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Connecting the dots between a sustainability agenda, infection prevention and antimicrobial resistance

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ABSTRACT

Australia's healthcare sector accounts for up to 7% of Australia's carbon footprint. However, the sector has broader direct and indirect environmental impacts. There's a balance to be struck between reducing environmental impact and optimising infection prevention and control strategies, which include minimising antimicrobial resistance. The discussion covers health service demand, low carbon care, patient-centred treatment, safe medication disposal and single use medical supplies, as well as wastewater with Australian-based examples. Barriers to implementation of a sustainability agenda include an already stretched health system and a disconnect between community health, hospital systems and processes and those who have the capital, capability and resources to drive these efforts. This article explores the environmental impacts of the healthcare system and current strategies to improve sustainability through the lens of infection prevention. This includes the potential unintended negative consequences for the prevention and management of antimicrobial resistance.

Keywords: AMR, antimicrobial resistance, carbon footprint, environment, healthcare, infection prevention, One Health, pollution, sustainability.

Australia's healthcare sector has numerous direct and indirect environmental impacts (Fig. 1). Direct impacts include pollution and waste (plastic waste, air pollution, water contamination) whereas indirect contributions stem from resource consumption, land use and urban development including building and maintaining healthcare facilities. Medical supply chains and transport distribution networks are also part of the wider environmental considerations with healthcare's carbon footprint estimated to be 5.3–7% of Australia's total emissions.[1]

This complex system of environmental impact and healthcare delivery has significant interdependencies. Therefore, there is a need for a clear problem definition and a clarifying question such as: how can environmental impact be reduced in the age of superbugs and pandemics where infection prevention practices consist of single-use personal protective equipment (PPE)?

At the superficial level, at least for this challenge, the first principle of environmentalism's maxim of *Reduce, Reuse, Recycle*, is a useful starting point. Explored another way, this equates to reducing health service demand and improving the efficiency and sustainability of healthcare supply.

Reducing health service demand

Reducing the demand on the health system and connected services by preventing disease, and empowering individuals' engagement and opportunities to manage their health and wellbeing in meaningful ways will not only improve patients' wellbeing and overall health, it will also help to lower carbon emissions within the medical system.

Shifting our primary modes and models of care toward more home-based and low-emission options will help reduce the number of patients who enter the high emission-high waste hospital setting. This, in turn, may also decrease the likelihood of multidrug resistant organisms (MROs or superbugs) evolving as well as lower the amount or concentration of waste associated with hospital treatment and management, including personal protective equipment (PPE) and antimicrobials.

A holistic approach to sustainable healthcare – including infection prevention – acknowledges the environmental, cultural and social determinants of health. One

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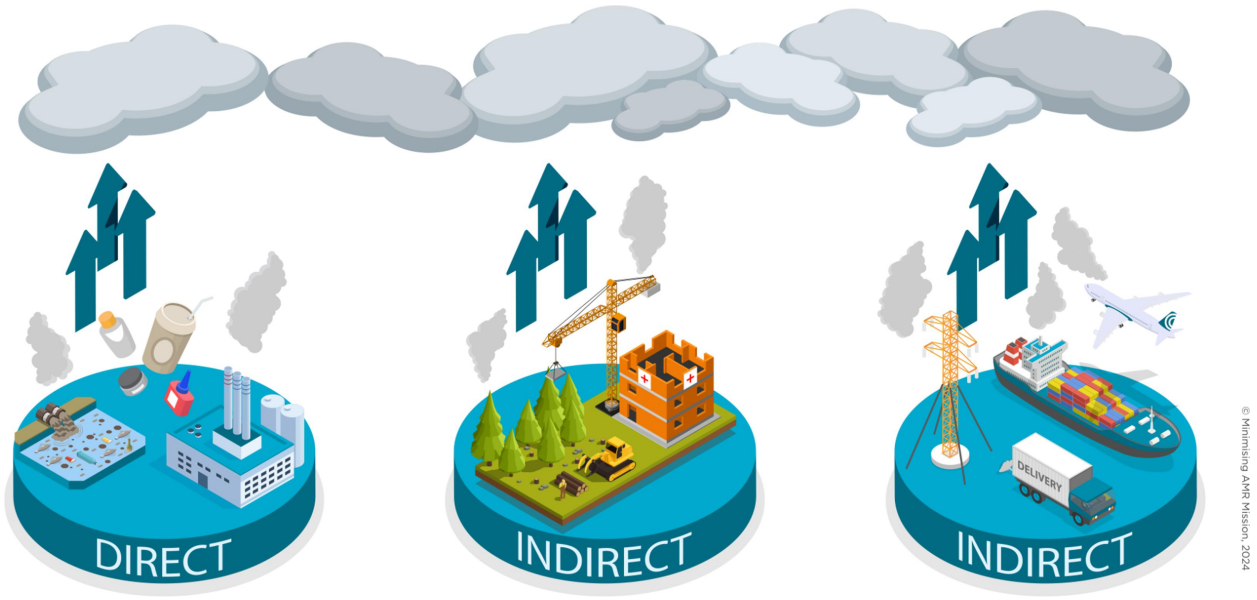

