



Australian College of Nursing

The Nursing Response to the Climate Emergency

A WHITE PAPER BY ACN 2023

***“With the world in turmoil,
putting human health at the
centre of an aligned response
to these concurrent crises
could represent the last hope
of securing a healthier, safer
future for all.”***

The 2022 report of the Lancet Countdown on health and climate change:
health at the mercy of fossil fuel (Romanello et al. 2022).

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Abbreviations

ANMAC	Australian Nursing and Midwifery Accreditation Council
APN	Advance practice nurse
GHG	Greenhouse gas
GP	General practitioner
ICN	International Council of Nurses
IPCC	Intergovernmental Panel on Climate Change
MBS	Medicare Benefits Scheme
NCCTRC	National Critical Care and Trauma Response Centre
NMBA	Nursing and Midwifery Board of Australia
NP	Nurse practitioner
UK	United Kingdom
US	United States
WHO	World Health Organization

EXECUTIVE SUMMARY

Health care professionals are witnessing the health effects of climate firsthand. The increasing intensity, frequency, and occurrence of natural disasters combined with unprecedented climate-affected health problems are placing significant pressure on our health system. Paradoxically, the health sector significantly contributes to emissions while caring for the communities climate change impacts most.

Climate health and emissions reduction are complex issues that require nuanced, evidence-based solutions, and nurses are ideally placed to deliver these. As the largest group of health professionals in Australia (Australian Institute of Health and Welfare, 2020), nurses are uniquely positioned in the health care sector and our communities. This combination of expertise, community trust, and engagement must be utilised to build resilience and reduce emissions.

This white paper presents a three-step climate stewardship approach for nurses responding to climate emergencies. First, we must rethink health service provision in the current climate emergency. Traditional, reactive health models focusing on continual disaster response will not meet the health system's climate-affected demands. We must develop a coordinated, national climate response that foregrounds nursing wisdom and expertise.

Second, nurses must be enabled to lead emissions reduction strategies within health care through quantifiable and sustainable targets in the urgent transition to low emissions health care. This requires a national inquiry to measure the existing carbon footprint allowing the industry to set measurable targets. A nurse with climate and sustainability expertise must be placed within health care settings and across all industry and government partners to develop and implement sustainable models of care and lead climate action efforts. Furthermore, we must identify where nurses can be deployed to utilise the health care workforce better and drive cross-sector collaboration. This includes considering transitioning to local nurse-led models of care that limit transport emissions. Effectively using the nursing workforce, which is equipped to deliver critical health care services, will assist in keeping people out of high emissions of care. Nurses must also be enabled to work to their full scope of practice and a move to value-based, sustainable health care models to support patients.

Third, climate stewardship needs to be developed in the nursing workforce through climate education and research. This requires a radical shift in the education of nurses in climate health, emissions reduction, and sustainability. Climate stewardship must be integrated throughout the nursing curriculum. Consolidating climate health and sustainability as a nursing specialty is required to build additional capacity. The profession must establish, define, and train climate nurse specialists through targeted post-graduate education. Nurses must quantify the success of their interventions through inter-professional and cross-sector nurse-led climate research.

We must deliver fiscal, equitable, and quality services in a climate emergency while reducing health care emissions. More broadly, the nursing profession calls on all industries to prioritise lowering emissions.

INTRODUCTION

Climate health in a climate emergency

Climate change is the statistically significant observable change in Earth's weather patterns, temperature, ocean levels, land surfaces, and ice sheets over a defined period (Australian Academy of Science, 2022). Recent climate change, caused by the increased atmospheric concentration of greenhouse gases (GHGs), directly results from human activity. Since the industrial revolution of the late 1800s, there has been a rapid increase in the use of fossil fuels which correlates with the rapid rise in global temperatures (Masson-Delmotte et al., 2021).

Methane and carbon dioxide are the primary gases released through fossil fuel consumption. These extra gases form a layer around the planet and act as heat traps that raise temperatures and disturb weather patterns. The earth is now 1.1 degrees Celsius hotter than it was in the late 1800s (Intergovernmental Panel on Climate Change [IPCC], 2022). The last decade was the hottest on record (IPCC, 2022). The evidence for climate change is unequivocal – atmospheric and ocean temperatures have increased, polar caps have melted, and sea levels have risen (Australian Academy of Science, 2021; IPCC, 2014; Masson-Delmotte et al., 2021).

Climate change is also causing unprecedented increases in frequency, intensity, and occurrence of natural disasters. Current consequences of climate change include intense droughts, water scarcity, severe fires, rising sea levels, flooding, catastrophic storms, and declining biodiversity (Butler et al., 2022). In 2021, the Intergovernmental Panel on Climate Change (IPCC) described climate change as a 'code red for humanity' (United Nations, 2021). Retrospectively and generatively managing the health impacts of climate change while reducing health care emissions will significantly impact the effects of climate change.

In Australia, the health care industry accounts for 7% of the national carbon footprint (Malik et al., 2018). The footprint needs to be nationally quantified to define and measure reduction targets. The most significant contributor to the health care sector's carbon footprint is purchased products, which account for 71% of overall carbon emissions. Other sources of emissions are the disposal of medical consumables, pharmaceutical devices and equipment, food, and agricultural products such as paper (Kiang & Behne, 2021). Without any attempts to reduce emissions, the health industry's carbon footprint is expected to triple by 2050 (Kiang & Behne, 2021).

The impact of climate change on health outcomes

Climate change is one of the most significant health crises facing the nursing profession today (Australian College of Nursing, 2021). It has created irreversible human health and welfare symptomology (Butterfield, Leffers & Vasquez, 2021). The predicted death rate from climate change is expected to reach 250,000 deaths per annum between 2030 and 2050 (World Health Organization, 2017a). With natural disasters occurring at unprecedented frequencies, the demand for health service response will match. The relationship between climate change and the impacts on health is illustrated below in Figure 1.

The 2019-20 Australian bushfires resulted in 450 deaths, including 33 directly from the fires and 417 from smoke exposure. Over 1,300 asthma emergency department presentations and over 3,150 hospital admissions for cardiovascular and respiratory conditions during this time (Zhang et al., 2020). For more information, refer to Appendix A. Severe weather events notwithstanding,

climate change has long-range and indirect impacts on health. Rising air temperature and atmospheric composition increase cancer and respiratory disease burden. Rainfall and temperature patterns alter insect prevalence and associated vector-borne diseases, such as Japanese encephalitis virus, now found in the temperate climates of southern Victoria (Slezak, 2022). For a complete list of the health effects of climate change, see Appendix B.

Poor health outcomes resulting from climate change intersect with socio-demographic issues such as age, gender, health status, socioeconomic status, social capital, public health infrastructure, mobility, and geopolitical conflict (Butterfield, Watts & Vasquez, 2021). Combined, these environmental and social determinants of health result in a higher disease burden (Crear-Perry et al., 2021). Human habitat destruction and mass migration as a result of climate change unequally impact developing nations and vulnerable populations, such as young children, older people, women, and people in poverty.

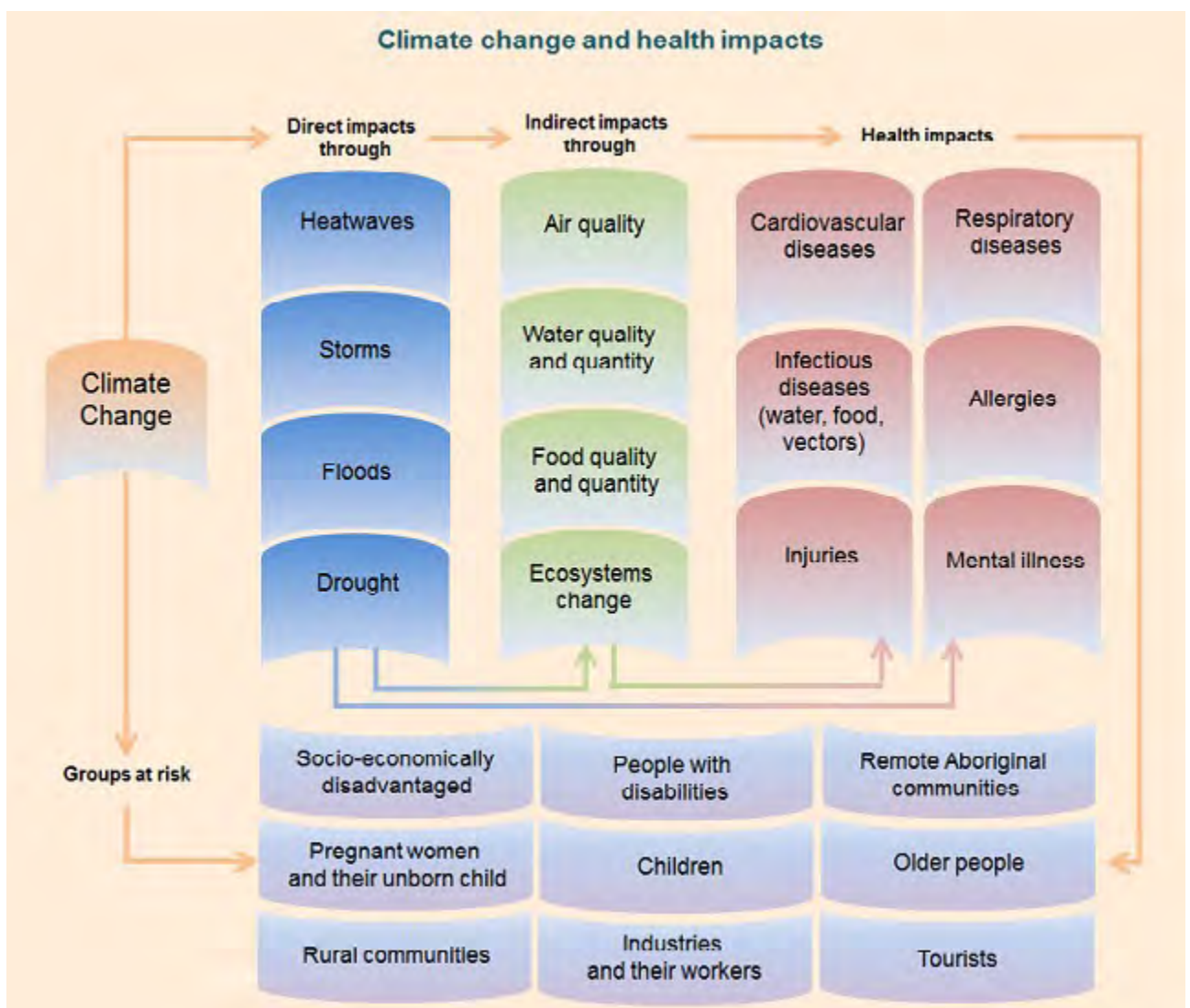


Figure 1. Climate change and health impact diagram. (Source: New South Wales Health, 2017, <https://www.health.nsw.gov.au/environment/climate/Pages/climate-change-and-health.aspx>)

The climate health paradox

Australia's health system confronts the dual challenge of addressing climate change's poor health outcomes and reducing its substantial contributions to the national carbon footprint (Malik et al., 2021). Australia's health system contributes approximately 7% of the nation's carbon dioxide (CO₂) emissions — and emissions output equivalent to the whole of South Australia (Malik et al., 2018). See Appendix E.

