

A beginners guide to
Sustainability
in the ICU



Sustainability toolkit evolved from the ANZICS 2020 NZ ASM and Australian Quality and Safety committee sustainability e-conference.

ANZICS 2020 NZ ASM. Practical sustainability in the ICU and beyond Workshop. FASTHUGS for sustainability. Helen Polley, Debbie Wilson, Louise Trent, Forbes McGain, David Galler, Hayley Bennett, Jessie Smith.

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Endorsed by the ANZICS Board of Directors on 23 February 2022.

Suggested Notation to ANZICS: A beginners guide to sustainability in the ICU

ABN: 19 657 679 556 ISBN: 978-1-876980-56-6

A sustainability toolkit for ICU

Working in the Intensive Care, we are frequently responding to upstream failures to address the social determinants of health: issues such as poor nutrition, lack of exercise, poor housing, contaminated environments, smoking, and alcohol abuse. The recent bush fires and extreme weather events in Australia and New Zealand show that the consequences of climate change may increasingly impact on hospitals and intensive care departments. Tackling climate change and biodiversity loss requires urgent, immediate action. This climate crisis is also a health crisis.

Health care is a significant contributor to global pollution and so part of the solution, and this work must happen at all levels including with us in ICU. We should not get the urgent of COVID confused with the important of climate change as the most profound long term threat to the health of the world.⁽¹⁾

Our challenge ahead is to both reduce carbon and improve the health of our population. This challenge involves both reducing activities and reducing carbon intensity. Intensive care for our critically ill patients is by its very nature intensive, in both energy and care. Even so, we too have a role to play in helping this change take place by finding leaner pathways, using lower-carbon alternatives, and making our infrastructure and processes sustainable. We need to make sustainability part of the domains of quality care, along with safety, timeliness, effectiveness, efficiency, equitability and patient-centeredness.⁽²⁾ We should be aware in our sustainability actions to “do less” only where this is evidence-based and good practice and without disadvantaging or harming individual patients.

The most significant impact on intensive care carbon reduction long-term will be reducing people’s need for ICU through the primary and secondary prevention of illness. We need to industrialise prevention. Although our core work is centered at the bottom of the cliff, intensive care staff should use their influence and expertise to advocate for good self-care and preventative medicine whenever we can, both with ourselves, our patients, in better systems – like reducing rates of smoking, alcohol, diabetes and obesity, sepsis prevention, better trauma care, Patient at Risk services – and upstream in our community.

Social justice and equity must be kept central throughout climate mitigation and adaptation processes and our governments must ensure genuine partnership with our indigenous peoples.

Environmental sustainability in health care is a rapidly changing space. Much work is already happening locally, and many New Zealand and Australian health services and their sustainability teams will already have strategic intent across broad emission areas and have set reduction targets. The common areas of focus are energy, transport, waste, buildings, procurement, food, water, and pharmaceuticals, based on typical hospital carbon footprints.

This sustainability toolkit for intensive care collates ideas and actions we can do at our place. Sustainability as an integral part of intensive care practice is vital, and it is motivating to understand how simple changes can be very effective on a scale. This toolkit extrapolates ideas, case studies and research from health care settings, including ICU, when available. Over the next few years, we imagine there will be much more intensive care specific case studies and research findings to guide us in the race to low carbon and zero emissions healthcare. Further, it is quite evident that we are only at the beginning of ICU sustainability research. An environmentally sustainable ICU may seem an oxymoron, but through research and collaboration we can (and indeed must) get to low carbon ICU care. Get in touch with inspiring case studies for our next edition. Every single decision to act more sustainably matters, however small – let’s get going...

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Practice

Develop your medical practice to be sustainable

To what extent can our medical practice be sustainable? To varying degrees probably much more than we think.

We work in a place called “Intensive Care” where perhaps “doing more” and being intensive and interventional is considered how we do things. More isn’t always better however and there are a number of ways to conserve stuff without risking quality care as we do so. This is not a new concept in medicine and intensive care practice. Deliberate clinical inertia is the art of doing nothing as a positive response⁽¹⁾ As described by Keijzers this involves the clinician specifically focussing on solving problems and making optimal clinical decisions including overcoming cognitive biases to move from “more is better” towards more temperate critical thinking. They advocate that this mindset should be institutionally supported and start early in medical curricula. As intensivist Malcolm Fisher from Royal North Shore Hospital used to say: “Don’t just do something, stand there and think”. Gopalratnam et al also propose “less is more” when making diagnostic and therapeutic choices in the ICU and illustrate with several common ICU dilemmas. They state the guiding principle in ICU should be *primum non nocere*; where in delicate situations it may be better not to do something or even to do nothing rather than risk causing harm.⁽²⁾ Zampiere describes how we over test patients because we can and are afraid of missing important findings. They caution that care must be taken to avoid replacing the dogma of “more is better” with a dogma of “less is better” but rather generate strong scientific evidence showing “less of what “ is safe, so we transition from over-testing to effective and enough testing.⁽³⁾ The Zentensivist movement aims to create more clinicians and intensive care units with a pragmatic patient centred focus.⁽⁴⁾ This international multi-professional group describe a minimalist, essentialist approach to the practice of critical care medicine where clinicians provide evidence-based care in a competent, compassionate, and minimally burdensome manner.

Actively promote prevention

Industrialising prevention is the best way to “do less” by having less patients needing our services and moving most care upstream of ICU. Social value to our communities can be added through many practical actions in our hospitals that also mitigate the climate emergency.⁽⁵⁾ One of the key competencies of an intensive care specialist is that of Advocate and here we have a role to play in primary and secondary prevention of disease, as outlined in CICM Competencies for Training in Intensive Care Medicine [T-30](#), [T-36](#) and [T-26](#)⁽⁶⁾ ⁽⁷⁾ ⁽⁸⁾

“For the patient the trainee learns how to advance the health and wellbeing of individual patients beyond the care of the specific critical illness. Individuals need the expertise of intensive care specialists to address their general health issues. Identify the important determinants of health affecting patients including occupational and environmental exposures, socio-economic factors and lifestyle factors by assisting individual patients in navigating the healthcare system and accessing health care and resources.

For the community the trainee learns how intensive care specialists use their expertise and influence to advance the health and wellbeing of communities and populations beyond the walls of the ICU by public advocacy and committee membership and that their focus is on the interests and needs of society”⁽⁶⁾

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People

Carbon pollution is relevant to every health care worker, and everybody in ICU has a role to play in the race to zero-emission healthcare. Sustainability should be part of our core business and embedded in our everyday practice within our intensive care roles and broader lives.

▶ Examples of implementation: actions you can do

Actions for the Intensive Care Clinical nurse manager.

- Consider sustainability part of core intensive care business and role model good practice.
- Ensure that a sustainability group is one of the working parties that staff can belong to and that it is given support to do the work.
- Add sustainability initiatives to general intensive care quality meetings as a fixed agenda item.
- Add sustainability as a portfolio of an associate nurse manager, or similar role in your ICU, to get sustainability considered right across quality. Aim for quality improvement projects with PDSA cycles etc.
- It is essential that staff are regularly made aware of the cumulative positive effects of their efforts and that they have the support of senior leadership in their effort.
- Encourage and make available education about sustainability for staff to use their paid work study days as well as funding allowances to attend education with a focus of sustainability.
- Formally induct new staff on sustainability interventions in your unit.

Actions for Intensive Care Director / Head of Department.

- Value, support and prioritise sustainability initiatives in your ICU.
- Set departmental sustainability goals and the ICU sustainability direction.
- Contribute to sustainability metrics – CCR, ANZICS PPP.
- Consider environmental as well as financial costs of purchasing decisions.
- Get Intensive care representatives to hospital wide procurement/equipment groups and advocate for LCAs.
- Encourage sustainable green design in upcoming retrofits and rebuilds.
- Encourage teleconferencing for academic and administrative meetings.
- Embrace sustainability within your sphere of influence in the hospital.
- Be supportive of sustainability initiatives by your staff and beyond – be an early adopter.

Sustainability champions.

- Identify them.
- Recognise them.
- Celebrate them.

Actions for Intensive Care Sustainability Group.

- Identify sustainability champions within your workplace.
- Form a multidisciplinary group of people for the departmental sustainability portfolio.
- Be inclusive of anyone who wants to be involved. Consider nonclinical staff too like, care assistants, secretaries and cleaners, as diverse groups are stronger.
- Get involved on multiple levels in the hospital and beyond.
- Drive sustainability quality improvement projects and audit in the ICU.
- Conduct Sustainability research in the ICU.
- Manage Sustainability Communications within the ICU.

- Provide Sustainability Education sessions.
- Include a sustainability section for journal club or have your own sustainability journal club.
- Get involved in outside advocacy work.
- Liaise with sustainability officer and hospital sustainability group for organisation wide changes.
- Motivate staff through challenges/ competitions like active travel to work.
- Coordinate staff to volunteer sponsor supported community initiatives with equity focus.

Actions for Intensive Care Nurses.

