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Transforming the health system for sustainability: environmental leadership through a value-based health care strategy

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key messages

- Sustainability is a complex, multifaceted concept that continues to evolve depending on the perspectives of different sectors and professions and their respective expertise and interests. Fundamental in all conceptualisations, though, is the challenge to shift thinking away from humans and nature being separate in the world, and their activities and effects being compartmentalised.
- The United Nations Sustainability Development Goals present an important opportunity to strengthen multi-sectoral collaborations for health. The goals signify that the economic, social and environmental dimensions of sustainable development are integrated and indivisible, with sustainability only able to be achieved when these areas are pursued collectively.
- Transforming the health system for sustainability requires consideration of the systemic and complex nature of climate change as a determinant of health. This will require attention to both patient level processes and different framework requirements at each level of the health system. The strategic framework for value-based health care transformation provides a guide for supporting the consideration of climate change and its impacts on health and health care.
- Health systems are at the forefront of responding to the impacts of climate change. The complexity of climate change and related health issues and systems challenges must be considered as an essential component of Australia's climate change strategy. This will require strong leadership within the health sector, supported by innovative, evidence-based and practice informed strategies that support the sustainability of a healthy Australia.
- Australian governments, policymakers and health leaders must commit to transitioning towards a green and resilient health system. Action to reduce the carbon footprint of the healthcare system must be a key priority to ensure the future prosperity of populations and the planet.

executive summary

Sustainability is a complex, multifaceted concept that continues to evolve depending on the perspectives of different sectors and professions, and their respective expertise and interests. It is shaped by people's views, and in turn, shapes how issues are formulated, and actions proposed. The environment, society and economy are often reflected as separate, interconnected dimensions of sustainability, and yet recognising their interdependence will be essential to the pursuit of sustainability.

In Australia and around the world, a value-based approach to health care is being used to transform health services and systems as they face similar challenges to sustainability including aging populations, a growing burden of disease, changing individual and community expectations and escalating health care costs. Yet health systems and services appear to be considering environmental sustainability independently of value-based health care, with limited evidence of initiatives or entities purposefully aligning the two concepts in practice.

Given that the frequency and intensity of extreme weather events is increasing with considerable impacts on health and wellbeing, the holistic perspective provided by value-based health care can deliver a framework structure that is able to support transformation towards more sustainable healthcare models - provided we achieve a definition of value that encompasses all dimensions of sustainability.

Strategies are needed that recognise the impact of climate change on the health of todays and future generations, including in rural and remote areas, on health workforce shortages and on vulnerable communities. These require:

- understanding climate-related health needs of patients;
- designing solutions to improve climate-related health outcomes and costs;
- integrated teams to address climate-related impacts;
- climate related health outcomes and costs in the value equation; and
- partnerships.

Designing and delivering care that provides a comprehensive solution to meet the needs of patients requires teams that not only address the clinical needs of patients affected by climate change but also consider their non-clinical needs, which when left unmet can undermine the health outcomes that can be achieved by patients.

A crucial principle in the delivery of health care must be that improvements in health outcomes do not come from treatments which themselves cause poorer health outcomes because of their impact on the planet.

1 Background

1.1 What is sustainability?

In an often cited definition, the United Nation's World Commission on Environment and Development (WCED) described sustainability as:

'meeting the needs of the present without compromising the ability of future generations to meet their own needs' (World Commission on Environment and Development, 1987).

The WCED went on to identify that the goals of economic and social development needed to occur with recognition of the interrelationships between people, resources, environment and development (World Commission on Environment and Development, 1987).

Over time, sustainability has come to be commonly depicted as three interconnected circles, reflecting environment, economy and society, each a distinct goal, with sustainability at their intersection(Figure 1). Gains in one area should not be accomplished by sacrificing progress in another (World Commission on Environment and Development 1987; Portney, 2015). Similarly, in the corporate world, companies use the triple bottom line reporting to identify financial, social and environmental returns on investment (Elkington, 1994).

Figure 1: Simplistic representation of sustainability.

However, it is important to recognise that sustainability is a complex, multifaceted concept that continues to evolve depending on the perspectives of different sectors and professions and their respective expertise and interests (Morelli, 2011). While simplistic definitions and conceptualisations may have benefits in communicating the concept of sustainable development (Purvis et al., 2019), concern has been raised that they contribute to the lack of success in the pursuit of sustainability (Rupprecht et al., 2020; Purvis et al., 2019). How sustainability is defined can shape people's views and in turn how issues are formulated, and actions proposed (Giddings et al., 2002).