The health care sector is a significant producer of emissions globally and, paradoxically, cares for those most impacted by climate change. The health care system will also need to manage the population's health issues, directly and indirectly, arising from the impacts of climate change. This places the health care system in an unenviable position of developing interventions to reduce their carbon footprint, addressing the population's health needs, and responding to health emergencies while developing preventive measures to empower communities to adapt and respond to climate change.

Historical and current structural racism has ensured that climate change has unequally impacted First Nations peoples in Australia and worldwide (HEAL network & CRE-STRIDE, 2021). The Torres Strait Islander community are already being affected by seawater inundation and an increase in vector-borne diseases (Hall et al., 2021). Other at-risk populations, including older adults and newborns, will be significantly impacted by climate change due to different physiological responses to heat and susceptibility to climate-related infectious diseases (IPCC, 2014). As climate-driven natural disasters become more powerful and frequent, health care systems and our communities face a vicious cycle that exacerbates the growth of social and economic inequality and social disadvantage. Left unaddressed, these communities will become increasingly vulnerable to climate-related events.

Complex problem = complex solution: Nursing climate stewardship in all industries is the case

To limit the catastrophic effects of climate change, there needs to be an urgent reduction in GHG emissions from the health care industry. Planetary health is intricately linked to human health, quality of life, and physical, chemical, biological, and social issues. Health care professionals must be at the forefront of reducing emissions and advocating for community-driven policy change (Nagai et al., 2021). As the largest, most geographically diverse health care profession, nurses are best placed to advocate for urgent policy development that delivers sustainable energy management in all health facilities (Nicholas et al., 2017). Nurses must be leaders in the health sector and work with diverse professions and industries to call for an urgent response to climate crises and further emissions reduction.

There is no 'one size fits all' response to the impacts of climate change on health care. Fundamental principles of optimal health care — prevention, early intervention, and low-value/non-evidence-based care reduction — are highly congruent with the climate change agenda. This nursing knowledge is transferrable to other industries and professions, including emergency services, education, heavy industry, transport, aviation, manufacturing, agriculture, government departments, and the corporate sector. These industries can look to the nursing profession for complex solutions to this complex problem. Nursing wisdom, founded on prevention, resilience,

and response, can be embedded and shared outside the health care professions and is vital for all industries to meet national and international targets.

Upstream action on climate change — particularly mitigation in Australia's context — will prevent burdens on the health care system and support its resilience and ability to deliver services in the climate emergency. Developing appropriate preventive strategies for climate change requires the expertise and knowledge of Australia's diverse nursing profession. Nurses should be critical in decision-making and immediate planning around emissions reduction and climate stewardship within a generative approach. Therefore, ACN proposes a four-pillar approach to nurse-led climate stewardship (see Figure 2 below).

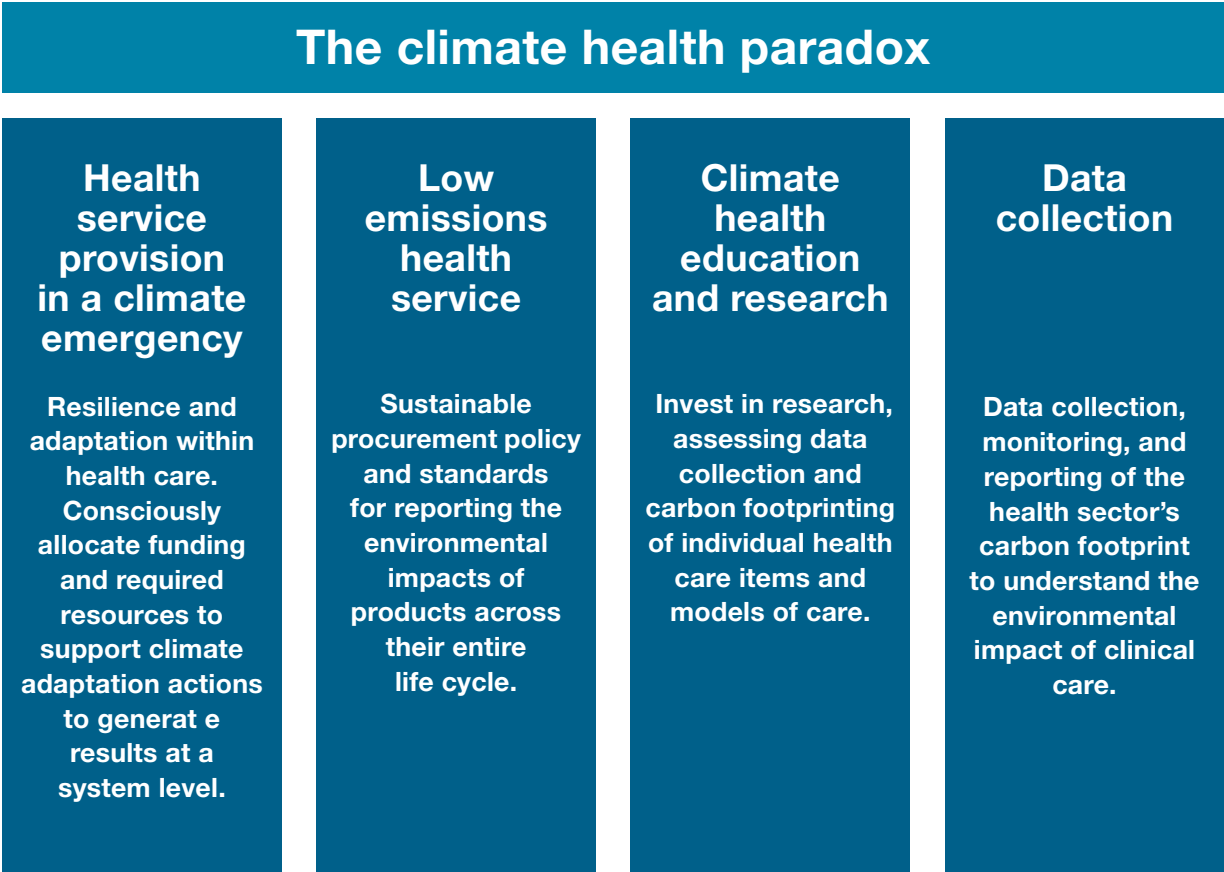


Figure 2. Four pillars for nurse-led climate stewardship. ACN, 2022. "Where nurses lead organisations follow....."

RETHINKING HEALTH SERVICE PROVISION IN A CLIMATE EMERGENCY

A move beyond disaster response: a national climate disaster response and prevention framework

Currently, the health care system is permanently in disaster response mode. Escalating natural disasters combined with the climate effects on chronic conditions and vulnerable people will only compound the strain on the health care system. The Australian Royal Commission into National Natural Disaster Arrangements cautions that the frequency and intensity of extreme weather events will only be compounded with further global warming (Binskin et al., 2020). Swift action to build resilience into our health care systems is required to meet this projected demand, allowing for a shift from continual disaster response to disaster preparation, prevention, and generative plans for service delivery in a climate emergency.

A generative approach to climate response is where climate stewardship is ingrained in an organisation. From the boardroom to the casual contractors, everyone thinks of climate change and the work they do as inseparable (Unsworth et al., 2021). The intention is to move beyond the typical governmental and health system emergency response. ACN welcomes the Australian Government's commitment to establishing the new Health, Sustainability and Climate Unit, though would urge government to ensure nurses are proportionately represented within this Unit. Nursing can play an integral role in advocating for and implementing generative strategies utilising knowledge gained from the community and cross-sector collaboration. Currently, health, emergency, and disaster response services are fragmented. This is due to poor coordination between local, state, and federal agencies. A new way of thinking about disaster service delivery in a climate emergency is required. Moving from disaster response to building climate resilience in our health care systems and communities will include climate, disaster, public health, primary, acute, and critical nursing expertise in national, state, and local plans.

In March 2022, two consecutive, climate-escalated flood events occurred in Lismore, northern New South Wales. This resulted in an unprecedented demand for health and emergency services. For full details of the supporting case study, please refer to Appendix C.

Through the Health, Sustainability and Climate Unit, a national cross-sector climate response and prevention framework must be developed urgently to be deployed in situations such as those in Lismore. For this approach to be successful, coordination between the Commonwealth, states, territories and local governments and defence, humanitarian, and disaster non-government organisations must be coordinated. Nursing knowledge will be integral in this cross-sector implementation, and nurses' practical problem-solving skills must be utilised at the highest level.

The National Critical Care and Trauma Response Centre (NCCTRC) in Darwin provides a successful example of this model. From the lessons of the Bali Bombings in 2002, the Australian Government established the NCCTRC to respond to offshore events that require a swift, coordinated response and to draw upon existing fragmented resources (NCCTRC, 2022). Nurses were central in developing this body which now coordinates and builds workforce capacity. For this model to respond effectively to the climate crisis, a national framework and body to administer it are required.

A national climate risk management framework to build climate-resilient health care systems

The climate crisis exceeds disaster response and preparedness. It requires a total rethink of the entire health system. This is particularly pertinent as demand across all health care sectors - particularly disaster, infectious diseases, mental health, and primary care - increases in response to climate change.

Climate risk management should be systematic and include necessary changes to the federal government's organisational structures, accountabilities, policies, and procedures. Climate risk management involves making resilience the goal of the system. This enhances the capacity to recognise, monitor, anticipate, communicate, and prepare for changing climate-related health risks. It includes preventive measures that respond to, manage, and cope with the uncertainty of a changing and unstable climate while promoting recovery. A learning culture that focuses on continual improvement to build and maintain future-focused capacity is also critical. Please refer to the supporting Case Study outlined in Appendix D for further details.

Engineering resilience in the health, emergency, and adjacent systems is required to support the unprecedented demands on these systems. This can be achieved by implementing a national climate risk management framework.

Resilience can be engineered to promote system capacity while managing risk and mitigating projected vulnerabilities (Hollnagel et al., 2006). Resilience can also foster financial incentives for a wide range of policies and supportive conditions for health and wellbeing, while optimising system performance (WHO, 2017b). Engineering climate resilience into the health system requires embedding climate resilience into all the system's building blocks, such as leadership, governance, workforce, technology, supply chains, service delivery, and financing.