- “Engaging staff in the effort to reduce the environmental impacts of ICU care offers many opportunities for education and idea generation. To a busy nurse in an adrenalin-filled ICU, reducing waste or saving energy may not be top of mind. To other nurses, who work hard to reduce waste, recycle, save energy, and water at home, it can be a frustrating experience to come to work and recognize the amount of resource use inherent in their daily work. Learning more about the links between resource use and health can help provide guidance and support for changing the way we practice.” Debbie Wilson NZ. Sustainability Champion.
- The Patient Care section outlines numerous sustainability actions at the bedside.
- Adopt a reduce mindset.
- Nurses are ideally positioned to be advocates for sustainability and climate friendly actions both within the ICU and beyond ⁽¹⁾

Actions for Intensive Care Doctors.

- Consider on a daily basis as part of the medical ICU round that “Doing Less Is More”, “Don’t just do something, stand there and think!”
- Be innovative and put a sustainability lens on your clinical practice. Tackle something in your practice/ unit that could be improved. Role model good sustainability practice day-to-day. The patient care section outlines numerous actions which reduce, reuse, recycle at the bedside. Many of these are regular evidence based intensive care practices.

Actions for ICU multidisciplinary team.

- Health care assistants’ cleaners and orderlies can play a large part in ensuring that recycling streams are being utilized effectively. If you have pro-active support staff who are happy to look at what is in bins and aren’t afraid to assist staff in getting it correct, you are going to have good quality waste reduction.
- Ward clerks and other ICU support staff can set the environmental scene in reducing paper and plastic waste at the front desk. These staff could be responsible for purchasing items for the staff tea room, for example second-hand items like mugs, cutlery, plates.
- Secretaries can be a valuable liaison with other departments and hospital sustainability officers.
- Allied health teams have a role to play in a more environmentally sustainable ICU. Mobilising patients both within and beyond the ICU bed reduces the need for patient turning and is at least psychologically and physically beneficial for the patient.
- Pharmaceuticals are a high carbon hotspot. Pharmacists can help reduce waste both by avoiding/ ceasing unnecessary pharmaceutical prescribing and assist ICU to deal with pharmaceutical waste safely.
- Dieticians can help by switching to enteral nutrition as soon as possible and considering plant-based proteins/fats/carbohydrates for oral nutrition.

Actions for research teams and educators.

- Participate in sustainability research.
- Sustainability research in the ICU is in relative infancy, there are numerous opportunities. Reach out to anaesthetic colleagues and local universities (at a more mature level of research) to learn how they began sustainability research.
- Include a sustainability topic in each nursing study day.

Share and learn with external teams.

- ICU nurses and doctors can showcase to non-ICU teams what’s happening in ICU sustainability and vice versa; cross pollination!
- A close relationship with a hospital wide sustainability officer and waste minimisation officer or equivalent is helpful within and between departments to build whole hospital action.

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Power

Focus within the ICU is on measures to reduce consumption and improve energy efficiency.

A large proportion of the total hospital energy use is for heating water and rooms. Within the ICU the predominant greenhouse gas (GHG) emissions come from energy use for heating ventilation and air-conditioning (HVAC). Consumables, lighting and waste contribute less.⁽¹⁾ GHG emissions depend very much on the energy source of the hospital and demonstrate the importance of switching to renewables, though they remain important and further research is required here. Reliance on coal-fired electricity needs to decrease as soon as possible. This coal reliance is particularly relevant to the east coast of Australia (in New Zealand, Tasmania, and South Australia the majority of electricity stems from renewables). Importantly, this coal reliance is beginning to change rapidly in Australia. NZ hospitals are also phasing out the remaining coal fired boilers, used for heating.⁽²⁾ We also need to transition rapidly away from fossil gas including natural gas. Unfortunately, even new hospitals are being built with gas, although a new Canberra Hospital is going 100% electric on renewables.⁽³⁾ There are increasing examples of energy efficient and sustainably designed hospital builds like Project Maunga Taranaki Base Hospital, part of which is targeting Net Zero Energy Certification.⁽⁴⁾

► Examples of implementation: actions you can do

Measure power use within your intensive care.

If individual departments in a hospital, like intensive care units, were provided with regular information on their energy expenditure this could help quantify their power-saving initiatives. Ask about the ability to measure power use within your ICU and whether an ICU specific power meter could be installed if it isn't already. Ask managers if savings made through energy efficient ICU initiatives could be used within the ICU for other sustainability actions. In the future ICUs could calculate the carbon cost in terms of energy use for an intensive care patient in Australian and NZ ICUs. This does depend heavily on source of power e.g. coal versus renewables, and would demonstrate how important the move to renewables is.

Reduce energy use from heating, ventilation and air-conditioning.

Always being cognisant that we are treating sick ICU patients, it is desirable to keep the ICU temperature between 18 to 25 degrees (approximately) depending upon your locale. This will still allow considerable HVAC energy savings for Summer/Winter in particular. If you have the ability to alter temperatures in your ICU, consider subtle changes depending on the season. Turn off unoccupied negative pressure type rooms when not in use. Simple measures like closing doors and closing curtains and blinds to reduce heat from the sun warming interior spaces will decrease air-conditioning too.

CASE STUDY:

Barts Health NHS trust - Operation TLC

“Operation TLC has become an award-winning behaviour-modification program, where training hospital staff to adopt simple energy efficient behaviours, (turning off unused equipment, switching off lights, closing doors) saves health organisations energy and money while also creating healing environments for patients.”⁽⁵⁾

Use energy efficient lighting and use less.

There are many ways to reduce energy use from lighting in your ICU. Firstly turn lights off manually, stickers on switches can help to remind people in non-automated systems.

Install light sensors to control lighting especially in infrequently used rooms. Fit energy efficient lighting like LEDs. Use natural light wherever possible.

SUCCESS STORY:

The green team at the Middlemore Hospital seized the opportunity to be involved in a lighting upgrade of the lights in the clinical area of the ICU. They were interested in improving the outcomes for staff and patients whilst being able to minimise energy consumption by introducing new LEDs. They trialled a range of lighting solutions including lighting controls because they recognised the impact of under and over lighting on patient and staff wellbeing. Ordinarily, clinical teams are less involved in these technical decisions, yet they are the specialists that connect the impact of technical decisions to both people and planet outcomes.

Turn off computers and equipment not in use.

Ensure equipment is off and not on standby. Turn off monitors and printers and enable automated sleep mode. Reduce monitor brightness. Remind people about switching off the TV in the staff room and patient waiting room or the radio that is not being listened to.

CASE STUDY:

Oldham hospital in the NHS developed an automated personal computer shutdown system at night with estimated decreases of 800 tonnes CO₂e per year and 41 000 pounds saved.⁽⁶⁾

Design energy efficient new and refurbished intensive care units.

“We would very much like to work in healthy, well lit, energy efficient hospital buildings. I think most healthcare professionals would. All NZ healthcare buildings should be rated to 5 Green Star above to help improve the value we get from buildings as long-term investments and to create future environments in which our patients, families and their families thrive” David Galler, Intensivist.

A new ICU facility is the best opportunity to build energy efficiency into an ICU designed for wellbeing of patients and staff. All new health infrastructure should provide high performing healing environments, be climate smart, adaptable and resilient and generate wider health outcomes.⁽⁷⁾

New Zealand and many Australian states are committing to carbon neutrality in government sectors and this will drive change.⁽⁸⁾

“Biophilic Design is the integration of natural elements into the built environment to increase user connectivity to the natural environment. The fundamental challenge of biophilic design is to address the deficiencies in the modern built environment by initiating a new framework for the beneficial occurrence of nature.”⁽⁹⁾

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Procurement

Purchasing is a large component of health care's carbon footprint. Of the 2019 NHS footprint, 62% came from the supply chain, 24% from the direct delivery of care, 10% from staff commute and patient and visitor travel, and 4% from private health and care services commissioned by the NHS. ⁽¹⁾ This is similar to the Australian Healthcare's supply chain footprint. ⁽²⁾ Greenhouse gases are categorised into 3 scopes for purpose of carbon accounting. Scope 1 is direct emissions from owned or controlled sources. Scope 2 is indirect emissions from the generation of purchased energy by the organisation. Scope 3 is other indirect emissions from activities not owned or controlled by organisation. Procurement sits in scope 3 emissions for hospitals.

▶ Examples of implementation: actions you can do

When purchasing consider whether a reusable option is available.

Instead of using and procuring single-use items, choose reusable alternatives or consider using items which are biodegradable and/or compostable. Reusables are more favourable in NZ with more renewable power than Australia where energy sources are more generally coal powered (see above).

Consider reprocessed single use medical devices.

Reprocessing single use medical devices involves disinfection, cleaning, remanufacturing, testing, packaging, labelling and sterilisation of a used medical device by a third party to be put into service again. This eliminates the most carbon intensive parts of processing. NZ Medical reprocessing company [Medsalv](#) explains reprocessing can generate key benefits such as direct reduction in carbon emissions per unit (and waste), improved cost efficiency and improved environmental sustainability for hospitals. ⁽³⁾

Approximately 1200 medical products can potentially be reprocessed (also known as [medical remanufacturing](#) utilising a circular economy model). ⁽⁴⁾

Use product stewardship programs – can manufacturers take back products/waste?