Fig. 1. Australia's healthcare sector has both direct and indirect impacts on the environment. Image © Minimising AMR Mission, 2024.

example of this is the relationship between secure, safe and affordable housing that is not overcrowded.[2] This type of consideration is reflected in the Climate and Health Alliance-led roadmap to a Healthy, Regenerative and Just future, which has 'health in all policy decisions' as a key policy recommendation.[3]

Further, for community, primary and preventative health measures to have maximal impact, the funding models must enable coordinated and collaborative efforts across Federal, State and local health delivery partners. In addition, the level of funding must reflect the required effort and needs to ensure the community and its healthcare workforce have all the skills and resources, including those for relationship building and co-design, and education to be involved in this approach.

Improving care delivery

'High value care is low carbon care' is a concept that links efficiency of care to sustainability.[4] The premise is that in aligning treatment to evidence and 'choosing wisely', we can decrease low value care and variations in care. Choosing wisely reflects the need to reduce unnecessary procedures, treatments and tests, including the duplication of tests ordered by other doctors. Indeed, pathology testing and diagnostic imaging are estimated to contribute 9% of healthcare's carbon footprint. Choosing wisely will also help to improve patient outcomes and prevent the excess emissions and waste cost from ineffective services and inappropriate prescriptions including those for antimicrobials. This concept is increasingly being incorporated into clinical guidelines and reports such as the UK Health Alliance on Climate Change's Green Surgery Report.[5]

Innovative approaches to shorten the length of hospital stays for particular patient cohorts while improving care also have a sustainability angle. For example, the South Metropolitan Health Service in Western Australia has a program called 'LifeFit-SurgFit'.[6] This program, delivered by a team of physiotherapists, dieticians, counsellors and other healthcare workers, provides support and educational materials to help patients prepare physically and mentally for their surgery.

This model, which is a form of multidisciplinary 'prehabilitation', can improve patient outcomes and has been shown to decrease the post-procedure time required in the hospital thereby decreasing the environmental impact of the care delivered and, potentially, the risk of picking up a healthcare-associated infection.

Low carbon, low waste alternatives

Following preventative health, patient empowerment and improved efficiency of care, we have the opportunity to reduce the waste and emissions associated with consumables, pharmaceuticals and equipment.

The number of global surgeries performed each year, including elective surgeries, is on the rise. This increase in surgeries leads to the use of more single-use medical items and consumables, all of which need to be disposed of. Clinical waste, anatomical waste and other waste such as sharps will usually be disposed of by incineration, which has the highest carbon footprint of all healthcare-associated waste.

Although many items need to be single use to eliminate infections and cross-contamination, there are others that have potentially unnecessarily moved to single use (e.g. during the COVID era). For example, are disposable surgery gowns essential? Would reusable cloth gowns that can be effectively sterilised using green energy and low-water, low-chemical processes be more sustainable? There are also many plastic single-use items that could be replaced with paper or bioplastic alternatives, which would have a lower environmental impact.

Exploring medical consumables and products through a full life cycle assessment, while still considering patient outcomes, gives clinicians and healthcare providers additional vital knowledge to help inform their sustainability-related decisions.[7]

Increasing water efficiency

Hospitals are high consumers of water. Water is essential for building operations, such as heating and cooling, waste management and laundry services, as well as in the delivery of medical care, which includes sterilisation and maintenance of equipment.

Although more than 15 years old, a report by researchers based at Griffith University and the Australian National University (ANU) provides a detailed analysis of where hospitals lose water and case studies relating to water saving initiatives as part of the Natural Edge Project.[8]

Analysing water usage and developing water-efficiency benchmarks allow health services to measure how well they are managing their water consumption.[9] For comparative purposes, volumes of water are often standardised based on the number of patient bed days.[10]

The Griffith–ANU report[8] provides details of water savings made at St Andrews Hospital in Brisbane, which was preceded by an analysis of use in 2004. It found that the major water users in the wards were taps (58%), showers (15%), ward appliances (13%) and toilets (12%). Once additional water saving measures had been implemented in these areas, including wash basin and shower retrofits with water saving devices, the hospital's water consumption was reduced from 89 ML of water per occupied bed day (OBD) to 73 ML per OBD in 2006.

However, reducing hospital water use may result in unintended consequences when it comes to the spread of infectious diseases. Hospital sinks around the world[11,12] have been identified as environmental reservoirs for numerous outbreaks of drug-resistant bacteria including in Australia. In this case, inappropriate sink design was found to be a contributing factor.

Prevention through design was the subject of a 2018 review that concluded there was a need for hospitals to have a rational surveillance and prevention strategy based on the current design, placement and state of their sinks.[13] This needs to consider the force of water needed to minimise the settling of bacteria and the building of their biofilms that, once in place, are difficult to remove. This is why a systems' thinking approach that brings engineers, microbiologists and infectious disease physicians together with hospital administrators is so valuable.