Building climate-resilient systems is a two-fold approach. It involves mitigating carbon emissions through the supply chain and contractor management, health care delivery, and reducing staff and patient travel (Barratt et al., 2021; MacNeill et al., 2021; NHS England & NHS Improvement, 2020). This aspect is covered extensively in Chapter 2. The second component of engineering resilience involves adapting processes that protect public health and health care systems without inadvertently causing adverse health impacts and undermining efforts to protect the environment.

The World Health Organization (WHO) proposes four key themes when considering how to build climate-resilient health care systems that move beyond disaster response (World Health Organization, 2021b):

- Comprehensively and systematically assess and analyse all system-level and health-related vulnerabilities to climate change.
- Create partnerships between all stakeholders (health care sector, government, community) to develop a systematic and integrated response plan for adaptation purposes.
- Consciously allocate funding and required resources to support climate adaptation actions to generate results at a systemic level.
- Develop an implementation plan with a robust methodology to monitor and evaluate the effectiveness of these actions.

As demonstrated by the WHO, climate risk management approaches need to extend beyond the health sector and address issues in adjacent health-determining industries such as water, energy, food, agriculture, and urban planning.

A critical component of a nurse's role is to advocate for vulnerable people and their communities. Nurses are the ideal link between communities and governments, working at the intersection of the health care system and those who seek health care (Salvage & White, 2019). Community engagement is paramount to a national climate risk management system. Local-level dialogue, two-way information exchange, and community mobilisation should be considered essential functions of the climate risk management system. This is achievable through a nurse-led, Australian implementation of the WHO operational framework for building climate-resilient health care systems as demonstrated below in Figure 3.



Figure 3. WHO operational framework for building climate-resilient healthcare systems and the primary connections to the building blocks of healthcare systems. (Source: World Health Organization, 2021, from https://www.researchgate.net/figure/Ten-components-comprising-the-WHO-operational-framework-for-building-climate-resilient_fig2_302976135).

Identifying and maximising the geographically diverse nursing workforce in a climate emergency

Utilising the geographically diverse nursing workforce to its full potential and scope of practice is vital in delivering health services in a climate emergency. Nursing is the largest single health profession, with 450,000 nurses and midwives making up 57% of the health workforce in Australia. As the lead clinician in many episodes of care, nurses are most likely to be the first health professional seen by people in remote communities for specialist and primary care needs (CRANAPIus, 2020).

Many of the most vulnerable communities are currently not fully serviced by medical officers (ACN, 2019; CRANAPIus, 2020). Climate and natural disasters increase demand for these services, requiring resilient systems to meet demand. To achieve this, a minimum dataset for the nursing workforce is needed to facilitate planning to optimise service provision in a climate emergency. Nursing workforce planning is multifactorial. The lack of a national minimum dataset prevents informed decision-making by workforce planners and strategic public health response in a climate emergency. A national minimum data set will maximise and mobilise a ready nursing workforce known anecdotally to be geographically diverse to continue to provide services to those most vulnerable in the escalating climate emergency.

Optimising advanced climate nursing practice to meet escalating climate demands

Increased climate pressures on health service delivery will threaten the current economic viability and quality of medical-led health care. A traditional medical-led model of care is not a sustainable or efficient use of health resources. There is a solid historical, legal, and regulatory assumption that health care services need to be led by medical practitioners (Australian Nursing and Midwifery Federation, 2009). These traditions, laws, and regulations are incongruent with the provision of health care in the climate-affected Anthropocene of the 21st Century. Enabling nurses to work to their full scope of practice to meet the escalating demands of climate on the health system will allow for a shift away from historic, medically dominated models of service delivery (ACN, 2019). Despite many nurses being the 'pulse of their communities', they are currently prevented from working to their full scope of practice due to local, state, territory, or Commonwealth restrictions. Respectful interdisciplinary care optimising all practitioners' education and practice potential is urgently needed to address the climate crisis and its impact on health.

Underutilisation of primary health care nurses

Primary health care nurses are not always employed to their full potential in Australia. The community and primary health care sector are a significant component of Australia's health care system, providing direct health care services to the community across the lifespan. This includes health promotion, the prevention, diagnosis, and treatment of acute and chronic health conditions, and support in managing long-term health care, particularly for individuals with chronic health conditions such as diabetes, chronic obstructive pulmonary disease, cardiovascular disease, and mental illness (ACN, 2021a). A survey of general practice nurses suggests that over one in three nurses are not maximising their knowledge and skills (Australian Practice Nurse Association, 2018). Thirty per cent identified that the practice manager or GP was the primary barrier to not functioning to their full scope. Furthermore, nurse-coordinated complex care management was recorded against the medical officer for funding purposes due to the exclusion of nurses from the Medical Benefits Scheme.

This new paradigm requires optimising advanced care nurses and nurse practitioners. Advanced practice nursing harnesses nurses' experience, education, and knowledge to allow them to practise at the full capacity of the registered nurse practice scope (ACN, 2019). Advanced practice nursing is neither a title nor role but is a level of clinical practice that integrates nursing knowledge and skills from the clinical, health care systems, education, and research domains of nursing (ACN, 2019). This allows the nurse to practise as a nursing leader and fulfil many clinical roles effectively and efficiently. It is vital to support nurses to work to their full scope of practice as autonomous practitioners, encompassing a broad and diverse set of roles and responsibilities within various clinical settings in the community and other health care settings.

Stretching the climate budget – A move to value-based health care

The cost of health provision in a climate emergency will escalate in parallel to growing demands on the system. Health provision, as a proportion of the gross domestic product, is the fastest rising Commonwealth budgetary cost, with the current delivery models paradoxically exacerbating the issue (WHO, 2019; ACN, 2019). Total health spending has increased by 50% in the last ten years, exceeding the population growth rate (Australian Institute of Health and Welfare (AIHW), 2022). The triple bottom line, which is the balance of financial, social, and environmental objectives, must be at the forefront of managing service provision in a climate emergency (Duane et al., 2014).

Rapid response to climate change requires nursing involvement to transform the fiscal management of Australia's health system. The sector has traditionally been reactive and focused on managing the impact of the climate crisis rather than delivering high-value, net-zero emissions and sustainable health care. In addition, the current Australian health industry is a piecemeal mix of funding sources delivered through private and public services. Some health services are nationally funded, while others are state or territory-funded (Commonwealth of Australia, 2014).

Policy development and service delivery vary significantly across the country. This results in an extensive, labour-intensive, expensive, and complex system that duplicates services.

A move to value-based funding models is essential. Value-based health care is defined as ‘health outcomes that matter to patients relative to the resources or costs required, over a full cycle of care’ (ACN, 2020a). Climate change will magnify the cost of health service provision. Current funding and practice models limit the potential for flexible health care delivery and person-centred care. The decline in service provision, climate effects on health, and exacerbation of poor health in conjunction with escalation of health costs could be reduced with a move to value-based funding.

Value-based health care reforms are expected to reduce carbon emissions by reducing unnecessary investigations and treatments while focusing on patient wellbeing and health (MacNeill et al., 2021, Barratt et al., 2022). A public health approach encompassing health promotion, education, and initiatives that aim to reduce the incidence and severity of the disease will also support the shift to value-based health care (MacNeill et al., 2021). However, more significant funding is required for primary care services, counselling, immunisation, screening programs, and chronic disease management.

A focus on preventive public health and value-based health care is required to ensure value is obtained from a climate-affected system. The recent COVID-19 pandemic has demonstrated that health systems can be quickly mobilised when there is a need to protect public health. Strong governance and leadership are required from all levels of government and business to achieve these goals.

Nurse-led cross-sector collaboration and leadership

As the most trusted profession, nurses can amplify vulnerable voices in community consultation and engagement (Climate and Health Alliance, 2021; Butterfield et al., 2021). The intention is to move beyond the typical government and health system emergency response. This requires deeply involving nurses and nurse leaders to play an integral role in advocating for and implementing responsive strategies that target emissions reduction and climate resilience across government, industry, and health services. For instance, proportionate nursing representation is vital to the success of the newly established Health, Sustainability and Climate Unit.

Educating and empowering nurses to develop, research, and implement innovative approaches and lead emissions reduction activities will benefit Australia’s national climate preparedness. This fosters a partnership approach between health care systems and the communities nurses work in to plan for and mitigate the impacts of emissions on our people and health care system.

Nurses with climate and sustainability expertise should be appointed at all levels of health care, including in leadership and strategy roles, to champion climate health risk management and emissions reductions. A nationally coordinated cross-sector approach led by nurses is needed to ensure appropriate responses to climate change are implemented across all jurisdictions. This systems approach involves nurses in all decision-making within and across all relevant policy portfolios. Nurses must collaborate with other health agencies across interdisciplinary and systems boundaries to amplify and facilitate emissions reduction and system resilience efforts in all industries and professions.

LOW EMISSIONS HEALTH SERVICES

National inquiry into lowering health care emissions

Globally the health sector is responsible for 4.4% of GHG emissions – this is close to double the emissions of the aviation industry (2.5%) (Association of American Medical Colleges (AAMC), 2022). This creates a paradox –the health care system not only cares for those most impacted by climate change but also significantly contributes to it. A US study found that the effects of health care emissions may cause up to 44,000 to 98,000 indirect deaths nationally every year (Eckelman & Sherman, 2016). The emissions contribution to health varies by country (see Appendix E and F).

The Australian health system is rapidly innovating and reforming, building on lessons learned during the COVID-19 pandemic response. Similarly, a rapid and innovative response is also needed to shift to low emissions health care service delivery as a matter of urgency to limit the impact of climate on the community and health system. This can be achieved by adopting environmental, social, and governance principles used extensively to guide business development in the commercial spheres (Butler et al., 2022). For this to be attainable, the health care sector must quantify and address the impact of emissions and climate change on all Australians.

An urgent national inquiry into the carbon footprint of the Australian health care industry is required to identify the baseline and guide emissions reduction targets. This will quantify Australian healthcare industry emissions and act as a data source to guide reductions by identifying a tangible target and metrics to measure emissions reduction strategies.

Nurses to drive sustainability at every level

Despite the nursing profession's pledge to 'do no harm', the health care sector is a significant contributor to global warming. As health care leaders, nurses are responsible to the community to serve as advocates for change in public policy that will protect humanity (Turale & Kunaviktikul, 2019). Nurses have an ethical imperative to lead the development of equitable climate change and transition to zero emissions for their patients, peers, community, and policymakers (ACN, 2020).