Product stewardship is a policy tool that ensures that the people and organisations who make, sell, use and dispose of a product share responsibility for ensuring that the product is effectively reduced, reused, recycled or recovered (in that order) minimising the product's impact on the environment, human health and safety. Some examples of current medical product stewardship programs include [PVC recycling in Hospitals](#) and recycling of aluminium canisters of gas anaesthesia. ⁽⁵⁾ The [Australian Packaging Covenant](#) aims to increase the proportion of packaging that is recycled to be 50% by 2025. ⁽⁶⁾

Review evidence for new and replacement medical devices before purchase and question suppliers about their products.

Ask the manufacturing company about the environmental credentials of any new and existing products you review for replacement in your ICU. What makes their product better in terms of its environmental impact? Is the product more energy efficient than its predecessor? Is there a full life cycle analysis LCA available? Mostly there isn't yet but normalising this will help signal to suppliers and manufacturers that this is something we require. Is the company itself embracing a carbon zero future? Does the company have a reusable option? Work with procurement, sterile services and facilities (including sustainability officer) to develop a Life Cycle Costing Tool, including waste streams, weights and costs. Develop this tool where possible to include energy consumption, and embodied/ operational carbon. Evidence also changes, examine whether you actually need the product.

Get representatives on your hospital/procurement committee and capital equipment groups.

Aim to improve environmental, social value, and economic outcomes in relation to patient outcomes by including sustainability in procurement decisions.⁽⁷⁾

Actions could include:

- Advocating for environmental criteria in procurement contracts. Consider buying only from suppliers that have a plan to address their environmental responsibilities quantifiably.
- Reducing the carbon footprint of purchases. Use for LCA to make informed choices.
- Considering reusable and multiuse options over single use equipment and consumables.
- Standardising where possible across the hospital (state/country).
- Consider packaging on products - can it be returned to suppliers.

Consider alternative stocking systems to avoid waste at the bedside – especially patients with Multi Drug Resistant organisms.

Label your storeroom and bedside trolley with prices. Assisting staff to know how much products cost often makes them think twice about opening a packet unless they are SURE they need it.

Do a stock take of your ICU supplies and consider environmentally preferable purchasing.

By engaging in environmentally preferable purchasing, a purchasing approach that evaluates goods and services for their effects on human health and the environment, the ICU team can evaluate goods across the lifecycle from production to disposal, avoiding products that have the potential to harm human health and the environment.

Manage stock volumes to avoid expiry.

Share expensive medical equipment with another department.

There is much to be gained by sharing costly, major equipment in your ICU with other departments nearby. This may be especially pertinent for expensive infrequently used equipment or for smaller ICUs and hospitals. Initiate LCA studies to assess Life Cycle impacts.

1. Tennison I, Roschnik S, Ashby B, Boyd R, Hamilton I, Oreszczyn T, et al. Health care's response to climate change: a carbon footprint assessment of the NHS in England. *The Lancet Planetary Health*. 2021;5(2):e84-e92.

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Processes, policy and procedures

There are multiple ways to apply a sustainability lens to how we do things within our ICUs, from education, quality improvement and research right up to the development of ICU services like PAR. We must communicate our sustainability success stories with our staff, the wider hospital and our intensive care community so we can learn from each other and move to a lower-carbon system faster.

► Examples of implementation: actions you can do

Communicate sustainability actions and successes.

Have a staff information board/hub where information related to sustainability can be shared and displayed. Share sustainability news in regular staff communications.

Successful sustainability related case studies should be shared more widely within our hospitals and amongst our intensive care community.

SUCCESS STORY:

Wellington ICU includes a sustainability section in monthly staff newsletter and includes clinical updates about sustainability group initiatives.

SUCCESS STORY:

CMDHB Critical Care Complex in South Auckland began an environmental group in 2014. Every 2-3 months a new environmental topic is displayed across a notice board so that staff can read new info or get ideas. Every member of the EPICC group chooses a topic they want to do and a roster is drawn up; members can help each other on a topic. Once info is taken down it is stored so it can be reused or rehashed the following year or whenever it may be appropriate. Topics include Composting, Xmas gifts & decorations, FAQ about Climate Change, water saving ideas, energy saving ideas.

Consider sustainability aspects on all policy, guideline and procedure review at quality meetings within the ICU.

Create a mindset of rethinking and reducing consumption amongst ICU staff.

Recycling is not as cool as minimising waste and we need to get the world thinking this way!

Promote and educate staff about product choice e.g. instead of using an expensive dressing, could a cheaper product that is available be just as effective? Labelling consumables with the cost per item can help staff choose wisely.

Add sustainability relevant articles to ICU journal club.

Add sustainability relevant articles to your regular journal club or have a specific sustainability journal club run by your green group. Discuss a range of articles and reviews on sustainability and also those areas of practice where the evidence base supports “doing less”.

Get involved in sustainability research and sustainability quality improvement.

Intensive Care researchers have the opportunity to expand the evidence base for ICU environmental sustainability. There are also many quality improvement projects that staff/trainees could work on that are not as costly or time consuming as research questions.

Some examples of research and quality improvement questions:

1. Life cycle analysis for a resource or process in the ICU e.g. renal replacement therapy (say compared with standard dialysis on wards/at home - the latter is well known), tracheostomy insertion, isolation room ventilation and air conditioning.
2. How much do patients value environmentally sustainable intensive care?
3. How does the carbon footprint of reusable PPE gowns compare to disposable PPE gowns?
4. How much climate change induced illness is presenting to intensive care in Australia and NZ?
5. What is the environmental impact of unnecessary radiological and blood testing investigations in the ICU?
6. Premade clinical procedure packs – how much of each pack is used in practice and how can the packs be improved?
7. Are there any practical ways we could return to greater use of reusable equipment in the ICU?
8. How do we work with pharmaceutical companies to reduce the environmental footprint of the ICU?
9. Are there any companies that would be willing to work with ICU physicians to take back their 'waste' and begin the transition to a circular economy?

Are you a trainee who wants an idea for a sustainability project? Get in touch with your local sustainability champion, reach out to anaesthetic colleagues and local universities (at a more mature level of research) to learn how they began sustainability research. If you're really stuck contact ANZICS and they will put you in touch with someone to guide you.

Go green for education and training.

Continue the virtual education revolution that the COVID pandemic has kickstarted.

Use green event planning principles for big education events you are involved in. All medical conferences should strive to minimise, measure and offset the proceedings and become carbon neutral.⁽¹⁾ All conferences should offer virtual attendance.

The total travel emissions for delegates to attend international critical care conferences can be staggering.⁽²⁾ Look at the staff travel on your hospital's carbon footprint; Senior medical officer travel is a big part of it and will make you think! At Hawkes Bay DHB this has fallen 75% between 2017/18 (36%) and 2019/20 (11%) due to COVID travel restrictions. Encourage discussion of environmental cost/ benefit of travelling for CPD, these conversations certainly seem easier than pre COVID. Discuss creative ways to build community where virtual meetings do not satisfy that goal.

Formally educate new ICU staff about the sustainability initiatives during induction programs, on orientation booklets and include an explanation of the underlying rationale to develop that Reduce mindset.

Integrate Health effects of Climate change and environmental sustainability into registrar and Intensive care nursing teaching programs.

Telemedicine for ICU.

Health related travel adds up, in England it accounts for 5% of all road travel.

Use videoconferencing when appropriate and convenient for family /whanau of intensive care patients.

ICU doesn't run many clinics, but we can do our bit. Use telemedicine for post ICU clinics and follow-up even if it's to determine who needs specific further help – if setting up this service consider telemedicine component.

Develop your Patient at Risk Service.

An effective PAR service will prevent some patients from needing ICU/ HDU care by early detection of deterioration and also drive teams to discuss goals of care with their patients. This an important part of secondary prevention of critical illness.

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2. Wooldridge G, Murthy S. Pediatric Critical Care and the Climate Emergency: Our Responsibilities and a Call for Change. *Front Pediatr*. 2020;8:472.



Plastic and pollution/waste

Waste does not add many carbon emissions to a hospital's total footprint – about 5%, but it is very visible, and therefore it is an excellent tool for the ICU to role model sustainable behaviour. Remember, the mantra is to reduce waste first, reuse if possible and then recycle, so recycling is not always the best solution.

Teaching the staff and public is a big step in the right direction. A lot is starting to happen in the waste space, from product stewardship, procurement criteria to reprocessing, which is very exciting and rapidly changing. Due to localities and regional ability to deal with the different waste streams, there is currently much variability in how various ICU's and healthcare facilities deal with their waste. This guide is to give you some pointers and encouragement – look at what others are doing and see if it can be replicated in your area. You might find a different waste solution that others can use too. If you see a problem, then look for a solution, be creative!