Of particular concern is the separation of environment, society and economy, each being reflected as dimensions that are interconnected, rather than interdependent (Giddings et al., 2002). Further, too great a focus on a perceived generational conflict between those currently living and those yet to be born, with nature seen only as a resource that serves humans, has been identified as taking the focus away from the complex interactions and interdependencies between species (Rupprecht et al., 2020). There is also debate over whether sustainability is a process or an outcome (Parliament of Australia, 2008).

Fundamental in all conceptualisations, though, is the challenge to shift thinking away from humans and nature being separate in the world, and their activities and effects being compartmentalised (World Commission on Environment and Development, 1987; Barter and Russell, 2012).

Box 1. Commonly referenced dimensions of sustainability

Environmental sustainability – is a term typically used to focus the concept of sustainability on the condition of the earth's biophysical environment (Portney, 2015), in particular the human impact on natural resources (Morelli, 2011). Environmental sustainability may be considered to occur when the earth's ecological systems are kept in balance and human consumption of natural resources occurs at a rate that allows natural replenishment and without diminishing biological diversity (Morelli, 2011). The term is distinguished from 'ecological sustainability', which reflects a broader and more interdependent context than just human impacts on ecological systems (Morelli, 2011). Human health and wellbeing are recognised to be tightly coupled with the ecological systems that create the foundations of life, including air quality, water quality, fuel, food production, materials, waste decomposition and other protective ecosystem mechanisms (Langmaid et al., 2020; Parkes, et al., 2020). One of the greatest threats to environmental sustainability is climate change; with its disruption to ecological system stability becoming more apparent and increasing in intensity over coming decades (Malhi, et al., 2020).

Economic sustainability – is often misrepresented as financial sustainability but is more accurately interpreted as 'the allocation of resources over time (savings and investment) in a way that provides the highest level of wellbeing for current and future generations' (Markulev and Long, 2013). However, with all of society's capital assets included – those that are produced (roads, buildings, machinery), natural, (ecosystems, minerals, fossil fuels), human (education, skills, knowledge, health) and social (institutions and relationships) - the implication is that depletion of natural capital can be offset by increases in other forms of capital (Markulev and Long, 2013). It ignores that natural resources may not be substitutable, and that economic growth may not be the key to sustaining well-being or environmental integrity (Gowdy, 2005), reinforcing that each of these dimensions is interdependent and cannot be considered in isolation.

Social sustainability – has been framed in various ways in the literature, as a foundation for, constraint on, and causal mechanism of, the economic and environmental dimensions of sustainability (Boyer, et al. 2016). It is considered a dynamic concept, proposed to incorporate both social equity, centred upon a notion of social justice, and sustainability of the community, including a focus on social cohesion and inclusion (Dempsey, et al., 2011). Influential factors may be referred to as the social determinants, which in health have been described as 'the circumstances in which people are born, grow, live, work and age' which are driven by the 'inequitable distribution of power, money and resources' (WHO and CSDH 2008).

1.2 The Sustainable Development Goals

The WCED report was a catalyst for the program of work that, over decades, led to the development of the Sustainable Development Goals, a shared international commitment to a 'blueprint for peace and prosperity for people and the planet, now and into the future' (United Nations, 2015a: United Nations, 2021). In 2015, 17 interlinked global goals were identified (see Figure 2) with 169 targets for action in which progress was to be achieved by 2030 (United Nations, 2015a: United Nations, 2021).

Figure 2. The Sustainable Development Goals (United Nations, 2015a).

The goals signify that the economic, social and environmental dimensions of sustainable development are integrated and indivisible, with sustainability only achieved when these areas are pursued collectively (United Nations, 2015a).

1.3 The health sector and the Sustainable Development Goals

While the Sustainable Development Goals are complex and wide-ranging, they highlight the interconnectedness between various sectors. Health care, for example, is only one contributor to 'good health and wellbeing', the only explicitly health-related goal, yet the remaining Sustainable Development Goals are also notable contributors. For the health sector, the Sustainable Development Goals present an important opportunity to strengthen multi-sectoral collaborations for health. For example, a shift in emphasis to systems of social protection to protect and promote access to health services has been identified as a priority (Bennett, et al., 2020), as well as a responsibility to secure the habitability and safety of planet earth in order to maintain health and equity (Racioppi et al., 2020).

1.4 Value-based health care and sustainability

A value-based approach to health care is being used to transform health services and systems, in Australia and around the world (Woolcock, 2019) as they face similar challenges to sustainability, including aging populations, a growing burden of chronic disease, changing individual and community expectations, and escalating health care costs (Treasury, 2015; OECDa, 2019; Borgonovi, et al. 2018).