Nurses control high emissions episodes of care and can lead by example to decarbonise health care while reaping the benefits of improved health outcomes. This helps ease the growing pressure on the health system with an ageing population and subsequent rise in chronic health conditions. Nurse leaders are required to deliver safe, cost-effective, and responsive clinical care while meeting productivity targets and acknowledging the environmental and social expectations of the community (Eckelman & Sherman, 2020). Nurses must adopt social sustainability concepts, which require the profession to uphold social justice and ethical decision-making in distributing limited resources (Dunphy, 2013).

Evidence shows that solid nursing representation and leadership in emissions reduction and climate resilience discussions at all levels provide mitigation interventions across all industries and governments (WHO, 2017; Butterfield et al., 2021; Watts et al., 2021). Nurses with climate and sustainability expertise should be embedded in every local health service and adjacent disaster, health, humanitarian, population, and community organisation. These nursing specialists would augment and support nursing and health care leaders to manage this complex issue. Nurses will be required to lead and empower all health professionals by embedding environmentally sustainable health care practice into every aspect of the health spectrum from an economic, social,

health, and environmental perspective (Schwerdtle et al., 2020). This is known as sustainability practice and climate stewardship. Nurses in these roles can learn from the corporate world, where sustainability practices are informed through consumer engagement based on environmental and social governance principles. Consumer-driven sustainability engages with relevant consumer stakeholders in decision-making to capture social aspects before implementing change (Hussain et al., 2019).

Guided by the expertise of these specialist nurses, all nurses and health care professionals must drive change within their area of influence. The deadline to reduce emissions and ensure environmental sustainability is now. Environmental preservation and action on climate change are essential to providing high-quality health care (Kiang & Behne, 2021).

Nurse-led emissions reduction strategies with targets and outcomes

Nurses must lead sustainable practices in the health care sector to provide a high-quality, clean, and safe physical environment as part of a broader, long-term sustainable ecosystem. Currently, the focus is on retrospectively assessing vulnerabilities and performing adaptation assessments, with most systems seeking to switch to renewable energy sources and optimising waste and recycling management (MacNeill et al., 2021; NHS England & NHS Improvement, 2020). Health care organisations must strengthen their systems by developing health-inclusive and health-promoting climate targets and policies (Desmond, 2018).

The scope of this White Paper is to propose a new vision for nurses to lead, research, and validate sustainable practices. Health care delivery generates considerable waste, energy, water consumption, agriculture and food use, chemicals, and transportation emissions (Hoban et al., 2021). Some effective evidence-based strategies to counter this are demonstrated in Appendix G.

Nurses directly control high waste episodes of care and should lead sustainable practices through 'environmental stewardship' (Schenk, 2019). ACN has published an Emissions Reduction Charter, Position Statement, and Guiding Principles, which should be implemented at all sector levels (ACN, 2020b; ACN, 2021b; ACN, 2021c). Nurses should partner with government, industry, and health services to promote and prioritise the importance of reducing emissions in the health care sector. Nurses must hold these bodies accountable by defining emissions reduction targets within health care and, most importantly, measuring their success.

A national approach is required to overcome the Australian health care system's current fragmented approach. Primary care practices operate as small businesses, making it difficult to track the overall impact of sustainability measures. Subsequently, organisations must individually assess their vulnerabilities and identify strategies to support greener health care. There is also a need to improve health care workforce climate literacy and the impacts of climate on health (Shaw et al., 2021). This contrasts with the United Kingdom's current model. For further details, please refer to the case study in Appendix H.

While many of the NHS initiatives in the UK can be adapted to Australian health care settings, a coordinated national emissions reduction framework underpinning health service providers would

promote sustainability and improve health outcomes. This would require the definition of nationally accepted and measurable targets. It would need to be transparent and auditable to encourage the sector to be accountable for meeting its emissions reduction targets. A national body aimed at reducing health sector emissions that foregrounds nursing wisdom would be required to administer the framework.

A national framework and nurse-led administrative body would ensure accountability. While some organisations have implemented sustainability officer roles to support local efforts, others have implemented environmental sustainability as a new dimension for quality measurement of health services (Esmaeili et al., 2008). For instance, NSW Health has established a Climate Risk and Net Zero Unit (NSW Health, 2022). Queensland Health has also committed to introducing an Office of Hospital Sustainability, responsible for setting sustainability targets, investing in sustainable hospital infrastructure, reviewing procurement to manage waste and encourage environmentally sustainable products; and providing advice to manage the effects of climate change on Queensland's health care system (Australian Medical Association, 2021). While these are state-level examples, similar strategies could be rolled out nationally to better coordinate and manage the existing costly and fragmented responses to the climate emergency.

Nurse-led models of care to reduce emissions

Low emission models of care are required to address the climate emergency facing health services. There is a substantial carbon footprint related to travel to health care appointments and patient movements to centralised specialist care (Forner et al., 2021). The health industry has become increasingly sophisticated in data collection on carbon emissions; therefore, an increase in transportation-related carbon emissions has become an important issue (Duane et al., 2014).

Localised nurse-led models of care to reduce patient transport emissions are required to transition to a sustainable health model. Examples include outpatient services in non-serviced areas and specialist liaison teams from large organisations to sub-specialties. Using nurses to perform tests locally, reducing unnecessary patient investigations (such as pre-operative testing when not indicated), using telehealth for primary health care, and reducing clinic visits and patient travel are proven strategies the health care industry can implement to reduce transport emissions (Wang et al., 2021).

Moving to the home hospital and maximising primary health and community nursing roles are lower emissions models (Malik et al., 2018). A localised nursing model of care prevents unnecessary high-emissions episodes (such as transport costs and acute hospitalisations) by focusing on prevention and early intervention. This nursing model of care provides high-quality, community-based health services, meaning people are hospitalised as a last resort, thus reducing high-emissions episodes of care.

The use of monitoring via 'virtual wards' has been implemented during the pandemic period as an effective way to reduce the burden on the health care system. However, this is also effective in reducing emissions through the prevention of high-emissions episodes of care. The implementation of nurse-led pre- and post-hospitalisation telehealth can be an effective way of reducing emissions (Wang et al., 2021). Outreach clinics and bolstering regional, rural, and home-based nurse-led rehabilitation care may reduce GHG emissions (Forner et al., 2021).

Engaging aeromedical services in emissions reduction through tasking, fleet modernisation, and sustainable aviation fuel use is vital. A centralised health service may reduce health service carbon and service costs. However, patients still must travel a distance for health care, contributing indirectly to emissions (Duane et al., 2014). Australia experiences the tyranny of distance, and the system works hard to ensure equitable access. Patients must always be transported for specialist care, so collaborating with most nurse-led aeromedical services is important (Brideson, 2017).

Schemes encouraging health staff to commute more sustainably via public transport, car sharing, walking, and cycling would help reduce transport emissions. This has the added benefit of a public health strategy that fosters staff wellbeing through reducing obesity and improving cardiovascular fitness. Installing electric vehicle charging points in health facilities is also encouraged.

Nurse-led and mediated telehealth and digital health models reduce the environmental impact of face-to-face consultations. Telehealth was introduced in the late 1970s but saw a significant uptake due to the COVID-19 pandemic. This has had a positive environmental impact through reduced car journeys while maintaining optimal health care access (Filfilan et al., 2021). Some services reduced their emissions by 99% through telehealth and less patient travel (Filfilan et al., 2021).

CLIMATE HEALTH EDUCATION AND RESEARCH

Education for nurses in climate health, emissions reduction, and sustainability

The WHO has identified climate health as a critical priority in health care education (WHO, 2021c). The integration of climate health, sustainability, and emissions reduction within nursing education and research will build the capacity for the nursing workforce to respond to evolving workforce trends and produce graduates who are work-ready for the future. The nursing profession is underpinned by maintaining health and has currency in promoting the health of individuals and broader society (Goodman & Richardson, 2010).

Nursing education to support new climate and sustainability roles is limited and does not equip the workforce with the skills and knowledge required to fully capitalise on the nursing profession's capacity to lead change. The profession needs to rapidly evolve to address the climate emergency with the establishment of roles within nursing that focus on sustainability and climate health (Cook et al., 2019). Climate nursing is quickly becoming a sub-specialty within nursing leadership roles, with several states appointing chief sustainability nurse positions. The number and scope of these roles are projected to grow to address the health care industry's response to this emerging challenge (Nicholas & Breakey, 2017).

Evidence suggests that targeted education within curricula and health care settings for the nursing workforce improves the ability of the profession to reduce emissions, manage waste, and respond to the unfolding climate emergency (Ward et al., 2022). Education will position the largest workforce in health care to actively respond to the impacts of climate change and mitigate further climate impacts. The profession must begin with equipping their students, graduates, and future workforce with the curriculum's climate health knowledge and stewardship.

Climate stewardship in the undergraduate nursing curriculum

The International Council of Nurses (ICN) position statement on 'Nurses, climate change and health' calls for nurses to take immediate action to build climate-resilient health care systems (ICN, 2018). This demonstrates the importance of educating all nurses in our future and current workforce, regardless of their speciality. The Australian Nursing and Midwifery Accreditation Council (ANMAC) is the national accrediting body of nursing curricula. ANMAC mandates that nursing education providers must deliver a curriculum that is responsive to emerging trends (Standard 3.4) (Nursing and Midwifery Board of Australia [NMBA], 2019). Climate health, sustainability, and emissions reduction are undoubtedly emerging trends within the health care sector. Despite the requirements of ANMAC, there is currently limited evidence that climate health, emissions reduction, and sustainability have been integrated widely within nursing curricula in Australia. Anecdotal evidence suggests that some nursing schools have implemented some climate health content, but this is far from a requirement.

A rapid transformation of nursing education to build the capacity required to deliver services in a climate emergency while reducing health care emissions requires nurses to be educated. Nursing graduates should possess the knowledge, skills, and ability to respond to the climate emergency, reduce emissions and build resilience within the health care system and the communities in which they live. This can be achieved by educating nurses in their undergraduate degrees about how climate change can impact direct patient care, waste management, resource utilisation, client and community education, and health policy development (Boylan et al., 2019; Ward et al., 2022). This would ensure all graduates possess the foundational knowledge for practising in an evolving social and health care environment that addresses the impact of climate change and mitigates further climate impacts (Aronsson et al., 2020). Incorporating climate health into undergraduate nursing curricula would mirror the medical professionals who have already done so (Madden et al., 2022).

Climate nursing specialists – Professional development for the existing workforce

Nurses care for those most severely impacted by climate change while working within a system that is paradoxically one of the largest emitters. However, most registered nurses have had neither formal nor informal education opportunities on how to limit the impact of climate change within the health care system. This includes units on care for people under extreme climate circumstances or on how to assist people and communities in building resilience (Cook et al., 2019).