► Examples of implementation: actions you can do

Recycle better and more.

There are wide variations in options for recycling across Australia and NZ with some hospitals like Children's Health Queensland managing up to 35 segregation streams for hospital waste and other hospitals very little. Australia has a wider range of options for hospital recycling via private waste contractors than NZ. As demand for services grows, more companies offering alternative recycling will be viable. Find out what you can recycle in your hospital and in your area.

Some simple tips for better recycling at the bedside are:

- Get the right systems in place to make it easy for the bedside nurses to recycle.
- Create enough space to segregate the recycling streams.
- Display posters on what can and cannot be recycled.
- Label your area well and ensure items are clean.
- Educate your staff regularly about waste streams available especially as more streams are introduced. Clean the recycling and educate about contamination.
- Audit your progress.

CASE STUDY:

Sir Charles Gairdner Hospital ICU Perth shows how a simple recycling initiative can have noticeable impact. A nurse lead ICU Recycling Initiative was started in 2018 which has resulted in the amount of recycled material increasing 10X (see appendix 1).

Global green and healthy hospitals have many international [case studies on waste](#) which may be relevant to ICU. ⁽¹⁾

[War on waste hospitals](#) was very successful in highlighting the waste issue and innovations in the health sector. ⁽²⁾

Better segregation of waste streams and cost awareness.

Educate your ICU workforce to ensure you are using the right containers for waste streams – biohazard, clinical, non-clinical waste, cytotoxic etc. If your hospital doesn't have a specific education guide this useful resource from Health Victoria – [Clinical and related waste guidance supplement for health care](#) summarises waste streams and ways to minimise contamination. ⁽³⁾

Make your ICU staffroom area more sustainable.

Actions could include:

- Have department cutlery/crockery to reduce takeaway containers.
- If worried about infection control encourage staff to bring own coffee cup, utensils, containers. If possible, make space for storage of these.
- Welcome new staff with reusable coffee cups for the hospital coffee run.
- Consider composting staff food e.g. Bokashi bins, coffee grounds for people's gardens.
- Use vegetarian catering for department events.
- Discuss and disseminate the [EAT-Lancet](#) planetary diet. ⁽⁴⁾ International evidence shows that healthy and sustainable diets need to be more plant-based than current patterns. ⁽⁵⁾
- Set a goal of zero staffroom waste to landfill and motivate staff to achieve this.
- Replicate recycling streams within the staffroom.
- Use Circular recycling e.g. Nespresso takes back used aluminium foil coffee grinds, Fonterra take back their empty bottles so a collection point in the staff room for these is a good idea.
- Consider items that are biodegradable and compostable, there is an increasing number of suppliers of eco packaging and supplies.
- Create a ICU staff garden area for relaxation, fruit composting and food.

SUCCESS STORY:

Wellington ICU have a reusable 'keep cup' shelf in the tea room, near the door to the hospital coffee shop. This is for communal cups, and we encourage staff to bring in unneeded ones from home. Also new employees to hospital get given a reusable cup on generic orientation day. Relies on staff to take to cup shelf on unpacking dishwasher.

We have had some success with staff taking home staffroom food waste for home composting/worm farm, and their pigs – double effect as this also means they do not need to buy as much food for their pigs.

Incentivise ICU staff to consider alternative travel options especially active transport.

Discuss the co-benefits of active transport to personal health and the environment and really how it's just much more enjoyable than being stuck in traffic and struggling to find a carpark. Measure your whole of ICU staff travel carbon footprint and make a target to reduce. Make it fun with activities like staff competitions for active transport within ICU or even between hospital departments. Create incentives for public transport/active transport. Create or join rideshare programs that facilitate carpooling for staff starting shifts together. Get behind the push to get more electric vehicle charging stations in hospital staff carparks. By identifying safe routes and providing infrastructure such as bike racks, plugs for e-bikes and scooters, e-bikes for staff to use and changing facilities, your hospital can dramatically reduce its overall impact – talk to your hospital sustainability officer and management if these facilities need improvement. Encourage and normalise online participation at meetings on staff days off e.g. Zoom availability rather than coming in from home.

CASE STUDY:

Hawke's Bay Hospital's [Go Well Travel Plan](#) ⁽⁶⁾

Rehome your unneeded equipment in a developing country.

Organisations like Take My Hands, Medic Aid Abroad, Medearth, Airborne Aid, and Medical Pantry recover medical equipment in New Zealand and Australia.

- **Take My Hands**

"[Take My Hands](#) is social enterprise that connects those that have, with those that need it. We are collecting usable medical equipment and resources that can no longer be used in New Zealand and redistributing them to organisations that work with those in need in the Asia Pacific Region. So far, we've sent over 94,000kg of equipment to 15 different countries, helping more than 281075 people, creating over \$9 million in impact, and all for under \$43,000. Recently we have grown into connecting those with knowledge and expertise with those that requires a cross sector collective practice approach. We are focused on building biomedical expertise in the Pacific" ⁽⁷⁾

- **Medical Aid Abroad**

“Established in Christchurch (NZ) in 1965, [Medical Aid Abroad](#) is a not-for-profit charitable trust which assists health work in developing countries, by donating surplus medical, surgical and pharmaceutical supplies, from within New Zealand.”⁽⁸⁾

- **Medearth**

“[MedEarth](#) helps protect and enhance our natural environment by working with a range of partners to recover usable medical supplies and equipment that hospitals no longer want and would otherwise be destined for landfill. Australian hospitals generate a large amount of medical solid waste each year. Much of that solid waste is unused medical supplies and equipment. As part of our environmental protection program MedEarth redistributes the medical items we recover to communities in desperate need of them.”⁽⁹⁾

- **Airborne Aid**

“[Airborne Aid](#) are an international non-profit organisation based in Australia, connecting medical aid with destinations in need of your free luggage space”⁽¹⁰⁾

- **Medical Pantry**

[Medical Pantry](#) is an Australian organisation that rescues used medical supplies and equipment and delivers to underserved communities.⁽¹¹⁾

Do a waste audit in ICU.

Waste audits are a great way to suss out how your different waste streams are being used, and where opportunity for education, awareness, and guidance lies.⁽¹²⁾

CASE STUDY:

Hawke’s Bay Hospital’s last site-wide waste audit showed that 25% of general waste could be diverted from landfill, and 15% of clinical waste could be recycled, composted, or put into general waste (saving money). Within the ICU, 11.4% of recyclable material was put in general waste. This small-scale waste audit gives a better understanding of recycling opportunities.

Waste audit guidelines, like Victoria’s [Health Service Waste Audit guidelines](#), are available to assist with this useful activity.⁽¹³⁾

Reduce paper use in the ICU.

- Even small-scale ICU change can make noticeable differences to paper waste production.
- Think before you print - Confidential paper is expensive to destroy. Use locked Print.
- Make Double sided printing the default setting on all ICU computers.
- Reduce paper copies for meetings / education activities - Chairs of meeting send long documents electronically.
- Limit colour printing.
- Encourage systems for electronic storage and data transfer like online referral forms if you don’t have already.
- Use recycled paper and recycle paper.⁽¹⁴⁾

Make waste segregation as easy as possible at the bedside.

Simple changes in process at the bedside can reduce waste and incorrect waste disposal. Place recycling area as close to clinical areas as possible. Have care associates engaged with waste management at the bedside. Audit the number of bins to reduce costs and the use of plastic bag bin liners – think about whether an adjacent space could share bins. Encourage cleaners to empty rubbish bins only when full or use smaller bin bags if bags are to be emptied every shift.

Reuse sharps bins.

Reusable sharps bins are an option.

Repurpose waste thoughtfully to your community.

Unwanted goods and unused stuff can be thoughtfully donated to staff and your local community. Upcycling, repairing, repurposing unwanted and unused goods from hospitals keeps this out of waste streams.

Opened multipacks that haven't been used can be donated to Vets.

Blue sterile wrap can be donated to vets or house moving companies for wrapping where recycling option is not available. Some packaging boxes from medical supplies make excellent home storage boxes. Preschools love coloured lids and suture containers and other craft supplies from clean packaging/boxes/containers are useful for STEM projects in schools. Propofol bottles make lovely decorative lights at events. All the fisher people in your life should have a good, single use (used) set of artery forceps in their tackle box!

Partner with local charities in your area too and get creative with your waste.

CASE STUDY:

Hawke's Bay local charity Re-Source

Single use socks provided to patients in a private ophthalmology theatre and worn once are upcycled by local charity Re-source to a local primary school. They have nonslip soles which are perfect for children who arrive at school with cold wet feet. 3 Hawkes Bay ICU whanau room couches were donated to charity Re-source and were cleaned and delivered to a thankful client that afternoon.

CASE STUDY:

Wellington ICU have a 'repurpose shelf'. An allocated shelf in tea room for things that people are likely to want or be able to reuse, e.g. batteries that still have life left in them but not enough for clinical equipment – staff take home for kid's toys, remotes etc. Large zip-lock plastic bags that packaged medicine is supplied in, 'My food bag' style insulated packaging – wool used for composting or gardens. Also includes items from home that people think would be of use to colleagues e.g. kid's toys, books, etc. Anything that has not been taken after a period of time gets donated to a second shop.