Box 2. Value in health care and the value equation

Value in healthcare is 'the measured improvement in a patient's health outcomes for the cost of achieving that improvement' (Teisberg, et al. 2020) and may be conceptualised in terms of the value equation (Figure 3). It is an often-misunderstood concept, confused with quality improvement, process compliance, patient satisfaction and cost reduction, all of which may be important, but which do not connect clinicians to their purpose as healers (Teisberg, et al. 2020; Porter, 2010a). Value has a primary focus on patient health outcomes, with costs only considered within this context so that efforts to reduce costs do not lead to false savings or limit the effectiveness of care provided (Porter, 2010a).

$$\textbf{Patient value} = \frac{\textbf{Health outcomes}}{\textbf{Cost}}$$

Figure 3: The healthcare value equation.

Outcomes

Outcomes are defined by Porter as 'the results of care in terms of patients' health over time' (Porter, 2010b). They measure not only the clinical outcomes, but what is important to patients, from immediate procedural outcomes to longer-term functional status, recovery time, complications and recurrences (Porter, 2010b). Outcomes are not a measurement of processes or interventions designed to achieve the results, nor are they the measurement of clinical indicators that are predictors of results (Porter, 2010b).

It is contended that rigorous measurement of outcomes is the single most important step in improving health care within a value-based health care (VBHC) framework and must be extended beyond just the immediate outcomes (Porter, 2010a).

Costs

The denominator in the value equation represents the cost expended across a full cycle of care (Porter, 2010c). Costs from a value perspective are broader than just the costs of an individual service or treatment; they consider the total cost of all elements relating to treatment of a patient's medical condition within a cycle of care (Porter, 2010c).

Cost measurement in health care is challenging, influenced by the complexity of health care delivery itself and the variety of resources used; the fragmented way in which health care is delivered; and the costing systems used which may substitute costs with the fees charged or use limited methods for allocating indirect or shared costs (Kaplan and Porter, 2011; Porter, 2010c; Bindra, 2018). Accurate costing systems are crucial for accounting for the total costs or resources used in VBHC. Both direct and indirect costs are included. Direct costs relate to the immediate provision of a service or treatment within an episode of care, for example the health professional's time or the cost of medical supplies used to treat that patient e.g., syringes, medicines, gloves. Indirect costs are those not directly linked to a particular product or service, for example the cost of cleaners or administrators keeping a health service running (Bindra, 2018).

Value-based health care requires all elements that contribute to cost to be considered within the value chain such that efficiencies can be achieved without compromising outcomes (Bindra, 2018). Cost reductions are often best achieved through spending more on some services to reduce or eliminate the need for others (Porter, 2010a).

Teisberg, et al. (2020) establish that value-based transformation starts with understanding the shared health needs of a segment of patients who have similar circumstances and needs. Then, with a multidisciplinary team of care givers, designing a solution to improve the health outcomes of those patients, and measuring and monitoring those outcomes to drive improvements in care. Partnerships are fundamental, both within and outside the health sector, to align interests with improving health outcomes.

While sustainability is often identified as an underpinning feature in VBHC, health services often primarily focus on economic sustainability, or rather, the proper use of available financial resources (Borgonovi, et al. 2018). However, 'the assumption that sustainability at the financial and the economic levels is sufficient, on its own, to enhance the effectiveness of the health care system and to overcome the momentous challenges which affect the performance of health care organizations neglects the wicked nature of sustainability-related issues' (Borgonovi, et al. 2018).

Value-based health care encourages the active participation of patients in the design and delivery of their care, an important principle in supporting access and contributing to sustainability from a social perspective (Borgonovi, 2018). While the Porter and Teisberg (2006) definition of value provides a frame of reference for aligning stakeholder focus and resource allocation with the health outcomes that matter to patients, in a universal health care system such as Australia, there also needs to be consideration of the concept of social value (Woolcock, 2019). A broader conceptualisation of VBHC would represent a loss of opportunity for more sustainable improvements in health equity including deliberate policies to protect those Australian populations who are most vulnerable. (Verhoeven et al., 2020).

Health services and regions around Australia appear to be considering the environmental dimension of sustainability independently of VBHC, with limited evidence of initiatives or entities purposefully aligning the two concepts in practice. A crucial principle in the delivery of health care must be that improvements in health outcomes not be achieved by treatments which themselves cause poorer

health outcomes because of their impact on the planet. As such, a key focus needed for health services addressing environmental sustainability is reducing their own environmental footprint (Lenzen, et al. 2020), with the costs of health care to the environment incorporated into the financial reporting by health services (Vergunst and Berry 2019).

The focus on a single dimension of sustainability can compromise the gains in health that can be achieved at individual and population levels through more holistic approaches (Borgonovi, 2018). The holistic perspective provided by VBHC can deliver a framework structure that is able to support transformation towards more sustainable health care models, based on a definition of value that encompasses all dimensions of sustainability.