Nurses within all contexts require education to assist them in identifying how to reduce emissions and practise sustainably in a health care environment impacted by climate change (Cook et al., 2019). However, with the emergence of specialist sustainability and climate roles in nursing and, more broadly, health care, there are limited formal post-graduate programs available specifically for nurse clinicians. This means nurses cannot step into leadership roles and further develop the profession's capacity to adapt and respond to the impacts of climate change and the need for sustainable practice.

Providing education to enable nurses to drive innovation in addressing the climate emergency has positive impacts across health care (Cook et al., 2019). When nurses can engage in professional development opportunities, they are uniquely positioned to lead sustainable changes within the health care industry and build resilience in the communities they serve (Butterfield et al., 2021). Post-graduate education of climate nurse specialists and prioritising and maximising advanced climate practice are fundamental to foregrounding and expanding nurse knowledge.

Nurse-led climate research

Interdisciplinary clinician-led research is required to ensure that the most up-to-date evidence can be embedded within the practice to support climate stewardship. Implementation research is critical to ensure findings guide various practice contexts in Australia and identify barriers and enablers to ensure sustainable, resilient practice within the health care industry (Boyer et al., 2020). Nurses are utilising scientific research to ensure sustainable practice within the diverse nursing contexts of practice positions. The interdisciplinary clinical health care workforce must continue to use research to inform sustainable approaches to care that address the impact of climate change on the health care system and communities. (Leffers & Butterfield, 2018).

Both the scope and the magnitude of climate change-related health risks are daunting. Health adaptation efforts aim to reduce the health risks associated with climate change. They build on essential public health services and serve to strengthen core health system functions to potentially offset these risks. Across the health sector, however, implementation and uptake of these adaptation strategies have been uneven, constrained by limited resources and organisational capacity, inadequate assessments concerning the health risks, and imprecise estimates about the effectiveness of current or future climate-related interventions (Boyer et al., 2020). Further research is required to support the implementation of evidence-based strategies into practice.

Currently, there are limited opportunities in Australia for nurses to engage in clinician-led, funded climate health, emissions reduction, or sustainability research (National Health and Medical Research Council, 2022). Dedicated grant schemes for interdisciplinary, clinician-led research into sustainably reducing health care waste and emissions, responding to health impacts, and building resilience within health care systems have been supported worldwide (National Institute for Health and Care Research, 2022). This ensures that the health care industry and the Australian community can prepare for and respond to the impacts of climate change while mitigating the risk.

Nurses must be supported to acquire and develop the key sustainability-related competencies required to transition toward more sustainable health care systems. This starts with the foundation of education and nurse-led research in climate health (Butterfield et al., 2021; Aronsson et al., 2020). Investment in nurse-led research on climate health, emissions reduction, and sustainability will ensure the nursing profession's capacity to step into leadership roles and further develop the critical ability to address sustainability in a health care system directly impacted by climate. Please refer to the case study presented in Appendix I for supporting evidence.

CONCLUSION

The evidence is undeniable – climate change is humankind's most significant modern health crisis. The health care sector is an important carbon emitter while paradoxically caring for those most affected by climate change.

Nurses are equipped to take the lead on emissions reduction within and beyond the profession. Nurses have an essential role to play, both professionally and personally, in reducing emissions and mitigating climate-related health effects. Climate health and emissions reduction are complex issues that require a complex solution.

A complete rethink and overhaul of service provision in a climate emergency are required. We must forget traditional models of care that will not meet surging climate-related health care demands and develop a nationwide approach that foregrounds nursing wisdom and coordinates a national climate response. This will be achieved by forming a national climate response body to create and administer frameworks and strategies.

Nurses must be allowed to work to their full scope of practice and lead cross-sector collaboration to respond to surging health demands experienced in a climate emergency. This requires a minimum nursing dataset to drive efficient, evidence-based surge workforce planning. Nurses must lead an urgent transition to low-emissions health care as a significant contributor to GHG emissions. This will require a national inquiry to identify the current carbon footprint of health care. Only then can we set tangible and measurable targets. The new and evolving role for nurses with climate and sustainability expertise must lead this. These expert practitioners must be embedded at every level within health care and across all industries and governments. A shift to low-emissions health care services will mean a transition to localised, nurse-led models of care that limit transport-related emissions. The system must amplify the wisdom of advanced practice nurses, who are the experts in preventive, chronic and primary health care models.

Climate stewardship must be developed in the nursing workforce through climate education and research. Nursing education will require a radical reform that places climate health, emissions reduction, and sustainability at the core of undergraduate nursing curricula. Furthermore, the current workforce will require climate stewardship capacity-building. The nursing profession is at a critical juncture, and it must establish, define, and train climate health and sustainability specialists through targeted post-graduate education. This will further complement nurse-led inter-professional and cross-sector collaborative research, which can extensively evaluate climate interventions inside and outside the health care sector to contribute to the scientific climate discourse.

This White Paper has presented the nursing response to the climate emergency. We must continue delivering efficient, equitable, quality health services in a climate emergency while reducing health care emissions. Nurses are well positioned to lead the way. The survival of our species depends upon it. Humanity and the planet need nurses like never before.

RECOMMENDATIONS

ACN calls on state, territory, and federal governments to:

- Through the newly established Health, Sustainability and Climate Unit, urgently develop and implement a national climate disaster response and prevention framework and climate risk management framework to engineer climate resilient health care systems.
- Develop a minimum nursing dataset to identify and optimise the geographically diverse nursing workforce to enable a nurse-led, value-based, national health care emissions reduction strategy with achievable targets and outcomes administered by a national body.
- Ensure nurses are proportionately represented in the Health, Sustainability and Climate Unit.
- Provide funding to enable the provision of specialty post-graduate qualifications in climate health, emissions reduction, carbon health literacy and sustainability to support nurses transitioning into specialty leadership roles.
- Provide funding for a dedicated research grant scheme to expand nurse-led, inter-professional and cross-sector climate research targeting climate health, emissions reduction, and sustainability for clinicians in health care.

ACN calls on nursing education providers to:

- Embed climate health, emissions reduction, and sustainability in all undergraduate nursing degrees in Australia to ensure every nurse has access to education and training to respond to climate health, act as climate stewards and build community resilience.

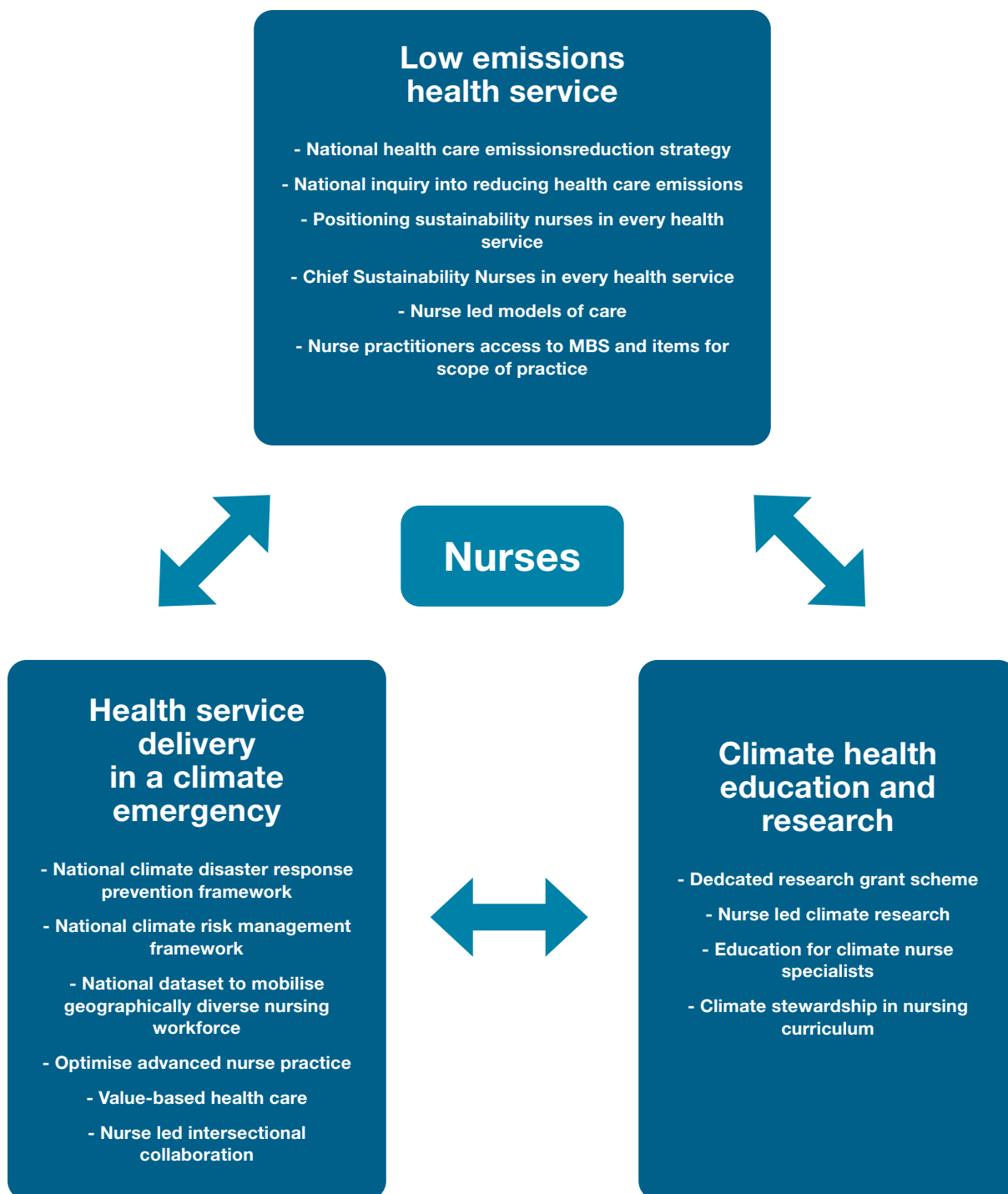


Figure 4. The role of nurses in emissions reduction. Emissions Reduction Policy Chapter, ACN (2022).

"If working apart, we are a force powerful enough to destabilise our planet, indeed, working together, we are powerful enough to save it. In my lifetime, I've witnessed a terrible decline. In your lifetimes, you could and should witness a wonderful recovery."

– Sir David Attenborough at the UN Climate Change Conference UK 2021 (COP26)

APPENDICES

Appendix A

Box 1: The impact of the Canberra bushfires (2019- 2020) on health services

Context: The Canberra bushfires of 2019-2020 were unprecedented in size and scale. Bushfire-related emissions from smoke caused more than **400 deaths and over 3,000 hospitalisations** – resulting in an estimated **\$1.95 billion cost** to the Australian health care system. Poor air quality also led to increased reports of eye irritations, coughing, and headaches for many Australians after the bushfires were extinguished.