1. GGHH. Case Studies from GGHH Members- Waste 2021 [Available from: <https://www.greenhospitals.net/case-studies-waste/>].
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8. Medical Aid Abroad - MAA [Medical Charity]. Available from: <https://maa.org.nz>.
9. Medearth [Available from: <https://www.medearth.org>].
10. Airborne Aid [Available from: <https://www.airborneaid.org.au>].
11. Medical Pantry [Available from: <https://medicalpantry.org>].
12. Kubicki MA, McGain F, O'Shea CJ, Bates S. Auditing an intensive care unit recycling program. *Crit Care Resusc*. 2015;17(2):135-40.
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Pharmaceuticals

These are an important part of healthcare, and intensive care is a significant pharmaceuticals consumer, however they do form a large part of our scope three emissions due to their manufacturing process, the procurement process and for many of them the carbon miles required to land them where they are required. Pharmaceuticals contributed 20% of Australian total CO₂e emissions.⁽¹⁾ The life cycle assessment of pharmaceuticals is rarely done so although we know they must contribute to scope three emissions there is no accurate documentation of such.

► Examples of implementation: actions you can do

Reduce: review the drug chart daily.

Review the drug chart daily and cross off what is no longer needed.

Watch for overprescribing. Review patients' admission medications, some may not be needed after the critical illness episode.

E.g. Antibiotics – Can we stop one of them? can the antibiotic duration be shorter?, can we head from IV to oral? Housekeeping – Do we still need PPIs and enoxaparin?

Reduce: avoid inadvertently leaving patients on ICU specific prophylaxis after discharge.

Make sure doctors doing discharge drug charts know when to stop intensive care specific prophylactic medications that may no longer be needed, e.g. omeprazole.

Reduce: draw up the minimum practicable number of syringes for drugs.

Reduce: leave emergency drugs unopened but immediately available.

Half of drugs drawn up for emergencies end up being discarded unused.⁽²⁾ Prefilled emergency drug syringes from pharmacy or purchased have a longer shelf-life so can reduce waste.

Reuse or limit the amount of pharmaceuticals discarded.

Reuse and limit the amount of drug discarded across an ICU. This is particularly pertinent to paediatrics and tiny people needing tiny quantities of drug.

Consider dilution changes to make drugs more titratable by infusion.

E.g. fentanyl 10mcg/ml rather than neat 50mcg/ml reduces amount of fentanyl used by infusion. Don't open large vials when a smaller vial will do for the job.

Rethink plastic e.g. use paper pill cups not plastic.

Recycle drug trays, instrument trays, containers for cleaning solutions.

Replace single use drug trays, containers or cleaning solutions and instrument trays with reusable varieties – put these in your premade packs and educate and also remind staff that they don't get thrown away.

There are also compostable options for drug trays.⁽³⁾

Recycle glass.

Check which pharmaceutical glass can and can't be recycled within your organisation. Empty medication vials may be recycled in clear glass recycling streams (along with other clear glass, including formula bottles from SCBU etc.). Make sure that all regulations and policies around the disposal of pharmaceutical waste are being adhered to and ensure that partially used bottles go into biohazard waste.

CASE STUDY:

Wellington ICU encourage staff to remove the caps from 100ml Propofol bottles to recycle the glass – this relies on individual bedside staff to remove caps and extract all drug content. (Including teaching to ensure people have a good technique and do this safely), recycle it.

Take care with pharmaceutical waste.

All ICUs must ensure that pharmaceutical waste is correctly disposed of and train staff in the procedure relevant to their organisation. Saline, sugar and nutrient solutions can be put down the sink/sluice however pharmaceutical substances must not be put directly into the environment, down sinks or flushed. They should be placed in biohazard waste.⁽⁴⁾

Become “critical consumers” and purchasers of pharmaceuticals.

Individual clinicians and intensive care units may not have much control over pharmaceutical procurement within the wider hospital or country but can use opportunities that do arise with pharmaceutical companies for advocacy. Ask about the environmental credentials for your pharmaceuticals and what makes the drug better in terms of its environmental footprint. Request life cycle analysis LCA studies, they are quite rare currently. In a LCA of morphine, the final stages particularly sterilisation and packaging accounted for more than 90% of its carbon footprint. This is likely to be similar for many drugs.⁽⁵⁾ By making enquiries about environmental costs, sustainability and the existence of alternatives clinicians can advocate for more work in this area. Environmental rating for drugs in the future may allow preference for those medications with lower environmental impact. The Stockholm Drug Therapeutic Committee Janusinfo website provides drug information to support healthcare professionals in their everyday work, including an environmental classification of pharmaceutical substances. Their Hazard score expresses the inherent environmentally damaging characteristics of the active substance with values 0-9, best to worst.⁽⁶⁾

Anaesthetic gases in ICU and ED.

Anaesthetic practice worldwide is moving away from the most environmentally harmful anaesthetic gases e.g. desflurane and nitrous oxide, in favour of gases with lower global warming potential (GWP).⁽⁷⁾ Although the use of anaesthetic gases is infrequent in ICU being aware of the huge environmental impact of some anaesthetic gases is vital. Emergency departments also use nitrous oxide for procedural analgesia (GWP 298) and encouraging methoxyflurane use (GWP 4) would be a more environmentally sustainable substitution.

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Patient care – general and systems based

Bedside patient care has numerous potential sustainability actions that can be ecological as well as economical. Many of these are already part of our core practice, but we may not have considered them sustainability actions as such. The following system-based lists are by no means exhaustive, instead collated to stimulate clinicians to develop a sustainability orientated REDUCE mindset where we reduce low yield and unnecessary care and unwanted variation. There are numerous ways to conserve stuff without risking quality care as we do so. Focus here on the R's; Refuse, reduce, reuse, recycle, rethink, repurpose and research.

► Examples of implementation: actions you can do

General

Develop a reduce mindset.

Choose your bedside actions with the “more is less” and REDUCE mindset which includes reducing low yield care and investigations in ICU. The international “choosing wisely” initiative makes specific recommendations for many specialities including intensive care. This can be broadened out to include other research where “less” is effective management. This does not mean withholding appropriate treatments and care for patients for sustainability's sake. The Zentensivist movement aims to create more clinicians and intensive care units with a pragmatic patient centred focus.⁽¹⁾

Create a healing environment – reduce noise, reduce lights, reduce toxic chemicals.

The ICU is a very noisy environment with alarms, beepers, overhead pagers, and staff conversations. The typical ICU has average sound levels of 55 to 70 dB(A), with pagers and alarms recorded at 84 and 79 dB(A), respectively, with peak sound levels in the ICU from 100 to 120 dB(A).⁽²⁾ Noise in the ICU environment has been shown to cause sleep disturbances, and there is a positive correlation between ICU delirium related to sleep deprivation and ICU sound levels. There are a number of ways nurses can be change agents to reduce the noise in the ICU. Alarms can be set on the basis of patient needs, not to the default, so that unnecessary alarms do not sound. Staff conversations have been found to be one of the largest contributors to hospital noise. Besides noise from alarms and monitors, many of these devices can also cause visual disturbances with flashing numbers and lights. The ICU rooms may not have natural light and the lighting in the room may be jarring, bright overhead lights. Natural light should be used as much as possible, as patients exposed to more natural sunlight have been shown to use less pain medication, report decreased stress, and have improved sleep quantity and quality.⁽³⁾ Even better, having a window looking out to a garden or a natural environment can result in decreased stress levels and a fewer pain medicine.

Don't order diagnostic tests at regular intervals – only when indicated to answer a specific question.

We may perform many tests simply because we can and because we hesitate to change longstanding routines. We need to move from this over testing to effective and enough testing.⁽⁴⁾ Environmental impact, together with cost effectiveness and health outcomes, should be considered when ordering all tests. The most effective approach to reducing the carbon footprint of pathology is to reduce unnecessary testing.⁽⁵⁾

CASE STUDY:

[Choosing wisely Australia](#) - “more is not always better when it comes to healthcare”

Choosing Wisely Australia® is part of a global healthcare initiative to improve the safety and quality of healthcare by promoting a national dialogue on unnecessary tests, treatments and procedures. ANZICS and CICM belong to this initiative and its members have identified 5 evidence based recommendations on end-of life care, invasive devices, anaemia, sedation and antibiotics.⁽⁶⁾

Don't open stuff until you need it.

Avoid routine opening of consumables in case of emergencies. They can still be ready to go in their packaging without being opened.

Minimise stocked supplies at the bedside.

Explore alternative supply stocking in infection control bedspaces.

Don't start everything again fresh when patients arrive in ICU.

When a new patient admission arrives in the ICU often drugs and equipment are replaced, and laboratory tests repeated. Consider using up drugs already drawn up, continuing to use single use equipment like ECG dots and not doing a full new set of routine laboratory tests.

