select only one)*

- Y 7 days
- Y 4 days
- Y Other *(please specify)* ____________________

Sustainability in the ICU

8.1 Patient requirement for PPE *(select only one)*

- Y Contact precautions
- Y Droplet precautions
- Y Airborne precautions
- Y Other
- Y No requirement for increased PPE

8.2 Length of shift including 10am on study day for which waste data collected in questions 8.3 & 8.4. *(select only one)*

- Y 8 hours
- Y 10 hours
- Y 12 hours
- Y Other *(please specify)* ____________________

8.3 Number of single use items disposed of from this bedspace during the shift that includes 10am on the study day

- Syringes |__ __ __| (total count)
- Gowns |__ __ __| (total count)
- Gloves |__ __ __| (total count)
- Masks |__ __ __| (total count)

8.4 Items recycled from this bedspace during the shift that includes 10am on the study day

- **a** Y N Paper/Boxes
- **b** Y N Glass vials
- **c** Y N PVC IV Fluid Bags
- **d** Y N Medication cups
- **e** Y N Metal Instruments

References

[1] Whitmee S, Haines A, Beyrer C, Boltz F, Capon AG, Dias BF de S, et al. Safeguarding human health in the Anthropocene epoch: report of the Rockefeller Foundation–Lancet Commission on planetary health. Lancet 2015 Nov 14;386(10007):1973–2028.

[2] Sherman JD, McGain F, Lem M, Mortimer F, Jonas WB, MacNeill AJ. Net zero healthcare: a call for clinician action. BMJ 2021 Sep 20;374:n1323.

[3] Malik A, Lenzen M, McAlister S, McGain F. The carbon footprint of Australian health care. Lancet Planet Health 2018 Jan 1;2(1):e27–35.

[4] Sustainable Health Care Archives [Internet]. DEA. [cited 2022 Jul 6]. Available from: https://dea.org.au/our-work/sustainable-healthcare/.

[5] OraTaiao [Internet]. OraTaiao. [cited 2022 Jul 6]. Available from: https://www.orataiao.org.nz/.

[6] Global Green and Healthy Hospitals [Internet]. [cited 2022 Jul 6]. Available from: https://www.greenhospitals.net/.

[7] Resources [Internet]. ANZICS. [cited 2022 Jul 6]. Available from: https://www.anzics.com.au/safety-quality-resources/.

[8] Greener NHS [Internet]. [cited 2022 Jul 6]. Available from: https://www.england.nhs.uk/greenernhs/.

[9] MacNeill AJ, McGain F, Sherman JD. Planetary health care: a framework for sustainable health systems. Lancet Planet Health 2021 Feb 1;5(2):e66–8.

[10] Hu X, Davies R, Morrissey K, Smith R, Fleming LE, Sharmina M, et al. Single-use plastic and COVID-19 in the NHS: barriers and opportunities. J Public Health Res 2021 Aug 4;11(1):2483.

[11] McGain F, Muret J, Lawson C, Sherman JD. Effects of the COVID-19 pandemic on environmental sustainability in anaesthesia. Response to Br J Anaesth 2021;126:e118-e119. Br J Anaesth 2021 Mar;126(3):e119–22.

[12] Hicks P, Huckson S, Fenney E, Leggett I, Pilcher D, Litton E. The financial cost of intensive care in Australia: a multicentre registry study. Med J Aust [Internet] 2019 Sep 9;211(7) [cited 2022 Jul 6], https://www.mja.com.au/journal/2019/211/7/financial-cost-intensive-care-australia-multicentre-registry-study.

[13] McGain F, Burnham JP, Lau R, Aye L, Kollef MH, McAlister S. The carbon footprint of treating patients with septic shock in the intensive care unit. Crit Care Resusc 2018 Dec;20(4):304–12.

[14] McGain F, Story D, Hendel S. An audit of intensive care unit recyclable waste. Anaesthesia 2009;64(12):1299–302.

[15] Kubicki MA, McGain F, O'Shea CJ, Bates S. Auditing an intensive care unit recycling program. Crit Care Resusc 2015 Jun;17(2):135–40.

[16] McGain F, Jarosz KM, Nguyen MNHH, Bates S, O'Shea CJ. Auditing operating room recycling: a management case report. A A Case Rep 2015 Aug 1;5(3):47–50.

[17] Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)—a metadata-driven methodology and workflow process for providing translational research informatics support. J Biomed Inf 2009 Apr;42(2):377–81.

[18] Mahase E. Sixty seconds on . . . gloves off. BMJ 2019 Jul 2;366:l4498.

[19] How do you fix healthcare's medical waste problem? - BBC Future [Internet]. [cited 2022 Mar 10]. Available from: https://www.bbc.com/future/article/20200813-the-hidden-harm-of-medical-plastic-waste-and-pollution.

[20] Fraifeld A, Rice AN, Stamper MJ, Muckler VC. Intraoperative waste segregation initiative among anesthesia personnel to contain disposal costs. Waste Manag 2021 Mar 1;122:124–31.

[21] Wyssusek KH, Keys MT, van Zundert AAJ. Operating room greening initiatives – the old, the new, and the way forward: a narrative review. Waste Manag Res 2019 Jan 1;37(1):3–19.