Impact: Along with the influx in emergency admissions, the air filtration systems in Canberra hospital could not deal with the unhealthy levels of smoke inside the buildings. Medical equipment, MRI, and CT machines failed from the smoke contamination. Birth suites and operating theatres were infiltrated with smoke, and staff working in clinical areas also suffered from smoke inhalation and heat.

Response: Air purifiers were installed in clinical areas, and comfort packs were provided to staff to lessen the effect of working in busy smoke-contaminated work environments. Health sites performed regular emission assessments, creating a level of preparedness in staff who could recognise when air quality was inferior.

Lessons: A paradigm shift in the health care system's approach to emissions reduction is crucial to mitigate the impact of climate change and emission reduction in the future. The only way to achieve this is through nurse-led strategic imagination, creativity, and interdisciplinary collaboration.

(Duckett, Mackey & Stobart, 2020).

Appendix B

Box 2: The health effects of climate change include:

- Increased temperature extremes related to poor health outcomes.
- Natural disasters occurring at unprecedented frequencies with associated physical and mental trauma presentations.
- Increased morbidity, mortality, and demands on health services as the frequency of floods, storms, bushfires, and heatwaves increases.
- Increased burden of vector-borne infectious diseases associated with warmer and wetter climates.
- Poorer water quality and subsequent rise in water-borne infectious diseases.
- Increased air pollution.
- Arable land changes with reduced biodiversity leading to food insecurity and related nutritional deficiencies.
- Increased occupational health risks and heatstroke presentations for outdoor workers.
- Increased burden of psychological distress from severe weather events and climate change.
- Increased burden of aeroallergen and air pollution diseases related to warmer temperatures, longer pollen seasons, high emissions industries, and bushfires.
- Increased cardiorespiratory diseases.

(IPCC, 2018). The Health Effects of Climate Change. <https://www.ipcc.ch/report/ar5/wg2/human-health-impacts-adaptation-and-co-benefits/>

Appendix C

Box 3: A case study

'A Lismore nursing home was left to fend for itself for more than seven hours after a record-breaking flood inundated the premises, forcing night staff to move more than 30 residents out of the floodwater without help from emergency services.

At the time of the crisis, NSW Police were receiving a record number of triple zero calls, prompting police to activate an "extreme event" recorded message, which was played to people whose calls could not be immediately answered by police or fire operators. The SES helpline was also overwhelmed by calls for help, and the service used the Rural Fire Service's Bush Fire Information Line call centre to help answer the SES calls.

Under the Lismore local flood plan, NSW Ambulance is responsible for evacuating elderly and infirm residents, and health services assist with warning and evacuating aged care facilities. NSW Health said it was not responsible for this. The federal health department and Ambulance NSW have both declined to comment.'

Naylor and Gilmore. (2022). *Lismore nursing home was left to fend for itself as flood inundated premises*. <https://www.smh.com.au/national/nsw/lismore-nursing-home-left-to-fend-for-itself-as-flood-inundated-premises-20220630-p5ay14.html>

Australia needs to rapidly learn from this fragmented disaster response and urgently work towards national coordination of services for fiscal and community reasons.

Appendix D

Box 4: A case study

In 2016, a high pollen count combined with an unusually severe thunderstorm cell contributed to a high level of respiratory distress in Victoria.

This resulted in a 73% increase in demand for health services over six hours, with a 58% (9090 presentations) increase in emergency department presentations. This amounted to a 672% increase in respiratory-related presentations.

There was a fivefold increase in telehealth demand.

A total of nine people died in relation to the climate event.

Ambulance resources were stretched with resultant delays in dispatch and hospital wait times.

The event was directly linked to poor awareness and planning for predictable climate events.

Better planning could have anticipated and provided surge capacity.

Appendix E

Box 6 – Percentage of health care contributions to total national emissions per country

India 1.5%

United Kingdom, 3%

China 3.1%

Canada 5.2%

Netherlands 5.9%

Japan 6.4 %

Australia 7%

USA 10%

[https://noharm-global.org/sites/default/files/documents-files/5961/](https://noharm-global.org/sites/default/files/documents-files/5961/HealthcaresClimateFootprint_092319.pdf)

[HealthcaresClimateFootprint_092319.pdf](https://noharm-global.org/sites/default/files/documents-files/5961/HealthcaresClimateFootprint_092319.pdf)

Appendix F

Contributor to health system emissions	Descriptor	Examples
17%	Direct emissions from sources controlled by the organisation	Hospital/care facility emissions Vehicle emissions
12%	Indirect emissions resulting from energy consumption	Purchased electricity, steam, heating, and cooling
71%	Indirect emissions from sources not directly controlled by the organisation (e.g., supply chain) but directly related to its activities, including upstream and downstream	Consumables manufacture and transport Agriculture for meals/clothing Pharmaceuticals and chemical products

Source <https://www.pwc.com.au/health/health-matters/net-zero-emissions-in-health.html>; No author. *Overview of GHG Protocol scopes and emissions across the value chain*, Greenhouse Gas Protocol

Appendix G

Box 8 – Evidence-based nurse-led emissions reductions strategies

- Reduction of travel, transportation, and energy consumption in health care.
- Use of recyclable and reusable alternatives where plausible.
- Sustainability is embedded in procurement and investment in all new products or tenders.
- New hospital design projects include renewable energy, green computing, and environmentally considerate architecture (Desmond, 2018).
- Operating theatres that shift away from central heat-trapping anaesthetic gases maximise instrument reuse or single-use device reprocessing, reducing energy use in the operating room (Thiel et al., 2018).
- Use biodegradable materials wherever possible.
- The ‘Healthy People, Healthy Planet’ coalition of health care facilities collaborates with other healthcare organisations to reduce greenhouse gas emissions (Bennett, 2021).
- Food management through order-on-demand services in health care facilities.
- Robust food waste management and monitoring schemes.

Appendix H

National Health Service (NHS) England – Low emissions health care strategies

In 2020, NHS England committed to net-zero carbon emissions by 2045 (NHS England & NHS Improvement, 2020). Since then, every NHS Trust has been able to implement an ambitious climate change mitigation and adaptation plan and even legislate the health care professionals’ responsibilities in addressing climate change impacts. Fundamental changes were implemented using inhalation anaesthetics, metered-dose inhalers, recycling non-clinical waste, and reviewing food waste. There is also a significant investment into renewable energy, efficiency and use of lighting, transition to electric vehicles, including ambulances, transport of blood specimens, patient transport and wielding substantial negotiating power to force suppliers to provide products supportive of emission cuts (NHS England & NHS Improvement, 2020).

Appendix I

Case study

The Nurses Climate Challenge in the United States (US) aims to educate 50,000 nurses, with 42,000 nurses already undertaking climate health, emissions reduction, and sustainability education within their workplaces (Nurses Climate Challenge, 2022). Furthermore, the US Nurses Climate Challenge is supporting Schools of Nursing in higher education facilities to embed climate health within their curriculum. To date, 55 Schools of Nursing in the US have pledged a commitment to prepare nurses to care for patients impacted by climate change and to understand how to mitigate further climate impacts (Nurses Climate Challenge, 2022).

REFERENCES

Aronsson, J., Clarke, D., Grose, J., Richardson, J. (2020). Student nurses exposed to sustainability education can challenge practice: a cohort study. *Nursing and Health Sciences*, 22(3), pp 803-811. DOI: 10.1111/nhs.12734.

Association of American Medical Colleges. (2022). Hospitals race to save patients – and the planet. <https://www.aamc.org/news-insights/hospitals-race-save-patients-and-planet>

Australian Academy of Science. (2022). What is Climate Change? <https://www.science.org.au/learning/general-audience/science-climate-change/1-what-is-climate-change>

Australian College of Nursing. (2020a). 'Value-based health care through nursing leadership – a white paper by ACN 2020'. <https://www.acn.edu.au/wp-content/uploads/white-paper-value-based-health-care.pdf>

Australian College of Nursing. (2020b). Emissions reduction charter. <https://www.acn.edu.au/wp-content/uploads/emissions-reduction-charter.pdf>

Australian College of Nursing (ACN). 2021a, 'Reimagining the community and primary health care system – a white paper by ACN'. <https://www.acn.edu.au/wp-content/uploads/white-paper-reimagining-the-community-and-primary-health-care-system.pdf>

Australian College of Nursing. (2021b). ACN position statement - Ethical leadership in emissions reduction. <https://www.acn.edu.au/wp-content/uploads/position-statement-ethical-leadership-in-emissions-reduction.pdf>

Australian College of Nursing. (2021c). ACN guiding principles – Nursing leadership in emissions reduction. <https://www.acn.edu.au/wp-content/uploads/guiding-principles-nursing-leadership-in-emissions-reduction.pdf>

Australian Institute of Health and Welfare. (2022). Health workforce. <https://www.aihw.gov.au/reports/workforce/health-workforce>

Australian Medical Association (Queensland). (2021). Office of Hospital Sustainability a win for AMA Queensland advocacy. <https://qld.ama.com.au/news/Sustainability>

Australian Nursing and Midwifery Federation. (2009). Primary health care in Australia: a nursing and midwifery consensus view. https://anmf.org.au/documents/reports/PHC_Australia.pdf

Australian Practice Nurse Association. (2018). APNA Health Professionals Bank Workforce Survey. <https://www.apna.asn.au/profession/apna-workforce-survey>

Barratt, A. L., Bell, K. J., Charlesworth, K., & McGain, F. (2022). High-value health care is low-carbon health care. *The Medical Journal of Australia*, 216(2), 67–68. <https://doi.org/10.5694/mja2.51331>

Bennett, J. (2021). Healthcare Industry: A movement towards a reduction in greenhouse gas emissions, *Journal of Vascular Nursing*, 39, pp 89-90.

Binskin, R., Bennett, A., Macintosh, A. (2020). Royal Commission into National Natural Disaster Arrangements. Canberra, Commonwealth of Australia. <https://naturaldisaster.royalcommission.gov.au/publications/royal-commission-national-natural-disaster-arrangements-report>

Bosurgi, R. (2019). Climate crisis: healthcare is a major contributor, global report finds. *BMJ (Clinical research ed.)*, 366, l5560. <https://doi.org/10.1136/bmj.l5560>

Boyer, C.J., Bowen, K., Murray, V., Hadley, J., Hilly, J.J., Hess, J.J. & Ebi, K.L. (2020). Using Implementation Science For Health Adaptation: Opportunities For Pacific Island Countries. *Health Matters*, 39(12), pp 2160-2167.