Some single use equipment can stay with the patient throughout the hospital journey.

Is there a reusable option available for my patient today?

Place some single use items used by a patient into a bag for further use as they journey through the hospital system. Stuff like O2 masks and tubing, bag masks. Choose reusable options when available.

Sustainable patient food and drink options.

Advocate with catering staff for reusable products for food and drink containers in the ICU. Avoid single use plastic bottles for water if there are washable crockery options. Consider items that are biodegradable and compostable if reusable is not an option. Avoid single use cups and straws for patients.

Champions in your hospital food service can drive change toward sustainable food services.⁽⁷⁾ They can promote the use of sustainably sourced local food and likewise implement the planetary diet within hospital catering services. There are many [GGHH](#) case studies on food.

Cardio-respiratory

Reduce: appropriate use of high flow oxygen.

High flow oxygen is a great clinical tool. Do however consider when it's not necessary and other simpler devices like low flow nasal prongs or facemask oxygen will suffice for the clinical situation.

Reduce: is a conservative oxygen saturation target appropriate for this patient.

The ICU-ROX trial⁽⁸⁾ of conservative oxygen therapy during mechanical ventilation in ICU should restore equipoise about oxygen therapy in the ICU but it is not a definitive answer. We don't know yet which intervention is best usual or conservative oxygen therapy. The Mega ROX study currently recruiting 40,000 patients is powered to detect a small mortality effect that matters and will hopefully answer this question for different patient groups too.

Spontaneous breathing trials.⁽⁹⁾

Peripheral pressors are appropriate for some patients to avoid central venous access.

Metaraminol, adrenaline, noradrenaline, dopamine, dobutamine and phenylephrine in low doses peripherally can be safe and effective in the right patients. Clinicians should not regard the use of vasoactive drugs is an automatic indication for central venous access.⁽¹⁰⁾

Reuse: can we use reusable airway equipment rather than disposable.

LMAs, laryngoscopes, video laryngoscopes and face masks all have reusable brands. These will save money and decrease carbon footprint depending on the prominent form of energy for the hospital.⁽¹¹⁾

Use reusable blood pressure cuffs.

For all use and cleaning scenarios, the reusable cuff was environmentally preferable in terms of GHG emissions and other impact categories, in some cases by a factor of 40.⁽¹²⁾

Reduce mean arterial pressure target and use less vasopressors.

In patients without hypertension an initial MAP can be targeted at 65- 70mmHg in sepsis and then moved up or down based on organ and tissue perfusion assessments. ^{(13) (14)}

Reduce unnecessary CXRs

Do I really need a routine CXR today? A more restrictive strategy of ordering CXRS for specific indications only may be appropriate and is generally safe. ⁽¹⁵⁾

Refuse Early Goal Directed therapy (EGDT)

EGDT is not better to usual care for patients with septic shock in the Emergency Department and is associated with increased use of intensive care resources. ⁽¹⁶⁾

Promote the switch to greener inhalers.

Metered dose inhalers contain propellants known as hydrofluorocarbons (HFCs) which are powerful greenhouse gases. Many people will be able to achieve the same benefit from dry powder inhalers (DPIs). Metered dose inhalers have estimated carbon footprints of 500g CO₂eq per dose, compared to 20g in DPIs. Rates of prescribing for DPIs are high in Sweden 70%, compared to UK 13% and Australia and NZ. ^{(17) (18)}

Explain the environmental benefits of a greener inhaler to patients on MDIs and suggest further discussion with their GP to move to DPIs where appropriate. The impact of switching one MDI to a DPI could be a personal lifestyle change equivalent to cutting out red meat. ⁽¹⁹⁾

Avoid use of MDIs in ICU by using ventilator and oxygen driven nebulisers.

Reuse disposable saturation probes.

SUCCESS STORY:

Wellington ICU – Single patient use saturation probes, wipe these down, and reattach a new tape so these can be reused. Tape available from manufacturer.

Neurological

Undertake daily attempts to lighten sedation in ventilated patients unless contraindicated. ⁽²⁰⁾

Deeply sedate mechanically ventilated patients only if there is a specific indication. ⁽²⁰⁾

Aim to discontinue sedation as soon as possible.

Try nonpharmacological measures for sleep first.

Limit routine use of antipsychotic drugs to manage symptoms of delirium.

Gastro-intestinal

Reduce: don't overprescribe stress ulcer prophylaxis.

In SUP-ICU Pantoprazole reduced the incidence of clinically important GI bleeding by 1.7%, yielding a number needed to treat (NNT) of 59. This suggests that SUP should be restricted to a more highly selected population of patients, who are at greater risk of stress ulceration. Further work is needed to define which patients may benefit from SUP. There is probably a role for it, but we are using it too often. ⁽²¹⁾

Reduce: stop acid suppression medication in patients established on enteral feed except in high-risk group.

Patients started on SUP should have it ceased on discharge.

Patients started on SUP in ICU should have it ceased on discharge. A simple bundled intervention protocol can significantly decrease inappropriate continuation of SUP at hospital discharge, reduce recognised complications and save money. ⁽²²⁾

Reduce: gastric residual volume measurement – to do or not to do?

Measuring GRVs seems to be more a unit culture practice rather than evidence-based practice. Some ICUs reduce the number of aspiration syringes used by reusing the aspiration syringe for 24 hours. Some ICUs don't overseas. ^{(23) (24)}

Plant-based enteral and parental nutrition?

There are not many fully plant-based options available in Australia and NZ yet. Fresenius-Kabi have an oral sip-feed ProvideXtra with hydrolysed pea protein (containing a slight amount of fish collagen as carrier for Vit A). Baxter have parental nutrition product Olimel from soybean and olive. There is currently unmet need for feeding vegan patients in ICU. ⁽²⁵⁾ US has more plant based enteral nutrition product options – [Kate farms](#).

Reduce: don't use parental nutrition in adequately nourished critically ill patients within the first seven days of an ICU stay. ⁽²⁶⁾

Renal/fluids

IHD or CRRT – what's best?

Most extracorporeal dialysis machines generate large volumes of single use plastic and other waste from the filters, bags and tubing as well as packaging waste. They also use large amounts of energy and water. As there are no head-to-head comparisons available it is difficult to compare environmental impact of continuous versus intermittent dialysis. Some simple comparisons of waste and water are:

- CRRT: 24 hours of CRRT with Baxter Prismaflex: total weight = 1.86kg for 24 hours.
- IHD: A single haemodialysis session produces approximately 2.5 kg of solid clinical waste, of which 38% is plastic. This amounts to an estimated 390 kg per year. ⁽²⁷⁾ There is also another 2kg of potentially recyclable waste, per single dialysis session. ⁽²⁸⁾
- Peritoneal dialysis: 617 kg per year produced by a patient undertaking a standard continuous ambulatory peritoneal dialysis regime. (Not including packaging waste)

Another form of waste is the large volume of fluid used and effluent produced during CRRT. IHD is however more water intensive. Accounting for the water necessary to prime and cleanse the dialysis machine, a total volume approaching 500 litres of mains water is required per patient per 4-hour session. ⁽²⁷⁾ A research study awaits to compare the environmental effects of different types of ICU renal support.

The environmental footprint of CRRT with Baxter Prismaflex treatment system has been calculated as 113kg CO₂e for a 72 hour treatment. The majority of the life cycle GHG emissions were associated with the manufacture and supply of the filled CRRT fluid bags. ⁽²⁹⁾ Environmental hotspot identification like this is useful for companies to focus on initiatives to reduce manufacture and distribution impacts.

Future technologies will improve sustainability with technical advances like miniaturisation, reuse of some plastic components, sorbent-based techniques and membrane-based reclamation of used fluid.

Nephrology is actively working towards greener dialysis practice. ^{(27) (28)}

Reduce CRRT effluent bags.

There are several options for reducing CRRT effluent bags:

1. Try a reusable bag option e.g. Tekmed.
2. Recycle and reuse one of the other bag sets.
3. Auto Effluent feature on the Baxter PrisMax eliminates the need to change effluent bags. This decreases labour at the bedside and avoids ten 5 litre disposable effluent bags per day.

CRRT – a standard strategy rather than accelerated strategy for starting renal replacement therapy.

The [STARTR-AKI](#) trial (Standard versus Accelerated Initiation of Renal Replacement Therapy in Acute Kidney Injury trial) concluded that in critically ill patients with severe acute kidney injury, an accelerated strategy for the initiation of renal-replacement therapy did not result in a lower mortality at 90 days than a standard strategy. ⁽³⁰⁾

CRRT – use optimal dose and optimal anticoagulation.

Use optimal doses of CRRT. Higher doses of CRRT have been shown to not be superior including the ANZICS RENAL study 2009. ⁽³¹⁾

Optimal anticoagulation helps prevent circuit loss. Citrate anticoagulation can prolong circuit life although may be more expensive. ⁽³²⁾

Albumin versus crystalloid.