1.5 Climate change, sustainability and value-based health care

There is global concern that the adverse impacts of climate change 'undermine the ability of all countries to achieve sustainable development' (United Nations, 2015a). However, climate change impacts more than just the environmental dimension of sustainability; there are significant impacts on the social dimension, including health equity. Health is inextricably linked with climate change and 'without urgent action on climate change, the conditions that underpin the health and well-being of the human population will be greatly diminished in coming decades' (CAHA, 2017). Transforming the health system for sustainability must also include consideration of the systemic and complex nature of climate change as a determinant of health.

2 Climate change and Australia's health

2.1 Climate change and human health

The WHO has declared 'climate change the greatest threat to global health in the 21st century' (WHO, 2020a). Climate change threatens the fundamental components of good health; clean air, safe water, food supply and secure shelter (WHO, 2018a). The WHO estimates that between 2030 and 2050 climate change will result in approximately 250 000 additional deaths per year; and by 2030, the direct damage costs to health at an estimated USD 2-4 billion per year (WHO, 2018a).

Climate change is the result of human produced greenhouse gases, such as carbon dioxide (CO_2), becoming trapped in the earth's atmosphere, restricting the radiant flow of heat to space, and causing global average temperatures to rise (Australian Academy of Science, 2015). This global warming is changing environment structures, eliciting fundamental long-term shifts in temperature, water distribution, food growing patterns, vector borne diseases, aeroallergens, sea levels and air pollution (NASA, 2021; IPCC, 2019; Rocklov and Dubrow, 2020; Nicholls et al., 2021; Demain, 2018).

The frequency and intensity of extreme weather events is also increasing. In Australia, more frequent and severe heatwaves, storms, floods, cyclones, droughts, and bushfires are reported (Steffen et al., 2017; CSIRO, 2019; Bureau of Meteorology and CSIRO, 2020).

These climate events are contributing to significant short-term direct health impacts including physical injury, respiratory illness and cardiovascular issues (Joshi et al., 2020; De Blois et al., 2015);

as well as long-term and indirect outcomes such as eco-anxiety and mental health trauma (Usher et al., 2019; Zhang et al. 2020; CSIRO, 2019).

Climate change is a stress multiplier placing increasing pressure on vulnerable systems and communities (Ebi et al., 2017). Climate-related events intensify health inequality (Armstrong and Capon 2020). At risk populations and communities not previously exposed to extreme environmental conditions are becoming increasingly susceptible to climate related adversity, with vulnerable populations bearing a higher health and economic burden (CAHA, 2017). In Australia, Aboriginal and Torres Strait Islander people are especially vulnerable to the impacts of climate change (Australian Human Rights Commission, 2021).

Box 3. Aboriginal and Torres Strait Islander communities and climate change

Rising sea levels, increased erosion, strong winds, land accretion, increasing storm frequency, heavy rain and flooding, extreme temperature ranges and changing water quality are impacting Australian flora and fauna and causing trauma to physical and cultural health (NACCHO n.d; Australian Human Rights Commission, 2021). This is intensified by existing socio-economic disadvantages such as inadequate health and educational services (accessibility), insufficient or inadequate infrastructure (housing, water supply), limited employment opportunities (income) and health risk factors (smoking, immunisation, blood pressure) (AIHW, 2020c).

Within this context, climate change has the potential to exacerbate not just individual physical health, but also the social, emotional and cultural wellbeing of the whole community (NACCHOb, n.d; Australian Human Rights Commission, 2021). Due to established issues of accessibility and use of health services (AIHW, 2019a), Aboriginal and Torres Strait Islander people living in rural, remote and northern communities are expected to experience the health impacts of climate change most severely (Australian Human Rights Commission, 2021).

2.2 Health systems and climate change.

Health systems in Australia and around the world are facing numerous challenges to economic and structural sustainability. In Australia, the ratio for health spending to gross domestic product (GDP) has increased from 8.3% in 2000-01 to 10 % in 2017- 18 (AIHW, 2020a). While comparatively smaller than some OECD countries, this increase has significant implications for the delivery of health care putting pressure on budgets, limiting opportunities for meaningful innovation and research, and potentially undermining the universality of the Australia healthcare system through increasing out of pocket costs. (Callendar et al., 2019, Laba et al., 2015).

While increases in health expenditure have stimulated the redesign of existing structures and systems with the aim of improving health outcomes and managing costs (Council of Federal Financial Relations, 2020), the increasing health burden attributable to climate change is compounding health system sustainability issues and placing additional pressure on the healthcare workforce (Rychetnik et al., 2018).

2.2.1 Air pollution

Air pollution linked to climate change (bushfire smoke, carbon emissions) contributes to the prevalence and severity of a range of health conditions that require additional resources and services to be provided and is associated with significant health and economic costs (AIHW, 2020b; Walter et al., 2020; Vardoulakis et al., 2020; Lal et al., 2020).