- Boylan, L., Breakey, S., Nicholas, P. (2019). Integrating Climate Change Topics into Nursing Curricula. *Journal of Nursing Education*, 58(6).<https://doi.org/10.3928/01484834-20190521-09>
- Brideson, G. (2017) Flight Nursing in Australia: A Hidden Profession. A critical qualitative inquiry into the work of Flight Nurses in Australia. <https://flex.flinders.edu.au/file/b1e4e849-fc5d-40b0-9fb1-14546010b92c/1/Brideson%202017%20OA.pdf>
- Bryce, J. (2019). MBS changes proposed for nurse practitioners, *Australian Nursing & Midwifery Journal*, 26(6), pp 27.
- Butler, S., Pringle, N., Hann, N., and Allan, M. (2022) The 'win' pathway to net zero for the health sector. <https://www.pwc.com.au/health/health-matters/net-zero-emissions-in-health.html>
- Butterfield, P.G., Leffers, J., & Vásquez, M.D. (2021). Nursing's pivotal role in global climate action. *BMJ*, 373.
- Centres for Disease Control and Prevention. (2021). Climate-ready states and cities initiative grant recipients. https://www.cdc.gov/climateandhealth/crsci_grantees.htm
- Climate and Health Alliance. (2021). Real, urgent, and now: Communicating the health impacts of climate change. <https://www.caha.org.au/run>
- Commonwealth of Australia (CoA). (2014). Reform of Federation white paper. https://ahha.asn.au/sites/default/files/docs/policy-issue/rotf_issues_paper_3_roles_and_responsibilities_in_health.pdf
- Cook, C., Demorest, S., Schenk, E. (2019). Nurses and Climate Action. *American Journal of Nursing*, 119(4) pp. 54-60, 10.1097/01.NAJ.0000554551.46769.49
- Backholer K, Baum F, Finlay S, et al. (2021). Australia in 2030: what is our path to health for all? *Med J Aust* 2021; 214 (8 Suppl): S1-S40; doi: 10.5694/mja2.51020
- CRANAPlus. (2020). The impacts of a Changing Climate on Remote Health. https://s3.ap-southeast-2.amazonaws.com/cranaplus-website-assets/files/CRANAPlus_CC_PS_2020.pdf
- Crear-Perry, J., Correa-de-Araujo, R., Lewis Johnson, T., McLemore, M. R., Neilson, E., & Wallace, M. (2021). Social and structural determinants of health inequities in maternal health. *Journal of women's health*, 30(2), 230-235.
- Desmond S. (2018). Health service planning and sustainable development: considering what, where and how care is delivered through a pro-environmental lens. *Australian health review: a publication of the Australian Hospital Association*, 42(2), 140-145. <https://doi.org/10.1071/AH16217>
- Duane, B., Taylor, T., Stahl-Timmins, W., Hyland, J., Mackie, P. & Pollard, A. (2014). Carbon mitigation, patient choice and cost reduction - triple bottom line optimisation for health care planning, *Public Health*, 128, pp 920-924, <http://dx.doi.org/10.1016/j.puhe.2014.08.008>
- Duckett, S., Mackey, W., & Sobart, A. (2020). The health effects of the 2019-20 bushfires. Submission to the Senate Finance and Public Administration References Committee on lessons to be learned in relation to the Australian bushfire season 2019-20. Grattan Institute. <https://www.aph.gov.au/DocumentStore.ashx?id=e5d99d3d-9c27-49ab-8270-262405ece380&subId=681735>
- Duffield, C., Roche, M. A., Wise, S., & Debono, D. (2020). Harnessing ward-level administrative data and expert knowledge to improve staffing decisions: A multi-method case study. *Journal of advanced nursing*, 76(1), 287-296. <https://doi.org/10.1111/jan.14207>

- Duffield, C., Twigg, D., Roche, M., Williams, A., & Wise, S. (2019b). Uncovering the Disconnect Between Nursing Workforce Policy Intentions, Implementation, and Outcomes: Lessons Learned from the Addition of a Nursing Assistant Role. *Policy, politics & nursing practice*, 20(4), 228–238. <https://doi.org/10.1177/1527154419877571>
- Dunphy, J.L. (2013). Contextualising education for natural and social sustainability for Australian healthcare degrees, *Focus on Health Professional Education: A Multi-Disciplinary Journal*- 15(1), pp 4-18.
- Eckelman, M. J., Huang, K., Lagasse, R., Senay, E., Dubrow, R., & Sherman, J. D. (2020). Health Care Pollution and Public Health Damage In The United States: An Update. *Health Affairs*, 39(12), 2071–2079.
- Eckelman, M.J. & Sherman, J. (2016). Environmental Impacts of the U.S. Health Care System and Effects on Public Health. *PLoS ONE*, 11(6). <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0157014>
- Esmaeili, A., McGuire, C., Overcash, M., Ali, K., Soltani, S., & Twomey, J. (2018). Environmental impact reduction as a new dimension for quality measurement of healthcare services. *International journal of health care quality assurance*, 31(8), 910–922. <https://doi.org/10.1108/IJHCQA-10-2016-0153>
- Filfilan, A., Anract, J., Chartier-Kastler, E., Parra, J., Vaessen, V., de La Taille, A., Roupret, M. & Pinar, U. (2021). Positive environmental impact of remote teleconsultation in urology during the COVID-19 pandemic in a highly populated area, *Progrès en Urologie*, 31(16), pp. 1133–1138, <https://pubmed.ncbi.nlm.nih.gov/34454847/>
- Forner, D., Purcell, C., Taylor, V., Noel, C.W., Pan, L., Rigby, M.H., Corsten, M., Trites, J.T., Eskander, A., McDonald, T. & Taylor, S.M. (2021). Carbon footprint reduction associated with a surgical outreach clinic. *Journal of Otolaryngology*, 50(26). <https://doi.org/10.1186/s40463-021-00510-4>
- Goodman B, Richardson J. (2010). Climate change, sustainability, and health in UK Higher Education: the challenges for nursing in Sterling, S. (ed.) *Sustainability Education: perspectives and practice across Higher Education*. Routledge: London.
- Hall, N. L., Barnes, S., Canuto, C., Nona, F., & Redmond, A. M. (2021). Climate change and infectious diseases in Australia's Torres Strait Islands. *Australian and New Zealand Journal of Public Health*, 45(2), 122-128.
- Hallström, E., Gee, Q., Scarborough, P. & Cleveland, D.A. (2017). A healthier US diet could reduce greenhouse gas emissions from both the food and health care systems. *Climatic Change*, 142 (1-2), pp 199-212.
- HEAL Network & CRE-STRIDE. (2021). *Climate Change and Aboriginal and Torres Strait Islander Health*, Discussion Paper. Lowitja Institute, Melbourne. DOI: 10.48455/bthg-aj15
- Hoban, E., Haddock, R., Woolcock, K. (2021). Transforming the health system for sustainability: environmental leadership through a value-based health care strategy. Deeble Institute for Health Policy Research: Canberra. https://ahha.asn.au/system/files/docs/publications/deeble_issues_brief_no_41._transforming_the_health_system_for_sustainability_2.pdf
- Hollnagel, E., Woods, D. & Leveson N. (eds) (2006). *Resilience Engineering: concepts and precepts*, CRC Press.

Hussain, M., Khan, M., Ajmal, M., Sheikh, K.S. & Ahamat, A. (2019). A multi-stakeholders view of the barriers of social sustainability in healthcare supply chains: Analytic hierarchy process approach. *Sustainability Accounting, Management and Policy Journal*, 10(2), pp. 290-313. <https://doi.org/10.1108/SAMPJ-05-2018-0140>

Intergovernmental Panel on Climate Change. (2022) Climate change widespread, rapid, and intensifying <https://www.ipcc.ch/2021/08/09/ar6-wg1-20210809-pr/#:~:text=The%20report%20shows%20that%20emissions,1.5%C2%B0C%20of%20warming>

Intergovernmental Panel on Climate Change (2014). Climate change 2014: Synthesis report. Contribution of Working Groups, I, II, III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Core writing team, R.K. Pachauri, and L.A. Meyer (eds). IPCC: Geneva. <http://www.ipcc.ch/report/ar5/syr/>

Kashef, Z. (2016). Environmental and health impacts of U.S. healthcare system. *YaleNews*. June 9, 2016. <https://news.yale.edu/2016/06/09/environmental-and-health-impacts-us-healthcare-system>

Kelly, J., Garvey, D., Biro, M.A. & Lee, S. (2017). Managing medical service delivery gaps in a socially disadvantaged rural community: a Nurse Practitioner led clinic. *Australian Journal of Advancing Nursing*, 34(4), pp 42-49.

Kerfoot, K.M. (2019). Chaos, Teamwork, Compassion, and Leadership: Disasters and Nursing's Finest Hours, *Nursing Economics*, 37(5), pp 265-267.

Kiang, K.M. and Behne, C. (2021). Delivering environmental sustainability in healthcare for future generations: Time to clean up our own cubby house. *Journal of Paediatrics and Child Health*, 57, pp 1767-1774.

Klein A. (2019). The Climate Crisis - Health and Care Delivery. *The New England Journal of Medicine* 381 (13)<https://www.nejm.org/doi/full/10.1056/NEJMp1906035>

Leffers, J. & Butterfield, P. (2018). Nurses play essential roles in reducing health problems due to climate change. *Nursing Outlook*, 66(2), pp 210-213. <https://doi.org/10.1016/j.outlook.2018.02.008>

Lenzen, M., Malik, A., Li, M., Fry, J., Weisz, H., Pichler, P-P. (2020). The environmental footprint of healthcare: a global assessment. *The Lancet Planetary Health*, 4(7), 271-279. [https://doi.org/10.1016/S2542-5196\(20\)30121-2](https://doi.org/10.1016/S2542-5196(20)30121-2)

MacNeill, A.J., McGain, F., & Sherman, J.D. (2021). Planetary health care: a framework for sustainable health systems. *The Lancet. Planetary Health*, 5(2), e66-e68. [https://doi.org/10.1016/S2542-5196\(21\)00005-X](https://doi.org/10.1016/S2542-5196(21)00005-X)

Madden, D., Horton, G., & McLean M. (2022). Preparing Australasian medical students for environmentally sustainable health care. *MJA*, 216(5). https://www.mja.com.au/system/files/issues/216_05/mja251439.pdf

Malik, A., Lenzen, M., McAlister, S., McGain, F. (2018). The carbon footprint of Australian healthcare. *The Lancet Planetary Health*, 2(1), 27-35.

Malik, A., Padget, M., Carter, S., Wakiyama, T., Maitland-Scott, I., Vyas, A., Boylan, S., Mulcahy, G., Li, M., Lenzen, M., Charlesworth, K. & Geschke, A. (2021). Environmental impacts of Australia's largest health system. *Resources, Conservation and Recycling*, 169, 105556. DOI: 10.1016/j.resconrec.2021.105556

Maru, Y.T., Chewings, V. & Sparrow, A. (2012). Climate change adaptation, energy futures and carbon economies in remote Australia: a review of the current literature, research and policy. CRC-REP Working Paper CW005. Ninti One Limited, Alice Springs.