There is currently no life cycle analysis for albumin or crystalloids like normal saline. The increased complexity in the production of albumin (and tenfold greater financial cost) could suggest that crystalloids would have a lower carbon footprint. Consider the evidence that albumin is equivalent to, but not better than, crystalloids.

Crystalloids should be used first. Avoid synthetic colloids like hydroxyethyl starch and gelatins. In general there is a trend to more restrictive fluid management strategies, larger trials are needed to confirm. ⁽³³⁾

Haematology and coagulation

Reduce: transfuse only if Hb < 70 or if the patient is haemodynamically unstable or has significant CVS or respiratory comorbidity. ⁽²⁰⁾

Reduce: DVT prophylaxis – appropriate use of sequential intermittent mechanical compression devices.

Don't use IPC devices on patients receiving chemical prophylactic anticoagulation. ⁽³⁴⁾

Reduce: coagulation testing for clearly defined specific indications not daily.

Use reprocessed sequential intermittent compression devices.

Reprocessed devices are available in New Zealand via Medsalv.

Sepsis/microbiology

Practice antimicrobial stewardship. ⁽³⁵⁾

“The right drug at the right time and the right dose for the right bug for the right duration.” ⁽³⁶⁾

Consider antibiotic de-escalation daily. ⁽²⁰⁾

Afebrile patients who are improving consider oral ABs when appropriate.

Don't repeat daily FBC, CPR as measures of response to antibiotic treatment if patients are clinically improving.

Rationalise microbial cultures.

Lines and infusions

Reduce: do you need that central line or that peripheral cannulation?

Is an extra peripheral line really needed? Could that central line be avoided? e.g. by peripheral vasopressors for low dose vasopressor support. ⁽¹⁰⁾

CASE STUDY:

In one ED setting, a 70% drop in the total number of IV cannulas used was achieved following an intervention to reduce unnecessary insertion. Projected annual reduction of CO₂ e was 8403kg, equivalent to 45,034 km by car and savings of 27, 830 pounds per year. Reducing Unnecessary Cannulation in the Emergency Department. Centre for Sustainable Healthcare. ⁽³⁷⁾

Reduce: remove all invasive devices such as intravascular lines and urinary catheters as soon as possible. ⁽⁶⁾

Reduce: keep antibiotic giving sets hanging for 24 hours – date and label them.

Reduce: have an alternative system for flushes from a hanging bag of saline rather than single use disposable saline syringe.

Reduce use of syringes when infusions could be made up in recyclable 100ml PVC bags.

Reuse surgical linens and drapes.

Have reusable gowns and drapes available for procedures within the ICU.

Reuse: watch that those reusable items in premade customised procedure packs don't get chucked out e.g. metal instruments, reusable drapes, gowns, reusable containers.

Educate new staff and remind old staff not to put reusable metal instruments, reusable drapes and gowns and reusable containers in waste.

Reusable CVL insertion kits are cheaper than single use kits. The environmental impact of single use versus reusable CVL kits again depends on the source of hospital electricity. ⁽³⁸⁾

Recycle PVC bags and other PVC items.

Saving PVC from landfill and recycling it instead is a great way to reduce environmental and financial costs. The PVC Stewardship Programme runs a collection service for PVC products free of charge, and turns the product into garden hoses and children's play mats. ⁽³⁹⁾ ⁽⁴⁰⁾

Recycle single use metal instruments.

Recycle instrument trays, containers for cleaning solutions, basins.

Recycle plastic syringes.

Some recycling trials are currently running in Australia/NZ.

Family/social

Create an intensive care wellbeing space.

Create a connection to nature in an intensive care space that can be used by patients and families away from the ICU bedspace. Whether indoor or outdoor, sun and natural light with greenery is important. These spaces can be designed with no water and soil to avoid infection control risks. ⁽⁴¹⁾

Have goals of care discussion at or prior to ICU.

For patients with limited life expectancy (such as advanced cardiac, renal or respiratory failure, metastatic malignancy, third line chemotherapy) ensure patients have a goals of care discussion at or prior to admission to ICU. ⁽²⁰⁾

Shared goals of care are when the patient, their family and whānau, and clinicians explore the patient's values along with the care and treatment options available and agree the goal of care for the current admission if the patient deteriorates. ⁽⁴²⁾

The [ANZICS Statement on Care and Decision Making at the End of Life for the Critically Ill](#) states that the goal of intensive care is to return patients to a quality of life that is acceptable to them. In order to achieve this goal, it is essential that clinicians explore the values and preferences of each patient. Engaging with patients and their families in the discussions around treatment limitations or withdrawal can improve the quality of dying and reduce family and staff stress and bereavement. ⁽⁴³⁾

For patients at high risk of death or severely impaired functional recovery ensure that alternative care focused on comfort and dignity is offered to patients and families. ⁽²⁰⁾

Use your health professional health promotion opportunities.

Although our work is centred "at the bottom of the cliff", intensive care staff should use their expertise and influence to advance the health and wellbeing of communities and populations outside ICU and advocate for good self-care and preventative medicine whenever we can, both with ourselves, our patients and upstream in our community.

As well as the regular health promotion activities like smoking cessation advice, discuss health effects of climate changes and co-benefits to patients' health of mitigating climate change e.g. active transport and eating less meat.

Infection prevention and control

Does every interaction for this patient need gloves?

CASE STUDY:

"The gloves off are off" Campaign Great Ormond Street Hospital.

"Wearing plastic gloves is an engrained behaviour common to hospital staff. This is particularly so during COVID times. Research says that nurses and other healthcare professionals put on gloves because they think it is protecting their patient in some way but it's not. The gloves used are non-sterile nitrile gloves, so your clean hands are better for patients. We should only wear those gloves if we are going to come into contact with a bodily fluid, non-intact skin, or mucus membrane." Nicola Wilson GOSH

This educational campaign to reduce unnecessary plastic glove use prevented 21 tonnes of plastic going to clinical waste in one year. ⁽⁴⁴⁾

Does every interaction for this patient need a plastic apron?

SUCCESS STORY:

CMDHB Critical Care Complex used to use a new plastic apron for every patient contact, this was a process that had begun approx. 9 years earlier and was instigated to encourage staff to ensure they handwashed between each patient. The thought was that if one was taking an apron on and off that would mentally link with a hand sanitation step. This worked BUT our infection control team has worked hard with the unit over time and we have been achieving over 90% on all of our audits on handwashing so... Do we need to wear aprons all the time? The process was changed so aprons are available for doing something that has potential to be messy; extubation, changing an art line etc but for simple cares they are not needed. Yahoo!! Lots less plastic waste. These aprons do get recycled but to not have the waste is better!! - Helen Polley sustainability champion.

COVID care can pollute – how can we make it a bit better.

There are both negative and positive environmental effects of COVID 19.⁽⁴⁵⁾

The most obvious negative effect is the huge amount of waste produced by single use items like PPE. Some suggestions to reduce PPE waste include: Limit people who need to don PPE to see patients and consider reusable PPE where feasible e.g. gowns – there are laundry systems for this.^{(46) (47)} Further info can be found at Health Care Without Harm [Coronavirus Resource Centre](#).⁽⁴⁸⁾

Reduce the use of excessive gowning for routine patient care whilst avoiding cross contamination.

Use washable theatre hats, shoes, glasses and visors.

Keep work shoes at work, avoid shoe covers.

Use washable theatre hats for procedures.

Use washable glasses and visors.

Switch to green cleaning products in appropriate areas.

Disinfection and proper cleaning are essential to infection control in the ICU. Many hospitals use strong disinfectant cleaners that, while effective, may pose health risks to staff and patients. For example, bleach-based cleaners are linked to respiratory and eye irritation among environmental services staff as well as nursing staff. Maybe make the switch to peroxide based wipes, UV light technology, ozone-based methods. Avoid Triclosan containing products.

CASE STUDY:

From GGHH Members⁽⁴⁹⁾

Skin/muscular-skeletal

Go green on personal care body products for patient use in the ICU.

Choose environment and patient friendly personal care products. Avoid single use sachets.

Ecostore products NZ have a plastic bottle recall system.

Sustainable mouthcare.

There are a variety of ways mouthcare can be made more sustainable. Try:

- Compostable toothbrushes, e.g. bamboo options (sadly the bristles are not compostable).
- Reusable dental products.
- Avoiding single use packets for mouth cares.
- More natural toothpaste.
- Using specialised recycling programs e.g. Colgate products.
- Rethink chlorhexidine mouthwash.⁽⁵⁰⁾

Early mobilisation and exercise.

Caring for patients with the ABCDEF bundle, including early mobilisation and exercise showed clinically meaningful outcomes.⁽⁹⁾

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Politics – taking personal and professional action

People are the essential component in changing systems. Don't underestimate any possibility of engaging people in the work needed to avoid catastrophic climate change and biodiversity loss. Health care workers are widely trusted and some good entry points to engage people are; that the future is happening now, fairness and justice, waste and pollution, holding ourselves accountable to future generations and making our health care organisations exemplary examples of sustainability. ⁽¹⁾

What it takes to change a system – change management big and small.