Safe medication disposal

At the other end of the medication trajectory is dealing with unwanted medicines and their environmental impact. The Return Unwanted Medicines (RUM) project[14] has been operating for almost 25 years, but awareness is low. The project was started by a small group of passionate Australian pharmacists, who ran a small trial where RUM bins were provided to pharmacies; it is now a national program.[15] After collection, their contents are disposed of by high-temperature incineration. Yet, getting the message to consumers about the need to safely dispose of their unwanted medicines through this program is an ongoing issue. One of the messages we need to convey is that, if unwanted, medicines, including antibiotics, are not returned and disposed of by this program, they flushed down the sink into our water or enter our waste systems or landfill. Here, they act as environmental contaminants, disrupting the soil microbiome and creating a potential hotspot for the evolution and transmission of antimicrobial resistance (AMR).[16]

Benefits and barriers to implementing a sustainable healthcare agenda

Everything affects health. Thus, policy in every sector has the potential to affect health and wellbeing because it is underpinned by social, economic, cultural, political and environmental factors. A 'Health in all Policies' approach highlighting this connection was first introduced in 2006 and is increasingly being embraced by governments around the world.[17]

Australia's new National Health and Climate strategy has 'Health in all Policies' as one of its six objectives with an aim to support 'healthy, climate-resilient and sustainable communities through whole-of-government action which recognises the relationship between health and climate outcomes'.[18]

More recently, it has been proposed that 'Health in all Policies', which focuses on the unidirectional benefits to the health sector from action in other sectors should be expanded to capture what the health sector can do for other sectors while deriving co-benefits. This win–win concept has been termed 'Health for all Policies'.[17]

For example, the World Health Organization reports that one in eight deaths is linked to exposure to air pollution that is the result of burning fossil fuels (coal, oil and gas) as well as forest fires.[19] Reducing air pollution requires collaboration between many stakeholders and industries, including governments, the energy sector, urban planning and transport. Improving air quality and lowering emissions to help offset global warming could, in turn, reduce the rising risk of infectious disease transmission and AMR.[20,21]

Despite the evidence and clear value of integrating environmental considerations into healthcare decision making, and vice versa, there are significant challenges to implementing a sustainable healthcare agenda. These include political, commercial and financial barriers along with lack of awareness or acknowledgement of the cross-sectoral interdependencies. This is compounded by siloed governance and economic arguments that prioritise short-term sector benefits over long-term costs to society leading to conflicting accountabilities. All of this is overlaid onto an already stretched and complex health system.[17,19]

There is no simple solution to this problem, but the starting point is to bring together those who have the capital, capability and resources to drive the necessary processes and programs. There is also a need to raise awareness of the

relationships between health and other sectors to encourage policy coherence and collective action.

How a One Health approach can help

At CSIRO, there is widespread awareness that acting in one sector may have unintended negative consequences on another. This is particularly pertinent when considering AMR mitigation because AMR affects human, animal and plant health, as well as the environment. A 'One Health' approach, which reflects this interconnectivity, is needed when designing and deploying AMR solutions.

Life cycle assessment tools can support the use of a One Health lens in product development, including the design of rapid diagnostic tests, the manufacturing and incorporation of new materials into medical products, and the development of water treatment processes to remove pharmaceuticals.

Through its Minimising AMR Mission, which brings together researchers, government and industry partners and connects major AMR-focussed initiatives, CSIRO is determining focal areas for action and where more evidence and data are needed to show the effect of interventions. For example, we know people metabolise medicines in different ways and, depending on composition of their gut microbiome and the integrity of their immune system, they may need shorter – or longer – courses of antimicrobials.[22] Reducing the duration of treatment by using diagnostics that show it is 'safe to stop' could have significant societal and environmental benefits.

If we have clear evidence that an infection is resolved at day four, this knowledge could prevent someone from unnecessarily continuing their antibiotic medication. On a 5-day medication course, this would be equivalent to a 20% saving. Using fewer overall antibiotics at a societal level would help to lower the environmental impact of antibiotic use and the concomitant AMR risk. Given the pharmaceutical industry has a larger carbon footprint than the automotive industry,[23] consideration of such reductions at a time when AMR is on the rise is critical.

Other CSIRO initiatives and Missions are also supporting the goal to mitigate AMR through a drive to end plastic waste, spearhead Australia's energy transition, and increase the efficiency of freight and supply chain processes.

Conclusion

Advocating for 'Health for All' policy approaches and the elevation of sustainable healthcare as a pillar of high-quality healthcare can lead to improved health and wellbeing. Notably, being conscious of the bidirectional relationship between the health system on the environment and acting accordingly can have the added benefit of reducing infectious disease transmission, and minimising AMR, including the evolution of superbugs.

While doctors, clinicians, nurses, pharmacists, administrators and others delivering healthcare are important decision-makers, so too are consumers. Educating the wider community about the connections between health and the environment and the need to reduce healthcare's resource footprint is an important part of the solution and safeguarding our future. After all, our own health is inextricably linked to the health of our environment and everything within it.

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