Masson-Delmotte, V., Zhai, V., Pirani, A., Connors, S.L., Pean, C., Berger, S., Caud, N., Chen, Y., Goldfarb, L., Gomis, M.I., Huang, M., Leitzell, K., Lonnoy, E., Matthews, J.B.R., Maycock, T.K., Waterfield, T., Yelekei, O., Yu, R. & Zhou, B. (2021). *Climate Change*. Cambridge University Press.

Nagai, K., Suzuki, H., Ueda, A., Agar, J., & Itsubo, N. (2021). Assessment of environmental sustainability in renal healthcare. *Journal of rural medicine*, 16(3), 132–138. <https://doi.org/10.2185/jrm.2020-049>

National Critical Care Trauma Response Centre. (2022). Australian Medical Assistance Team. <https://nationaltraumacentre.gov.au/about-us/>

National Health and Medical Research Council. (2022) NHMRC Special Initiative in Human Health and Environmental Change, <https://www.nhmrc.gov.au/funding/find-funding/nhmrc-special-initiative-human-health-and-environmental-change>

National Institute for Health and Care Research. (2022). NIHR announces package of funding for research on climate and health at COP26 <https://www.nihr.ac.uk/news/nihr-announces-package-of-funding-for-research-on-climate-and-health-at-cop26/29256>

NHS England and NHS Improvement. (2020). Delivering a ‘net zero’ National Health Service. <https://www.england.nhs.uk/greenernhs/wp-content/uploads/sites/51/2020/10/delivering-a-net-zero-national-health-service.pdf>

Nicholas, P. & Breakey, S. (2017). Climate change, climate justice and environmental health: implications for the nursing profession. *Journal of Nursing Scholarship*, 49(6), pp 606-616. <https://doi.org/10.1111/jnu.12326>

NSW Health. (2017). Climate Change and Health <https://www.health.nsw.gov.au/environment/climate/Pages/climate-change-and-health.aspx>

NSW Health. (2022) Climate risk and net zero. <https://www.health.nsw.gov.au/netzero>

Nurses Climate Challenge. (2022). US Nurses Climate Challenge. <https://us.nursesclimatechallenge.org/school-of-nursing-commitment>

Nursing and Midwifery Board of Australia. (2019). Registered Nurse Accreditation Standards. www.nursingmidwiferyboard.gov.au/Codes-Guidelines-Statements/Professional-standards.aspx

Richardson, J., Grose, J., O’Connor, A., Bradbury, M., Kelsey, J., & Doman, M. (2015). Nursing students’ attitudes towards sustainability and health care. *Nursing Standard (Royal College of Nursing (Great Britain))*, 29(42), 36–41. <https://doi.org/10.7748/ns.29.42.36.e9692>

Romanello, M., Di Napoli, C., Drummond, P., Green, C., Kennard, H., Lampard, P., Scamman, D., Arnell, N., Ayeb-Karlsson, S., Berrang Ford, L., Belesova, K., Bowen, K., Cai, W., Callaghan, M., Campbell-Lendrum, D et al. (2022). The 2022 report of the Lancet Countdown on health and climate change: health at the mercy of fossil fuels. *The Lancet*. Elsevier. [https://doi.org/10.1016/S0140-6736\(22\)01540-9](https://doi.org/10.1016/S0140-6736(22)01540-9)

Salvage J, White J. (2019) Nursing leadership and health policy: everybody’s business. *International Nursing Review.*, 66(2), pp 147-150.

Schwerdtle, P. N., Maxwell, J., Horton, G., & Bonnamy, J. (2020). 12 tips for teaching environmental sustainability to health professionals. *Medical Teacher*, 42(2), 150-155. <https://doi.org/10.1080/0142159X.2018.1551994>

Schenk, E.C. (2019). Environmental Stewardship in Nursing: Introducing the “WE ACT-PLEASE” Framework. *Creative Nursing*, 25(3), 222–231. <https://doi.org/10.1891/1078-4535.25.3.222>

Shaw, E., Walpole, S., McLean, M., Alvarez-Nieto, C., Barna, S., Bazin, K., Behrens, G., Chase, H., Duane, B., El Omrani, O., Elf, M., Farron Guzmán, C. A., Falceto de Barros, E., Gibbs, T. J., Groome, J., Hackett, F., Harden, J., Hothersall, E. J., Hourihane, M., Huss, N. M., Woollard, R. (2021). AMEE Consensus Statement: Planetary health and education for sustainable healthcare. *Medical teacher*, 43(3), 272–286. <https://doi.org/10.1080/0142159X.2020.1860207>

Sherman, J.D., Tiel, A. & MacNeill, C. (2019). Reducing Pollution from the Health Care Industry. *Journal of the American Medical Association*, 322(11), pp 1043-1044.

Slezak, M. (2022). Climate change was the defining issue of this election. So, what will more ambitious action actually look like? ABC News. <https://www.abc.net.au/news/2022-05-26/climate-change-election-what-are-labors-plans/101094986>

Thiel, C.L., Woods, N.C. & Bilec, M.M. (2018) Strategies to Reduce Greenhouse Gas Emissions from Laparoscopic Surgery. *Australian Journal of Public Health*, 108(S2), pp. S158-S164.

Tonmoy, F.N., Cooke, S.M., Armstrong, F. & Rissik, D. (2020). From science to policy: Development of a climate change adaptation plan for the health and wellbeing sector in Queensland, Australia. *Environmental Science & Policy*, 108, 1-13.

Turale, S., Kunaviktikul, W. (2019). The contribution of nurses to health policy and advocacy requires leaders to provide training and mentorship. *Int Nurs Rev*. 2019 Sep;66(3):302-304. DOI: 10.1111/inr.12550. PMID: 31429074.

United Nations. (1992). United Nations Framework Convention on Climate Change (UNFCCC), United Nations. https://unfccc.int/files/essential_background/background_publications_htmlpdf/application/pdf/conveng.pdf

United Nations (2021). Secretary-General calls latest IPCC Climate Report ‘code red for humanity’, stressing ‘irrefutable’ evidence of human influence. Press release. <https://press.un.org/en/2021/sgsm20847.doc.htm#:~:text=Today%27s%20IPCC%20Working%20Group%201,of%20people%20at%20immediate%20risk>

United Nations Climate change. (2022). The Paris Agreement. <https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement>

Unsworth, K. L., Davis, M. C., Russell, S. V., Bretter, C. (2021). Employee green behaviour: How organizations can help the environment. *Current Opinion in Psychology*, 42, 1 – 6. <https://doi.org/10.1016/j.copsyc.2020.12.006>

Walpole, S.C., Barna, S., Richardson, J., Rother, H.A. (2019) Sustainable healthcare education: integrating planetary health into clinical education. *The Lancet Planetary Health*, 3(1), pp e6-e7.

Wang, E.T., Zafar, J.E., Lawrence, C.M., Gavin, L.F., Mishra, S., Boateng, A., Thiel, C.L., Dubrow, R. & Sherman, J.D. (2021). Environmental emissions reduction of a pre-operative evaluation center utilizing telehealth screening and standardized pre-operative testing guidelines. *Resources, Conservation & Recycling*, 171(12). <https://doi.org/10.1016/j.resconrec.2021.105652>

Ward, A., Heart, D., Richards, C., Bayliss, L.T., Holmes, M., Keogh, S. & Best, O. (2022). Reimagining the role of nursing education in emissions reduction. *Teaching and Learning in Nursing*. <https://doi.org/10.1016/j.teln.2022.02.003>

Watts, N., Amann, M., Arnell, N., Ayeb-Karlsson, S., Belesova, K., Boykoff, M., Byass, P., Cai, W., Campbell-Lendrum, D., Capstick, S., Chambers, J., Dalin, C., Daly, M., Dasandi, N., Davies, M., Drummond, P., Dubrow, R., Ebi, K. L., Eckelman, M., Ekins, P., ... Montgomery, H. (2019). The 2019 report of The Lancet Countdown on health and climate change: ensuring that the health of a child born today is not defined by a changing climate. *Lancet*, 394(10211), 1836–1878. [https://doi.org/10.1016/S0140-6736\(19\)32596-6](https://doi.org/10.1016/S0140-6736(19)32596-6)

Watts, N., Adger, W. N., Agnolucci, P., Blackstock, J., Byass, P., Cai, W., Chaytor, S., Colbourn, T., Collins, M., Cooper, A., Cox, P. M., Depledge, J., Drummond, P., Ekins, P., Galaz, V., Grace, D., Graham, H., Grubb, M., Haines, A., Hamilton, I., ... Costello, A. (2015). Health and climate change: policy responses to protect public health. *Lancet*, 386(10006), 1861–1914. [https://doi.org/10.1016/S0140-6736\(15\)60854-6](https://doi.org/10.1016/S0140-6736(15)60854-6)

World Health Organization. (2021a). Building climate-resilient health systems. <https://www.who.int/teams/environment-climate-change-and-health/climate-change-and-health/country-support/building-climate-resilient-health-systems>

World Health Organization (2021b) Review of Health in National Adaptation Plans. <https://www.who.int/publications/i/item/978924002>

World Health Organization. (2017a). 'Climate Change and Health: Fact sheet. World Health Organisation. <http://www.who.int/mediacentre/factsheets/fs266/en>

World Health Organization. (2017b). Strengthening resilience: a priority shared by Health 2020 and the Sustainable Development Goals. https://www.euro.who.int/__data/assets/pdf_file/0005/351284/resilience-report-20171004-h1635.pdf

World Health Organization. (2021c). COP26 Special Report on Climate Change and Health. <https://www.who.int/publications/i/item/cop26-special-report>

World Health Organization. (2019). Global Spending on health: A world in transition. <https://www.who.int/publications/i/item/WHO-HIS-HGF-HFWorkingPaper-19.4>

Wróbel-J drzejewska, M., Markowska, J., Bie czak, A., Wo niak, P., Ignasiak, Ł., Polak, E., Kozłowicz, K., & Ró yło, R. (2021). Carbon footprint in vegeburger production technology using a prototype forming and breeding device. *Sustainability*, 13(16), 9093. <https://doi.org/10.3390/su13169093>

Zhang, Y., Beggs, P.J., McGushin, A., Bambrick, H., Trueck, S., Hanigan, I.C., Morgan, C.C., Berry, H.L., Linnenluecke, M.K., Johnston, F.H., Capon, A.G. & Watts, N. (2020). The 2020 special report of the MJA– Lancet Countdown on health and climate change: lessons learnt from Australia. <https://www.mja.com.au/journal/2020/213/11/2020-special-report-mja-lancet-countdown-health-and-climate-change-lessons>