Implementing sustainability into everything we do at every level of healthcare whilst essential can seem overwhelming. Like all challenges big and small using known change management strategies can be helpful. ⁽²⁾ People are the most essential component in changing systems. Actions like showing optimism, celebrating success and creating a pathway forward can engage people in the work ahead. ^{(3) (4)}

David Pencheon shared these helpful 15 tips on what it takes to change a system during the Sustainable Health Sector National Network conference NZ June 2021. ⁽¹⁾

What it takes to change a system:

1. Convene and listen (Engage).
2. Share real facts and real stories (Educate).
3. Stop harming people and planet (Eliminate).
4. Spread what is already working (Emulate).
5. Make your progress visible and well known (Exemplify).
6. Make actions allowable, easy and desirable (Enable).
7. Cede control, disseminate leadership (Empower).
8. Stimulate, support and join social movements (Enfranchise).
9. Reframe, positive aligning of values, and value over time (Encourage).
10. Follow the money and other resources (Economics).
11. Make change fun, possible rewarding, meaningful (Excite).
12. Make it normal (Expect).
13. Measure, report and make accountable (Evaluate).
14. Make it unacceptable/ shameful (Embarrass).
15. Make it compulsory/ seal positive change (Enforce).

People power – advocacy.

Take professional and personal climate action by joining advocacy groups. As clinicians we are supposed to help not harm but there is cognitive dissonance at work with the waste we put into the atmosphere and ground through our health care activities. The environmental footprint of health is enormous, and the health care system is contributing to the climate emergency. Health professionals are uniquely positioned to show leadership in addressing the climate challenge and for hospitals to become anchor organisations for their communities. There are numerous workstreams to contribute towards within these organisations.

DEA = Doctors for the Environment Australia ⁽⁵⁾

Ora Taiao = NZ Climate and Health Council ⁽⁶⁾

CAHA = Climate and Health Alliance ⁽⁷⁾

GGHH = Global Green and Healthy Hospitals ⁽⁸⁾

Other Useful references for taking action:

1. [Physicians guide to taking action.](#)⁽⁹⁾
2. [Actions that health professionals can take to counter the climate emergency and improve their health.](#)⁽¹⁰⁾
3. [Should health professionals participate in civil disobedience in response to the climate change health emergency?](#)⁽¹¹⁾

People power – equity and climate justice.

Those that least contributed to climate change will be disproportionately affected by its effects.⁽¹²⁾ It is vital we keep an equity focus at the centre of climate change and healthcare environmental sustainability actions.⁽¹³⁾⁽¹⁴⁾ There are many opportunities for pro-equity actions in healthcare and we should put this lens on our intensive care actions as well.⁽¹⁵⁾

Climate change is a final product of the colonisation process around the world, including Australia and NZ and decarbonisation must go hand in hand with a climate justice and decolonisation.⁽¹⁶⁾ Inclusivity to ensure a just transition as changes occur is important including decolonisation of ecological science and the recognition of a diversity of people, other knowledge systems, and solutions for the environmental crisis.⁽¹⁷⁾

Climate change is a symptom of severed relationships and attending to [relational tipping points](#) is also crucial.⁽¹⁸⁾ In NZ The Treaty of Waitangi, Te Tiriti, is the tool for effective partnership and governance.⁽¹⁹⁾

NZ Climate Change Minister James Shaw has laid out the principles the NZ government will follow in its Emission Reduction Plan:

- A just transition - to mitigate and adapt to climate change in a way that creates good jobs and ensure no-one is left behind.
- Enhancing the role of nature-based solutions to maximise opportunities that both cut emissions and help to restore indigenous biodiversity
- A genuine partnership with Maori to ensure a Te Tiriti-led approach to the transition and application of tikanga Maori lens to the Emissions Reduction Plan.”⁽²⁰⁾

Australia is also increasingly acknowledging indigenous communities’ old ways of seeing and doing. NAIDOC week 2021 has suggested that we need to “[Heal Country, Heal Climate](#)”.⁽²¹⁾ First nations peoples have been custodians of the land for more than fifty thousand years, and have a strong connection to country. Climate change threatens this connection by disrupting their culture and stories that are intimately linked with the land, and their practices of living from the land.⁽²²⁾

“We suggest that support for Indigenous adaptation programmes in these new days, acknowledge old ways of seeing and doing, build agency and partnerships and collectively address current climate impacts on both country and people.”⁽²³⁾

Managing climate anxiety/grief in our young people.

Young people are at risk of the ongoing health impacts of climate change. Young people are also deeply concerned about climate change and its impact on their current and future lives. They want to be actively involved in mitigation efforts, they also need help in developing realistic hope and confidence that their own efforts will make a difference.⁽²⁴⁾

Positive youth development frameworks have been shown to improve mental health, other health outcomes and reduce risk taking behaviours. Mana Taiohi is a Te Ao Maori informed reinterpretation of positive youth development frameworks for an Aotearoa context.⁽²⁵⁾ Climate change youth activism can enhance youth mana through the application of Mana Taiohi, reducing current mental health issues associated with fear of climate change and has co-benefits of achieving effective climate action.⁽²⁶⁾ Climate advocacy movements for youth are strong and growing.

Younger children are not immune from the mental health impacts of climate change. This simple [advice for parents](#) may be helpful.⁽²⁷⁾

1. remember that you do not need to be a climate expert.
2. try to validate, rather than minimise children's emotions.
3. negative information hits harder.
4. for younger children keep it local and tangible.
5. set practical goals as a family and follow through.

Get involved in sustainability with professional colleges and societies.

Get involved at governance level to set the sustainability direction for our professional colleges and societies. Advocate for ongoing actions to strengthening sustainability actions within our speciality. College training curriculum should include environmental sustainability in healthcare. Nurses are a vital part of climate change action and well placed to lead change. ⁽²⁸⁾

College of Intensive Care Medicine of Australia and New Zealand Statement on Sustainability. ⁽²⁹⁾

Australian and New Zealand College of Anaesthetists. Environmental sustainability. ⁽³⁰⁾

Australasian College of Emergency Medicine Position statement Climate Change and Health. ⁽³¹⁾

The Royal Australasian College of Physicians. Position Statements. ⁽³²⁾

Australian Nursing and Midwifery Federation- climate change. ⁽³³⁾

Recent reviews of environmental sustainability in intensive care and acute care specialities.

1. Environmental sustainability in anaesthesia and critical care. ⁽³⁴⁾
2. Paediatric Critical Care and the Climate Emergency: Our responsibilities and Call for Change. ⁽³⁵⁾
3. Ecological sustainability in Anaesthesiology and Intensive Care Medicine. ⁽³⁶⁾
4. What's new in intensive care: environmental sustainability. ⁽³⁷⁾
5. Environmentally sustainable emergency medicine. ⁽³⁸⁾

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Appendix 1:

ICU Recycling Initiative

CASE STUDY:

Sir Charles Gairdner Hospital, Perth.
ICU Recycling Initiative
Site Champion: Aoife Newton A/CNS High Dependency Unit

Education

- In July 2018 several members of the ICU Nursing team commenced working on a recycling initiative for ICU.
- We organised a meeting with the waste contractor (Suez) representative for SCGH to discuss what items we could recycle in the ICU and plan our education program.
- After going through a standard bay in ICU to identify what could and couldn't be recycled, we put together posters to display in several prominent areas of the unit.
- We developed a PowerPoint presentation that was delivered to the nursing staff at Clinical Development Seminar (CDS) Days, which incorporated around 70% of the staffing profile and also delivered in-services to capture remaining staff who did not attend CDS days.
- One on one education was provided to the HSA's and cleaners that worked regularly in ICU.
- Doctors were also given one on one education when able on the floor.

Implementation

- At the same time of the education we purchased small black bins with yellow lids that resemble the recycling bins at home.
- Each bin was placed in every bay with recycling signs on it (Posters YES and NO attached).
- We also increased the amount of large co-mingle bins we had at the unit going from 2 to 4 so they were more accessible for all staff and allocated a large dumpster bin in the pan room to only recycling.
- In the equipment nurse office we placed smaller tubs that could recycle batteries, single use metal instruments and ECG leads.

Results

- We have been unable to gather exact data of how much ICU has increased its recycling as the waste contractor only have the capability to give data of SCGH as a whole.
- We had observed though that the collection of our co-mingle recycling bins did increase significantly.
- Prior to the initiative our 2 co-mingle bins were only collected once a day.
- After the initiative the 4 co-mingle bins were now being collected up to 5 times a day.

Future Plans

- Ideally, we would like to introduce PVC and syringe recycling to ICU.
 - Our current issues remain space in both the unit to store the larger bins as well as in the bays.
 - We are currently working on solutions to be able to introduce these extra areas of recycling into our daily practice.
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Glossary

The Australian Glossary on Health and Climate Change is a useful terminology reference. ⁽¹⁾

Disclaimers

These are the views of the authors not necessarily those of ANZICS.

This toolkit does not recommend any specific company and reference to specific product is made and intended solely in the sustainability context in which it appears.

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