In 2015, an estimated 2,500 deaths in Australia were attributed to air pollution corresponding to 29,000 years of lives lost. Additionally, an estimated 8,700 years lived with disability in Australia were attributable to air pollution (AIHW, 2019b) with significant resource implications for the health system (Zhang et al., 2020). The health costs from air pollution mortality alone were estimated to be $5.3 billion per year (Zhang et al., 2020).[1]

2.2.2 Heatwaves

Exposure to heat has a detrimental effect on health, including triggering the onset of acute conditions such as heat stroke and dehydration, as well as exacerbating underlying conditions (Bi, et al. 2011). Older people, those with pre-existing chronic health conditions and people working outdoors or in non-cooled environments are more likely to experience illness and death from extreme heat events (Campbell et al., 2018).

Major heatwaves have been identified as Australia's deadliest natural hazard (Dept of Infrastructure and Transport, 2013). In Australia, between 2007-2017, mortality increased by 2% during heatwaves that occurred in that decade (Varghese, et al. 2020). Impacts varied geographically and within locations; being greater in areas where people were in rental housing and faced social inequity (for example, in their access to transport or the internet), there was low vegetation and there were newer houses. Person-level factors that increased impacts included renting privately, having a low English-speaking ability, having chronic health conditions, and using antidepressants, anxiolytics and sedative medications.

Climate change is predicted to increase the frequency, geographic spread and duration of heatwaves (Dept of Infrastructure and Transport, 2013).

2.2.3 Thunderstorm asthma

The Victorian thunderstorm asthma event in 2016, triggered by high levels of pollen and a severe thunderstorm event occurring simultaneously, caused a high level of acute respiratory distress in people with pre-existing allergies and asthma (Andrew et al., 2017). Within a 6-hour period, Victorian healthcare services experienced a 73% increase in calls (1,626 more calls) to the Emergency Services Telecommunications Authority, and 814 calls for an ambulance. Within a 30-hour period, public hospital presentations in affected areas (Melbourne and Geelong) were increased by 58% (9,909 presentations), with a 672% increase in respiratory-related presentations.

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[1] In 2019, the value of statistical life in Australia was $4.9 million and the value of statistical life year, $213,000 (Prime Minister and Cabinet, 2019).

In addition, there were 313 calls to NURSE-ON CALL for respiratory issues (compared to 63 the previous month), and 9 attributable deaths (Victorian State Government, 2017a).

This event challenged all involved in the response. Ambulance resources were stretched, with serious delays in dispatch times and lengthy hospital wait times (Victorian Government, 2017b). That the Victorian health system failed to immediately recognise the severity of this extreme weather event contributed to inefficiencies in communications channels and delays in establishing appropriate chains of command. This led to delays in implementing appropriate response procedures and the provision of additional surge resourcing to healthcare facilities (Victorian State Government, 2017).

2.2.4 Bushfire smoke

The impact of the 2019-20 Australian "black summer" bushfire season on the health system is estimated to have cost AU $1.95 billion in hospital admissions and premature life loss (Johnston et al., 2020; AIHW, 2020b; Royal Commission into National Natural Disaster Arrangements, 2020)(Box 4).

Box 4: Health impacts of the 2019-20 Australian "black summer" bushfire season

Analysis of the 2019-2020 "black summer" bushfires has highlighted the considerable impacts of a climate-induced disaster on Australia's health system. 33 deaths were directly attributable to the fires, with thick black smoke covering large parts of the country for weeks (Royal Commission into National Natural Disaster Arrangements, 2020).

Air quality

Across Australia air quality monitors recorded PM2.5 readings well in excess of hazardous levels[2] with the Australian Capital Territory (ACT) recording the worst air quality in the world in early January 2020 (AIHW, 2020b). 11 million people across the ACT, New South Wales (NSW), South Australia and Victoria reported exposure to smoke caused by bushfire (Biddle et al., 2020).

Analysis of Victorian and ACT emergency department (ED) data showed that presentation to hospital increased significantly (27%) on those days when air quality was poor (PM2.5 between 50 and 100) and up by 70% on days with PM2.5 above 200 (Duckett et al. 2020).

It has been estimated that the bushfire smoke from the "black summer" bushfires was responsible for 417 excess deaths, 1,124 hospitalisations for cardiovascular problems, 2,027 for respiratory problems and 1,305 asthma presentations to EDs across Australia (Borches -Arriagada et al., 2020).

Pharmacy data also shows a significant increase in sales of inhalers and scripts dispensed for medications to relieve shortness of breath corresponding to bushfire activity in the summer of 2019-20 (AIHW, 2020b).

[2] The World Health Organisation and the Australian National Air Quality Standards set the 'safe' threshold at 25 PM2.5μg/m3 on average over 24 hours (Australian Government, 2016; WHO, 2018c).

Mental health

The "black summer" bushfires placed additional demand on mental health services across Australia. In direct response to the fires the Australian Government introduced additional Medicare Benefits Schedule (MBS) items for mental health (Dept of Health, 2020c). As of October 2020, a total of 18,945 bushfire mental health services had been accessed through the MBS by 5,094 patients, with 64% of these services provided though face to face consultations and the remainder via telehealth (AIHW, 2020b).

Financial cost

The reported health burden associated with premature life lost and hospital admissions of the 2019-20 "black summer" bushfires is estimated to be AU$1.95 billion (Johnson et al., 2020; AIHW, 2020c; Royal Commission into National Natural Disaster Arrangements, 2020). This is 19 times higher than the comparable annual average costs of the previous 19 years of AU$211 million (Johnston et al., 2020).

2.2.5 COVID 19 pandemic

The emergence of SARS-CoV-2, the coronavirus causing COVID-19, has been attributed in part to altered climate conditions (The Lancet Editors, 2020a; Armstrong, 2020). Understanding the ecological origins and behavioural drivers of coronavirus infection emergence and spread will be essential for identifying and implementing policies that will bring short-term and long-term benefits to health and sustainability (HERA, 2021).

As of May 2021, over 167.1 million COVID-19 cases have occurred globally, resulting in over 3.4 million deaths worldwide (John Hopkins CRC, 2021). Health systems around the world have been inundated with cases, stretching resources to capacity with services close to collapse in some regions. For example, Italy, the United States, Brazil and the United Kingdom (Armocida et al., 2020; Berardi et al., 2020; de Andrade et al., 2020; Giovanna et al., 2020; Gurdasani et al., 2020; Lourenço et al., 2020; Dorsett, 2020; Blumenthal et al., 2020; Berlin et al. 2020).

Australia has, to date, managed to avoid the substantial acute impacts caused by COVID-19 on the health system that have been seen internationally. In a comparison of 98 countries, Australia ranked 8th overall based on its performance in managing the COVID-19 pandemic (Lowy Institute, 2021). Indicators measured included confirmed cases, deaths, cases per million people, deaths per million people, cases as a proportion of tests and tests per thousand people (Lowy Institute, 2021).

However, the Australian health system has still faced a number of challenges related to the pandemic. In the aged care sector personal protective equipment (PPE) shortages, disparate guidelines for their use, a lack of clarity around chains of command, and mixed messaging from Australian, state and territory governments placed pressure on an under-resourced and casualised workforce lacking the adequate training required to respond to the issues associated with a pandemic (Connolly and Carter, 2020; Pagone and Briggs, 2020; Malone, 2020).

The social, economic and health conditions created by COVID-19 have also increased the prevalence of mental ill health in the Australian population (National Mental Health Commission, 2020). Mental

health telephone support services have seen demand increase by approximately 30% (Ponniah, et al., 2020). Modelling predicted an increase in the suicide rate, but this has not eventuated.

However, any change in the risk of suicide associated with COVID-19 is likely to be dynamic and modelling should be interpreted with caution (Pirkis et al. 2020)

As first responders in times of crisis, health systems will be at the forefront of responding to the impacts of climate change. Understanding the complexity of climate change and related health issues and systems challenges must be considered as an essential component of Australia's climate change strategy. This will require strong leadership within the health sector, supported by innovative, evidence-based and practice informed strategies that support the sustainability of a healthy Australia.

2.3 Climate risk and health system governance

Governments, policy makers and those health leaders with fiduciary duties must recognise climate change as a significant threat to health and sustainability of the Australian health system. In 2020, climate-related issues dominated the top-five long term risks to global economic stability by likelihood (Figure 4)(World Economic Forum, 2021).

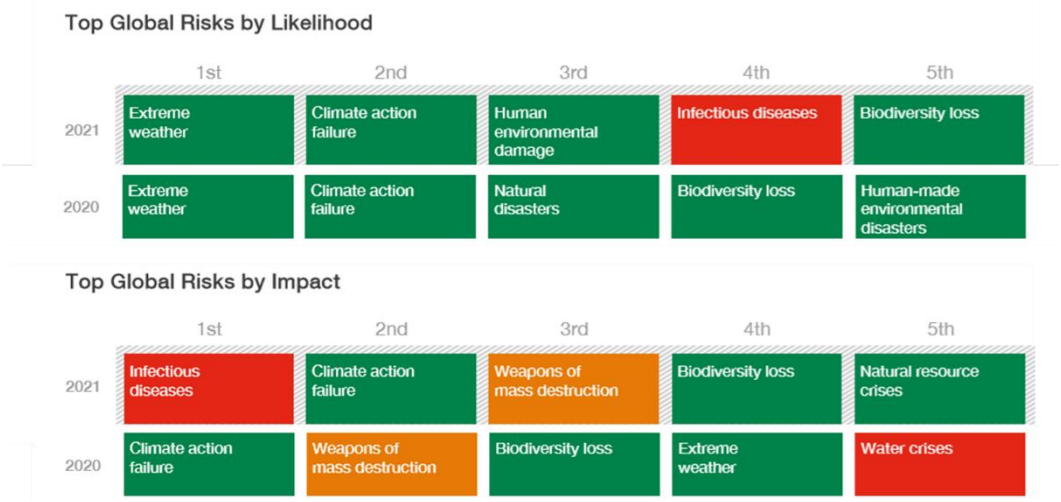

Figure 4: The global risks landscape. World Economic Forum Global Risks Perception Survey 2020 (reproduced from World Economic Forum, 2021).

In 2021, the impact of the COVID-19 pandemic saw a shift in global risks, highlighting the severe consequences of emerging risks to human health, and social and economic environments. Continuous monitoring of emerging risk within an evolving health landscape should be prioritised.

The Bank of England Prudential Regulation Authority has also identified three primary areas of climate change risk that must now be considered from a legal and governance perspective to mitigate long terms risk and future proof organisational stability (Carney, 2015; Bank of England, 2020).

2.3.1 Physical risk

Refers to the impact of climate change on the natural and built environment. From a health system perspective this could include risks associated with damage to essential infrastructure (OECD, 2019b; or difficulties accessing health services, as the result of a climate induced event (Australian Government, 2006; Keane, 2020; Evans, 2020; ABC, 2015). For example, floods, storms, bushfires, and heat stress can result in damage to health infrastructure, surges in hospital presentations (McMillan, 2019; Victorian State Government, 2017), mass health facility evacuations (Australian Institute for Disaster Resilience, 2011), or interruptions to supply chains and/or spoilage of essential medicines (Global Access Partners, 2020; Australian Government, 2006).

2.3.2 Economic transition risk

Refers to the risk associated with the unknowns of how the world will transition to a low carbon, climate resilient economy in terms of policy, regulation, social expectations and technological innovation; and the impact this will have on economic markets (Kells, et al., 2019; Sentier 2019; Rodriguez Valladares 2020).

An increasing number of countries are implementing policy and regulation around climate change aimed at mitigating economic risk (International Institute for Sustainable Development, 2019). This has implications for global markets as companies and shareholders adjust their policies and market behaviour in response (European Environmental Agency, 2016; Allen et al., 2015). Countries representing 45% of the global economy have introduced laws, or indicated that they will introduce laws, to facilitate the achievement of net zero emissions by 2050 (Energy and Climate Intelligence Unit, 2020). While such laws have yet to be implemented on a national scale in Australia, the Australian Government's commitment to the Paris Agreement (United Nations, 2015b; Department of Industry, Science, Energy and Resources, 2021), in addition to state and territory net zero emission commitments (Zhang et al., 2020), suggest that actions taken by health services to transition towards net zero emissions may assist in mitigating future regulatory and financial strain as a consequence of climate change.

Financial providers are increasingly considering the impact of extreme weather events and modifying financial products accordingly. For example, insurance companies are reducing the scope of coverage for property and professional lines of insurance. This has been highlighted in the media, where disaster prone areas see higher premiums and significant premium increases in the aftermath of disaster events (Wainwright and Nothling, 2019; Pupazzoni, 2020). Insurance in Northern Australia is considerably less affordable when compared to the rest of the country due in large part to the high risk of floods and cyclones in the region (ACCC, 2020). This presents a health equity issue as those who are under resourced and the financially vulnerable are more likely to feel the effects of premium increases resulting in inequitable divisions of financial stress (ABS, 2020).

Studies have also shown correlations between financial stress and health impacts including high levels of psychological distress (Taylor et al., 2017; Sargent- Cox et al., 2011), poor physical health (Gianaros and Wager, 2015) and negative health behaviours (French and McKillop, 2017). This has broader implications for society and the health system as an increasing number of people

experiencing financial stress can increase the population health burden and undermine strategies designed to address the social determinants of health. In turn, this places downstream pressure on the health system with more people requiring access to health services and resources at more advanced stages of illness (Marmot and Wilkinson, 2006).

Increasing insurance premiums also have financial implications for the Australian Government, who under the Premium Product Scheme cover part of the costs of eligible medical professionals' indemnity insurance (Department of Health, 2020a). If a medical practitioner's indemnity insurance exceeds 7.5% of their gross private medical income, then they will receive a 60% government subsidy towards the cost of the premium beyond the threshold amount (Department of Health, 2020a).

The Australian Government will need to consider the financial implications of climate change impact on subsidies for medical professional indemnity insurance within the context of a more resource intensive and expensive public health system.

Patient preferences are also shifting, with millennials (1979 – 1995) and generation Z (1996 – 2010) within Australian and around the world increasingly concerned and demanding stronger action from governments and business leaders on climate change (Ross et al. 2019; ABC News, 2019; The University of Sydney, 2019). This will likely have implications for the types of products and services demanded as these generations transition into healthcare markets and make healthcare decisions based on pro-climate values (Harpaz, 2019). For example, the way people choose to access healthcare services may change with an increasing demand for telehealth as consumers consider ways to reduced their transport emissions (Vidal-Alaball et al., 2019; Purohit et al. 2021). Products available from suppliers may also evolve as the health industry explores mechanisms to reduce low value care, cut costs and transition to a circular economy designed to benefit businesses, society, and the environment (MacNeill et al., 2020).

2.3.3 Liability risk

Encompasses the corporate governance responsibilities to consider the impact of climate change on an organisation's economic stability (Carney, 2015; Bank of England, 2020). This includes:

Financial disclosure: Financial disclosure or the requirements of health organisations to identify known trends, events, or uncertainties likely to have an impact on their assets, earnings, or competitive position (Seaman and DeLascio, 2010; Kells et al., 2019; Carney, 2015). In relation to this, the Financial Stability Board (an international body that monitors and makes recommendations about the global financial system) established the Task Force on Climate Related Financial Disclosures (TCFD) with the goal of developing a set of voluntary climate-related financial risk disclosures which can be adopted by companies so that those companies can inform investors and other members of the public about the risks they face related to climate change (TCFD, 2017). The value of a healthcare organisation asset base in reporting processes must also account for current and potential future impacts of climate change on health care services and should be disclosed in annual reporting.

Climate insurance: Internationally there has also been an upsurge in negligence and insurance legal claims as a consequence of governments and private companies failing to take reasonable precautions against reasonably foreseeable risks of injury or damage resulting from climate change (Brown and Nyce, 2019; Dlugolecki, 2008; Hunter and Slazman, 2007; Fajardo, 2010). For example, in 2015, the Dutch environmental group, the Urgenda Foundation, together with over 900 Dutch citizens sued the Netherlands government for failing to do more to prevent global climate change. This landmark case was successful, arguing that through a lack of regulatory action to curb greenhouse gas emissions, the state was committing negligence against its citizens (Cox, 2016; Climate Change Litigation Database, 2015). With legal action already being pursued in Australia over climate change risks (Equity Generation Lawyers, 2020; Equity Generation Lawyers, 2021), these international precedents highlight possible implications for organisations and health services in Australia. Failure to recognise the impacts of climate change and build and maintain climate resilient infrastructure and processes may place health services at risk of legal action.

Health and safety risk: In Australia, increased health and safety risks within health services as a consequence of climate related events have been highlighted during the COVID-19 crisis where work health and safety precautions have played a critical role in keeping the population safe.

Nevertheless, two climate related disasters in succession, the 2019-2020 bushfires and then the COVID-19 pandemic, created localised short-term shortages of medicines (Andrikopoulos and Johnson, 2020) and an initial shortage of PPE (Department of Health, 2020b) with many healthcare facilities reporting health and safety risks related to shortages in protective masks in particular (RACP, 2020; McCauley 2020). This occurred as a consequence of disruptions to Australian supply chains due to international border closures and international stockpiling (Sarkis, 2020). Reports also indicate that some health professionals had to resort to makeshift measures (Rowan and Laffey 2020), including sourcing supplies from hardware stores (Lewin, 2020). In 2020, the Australian National Audit Office reported that the Australian Government had failed to adequately plan and protect the healthcare workforce from a pandemic, with the National Medical Stockpile found to initially have inadequate supplies to meet workforce protection requirements (Australian National Audit Office, 2020).

Inadequate protocols around PPE fit testing and training also contributed to high numbers of health professionals contracting COVID-19 in the workplace, with modelling suggesting the healthcare workforce was at nearly three times the risk of becoming infected with COVID-19 compared with the wider community (Quigley et al. 2021; Gallasch et al., 2020; The Lancet Editors, 2020b).

Healthcare facilities should prioritise the health and safety of their workforce through mechanisms of governance by considering the relevant range of climate risks and exposures that frontline workers are likely to face (Department of Health, 2020b).

2.4 Australia's health system carbon footprint

'First, do no harm' is considered one of the defining ethical principles underpinning the provision of health care (World Medical Association, n.d: Ahpra, 2021; McNeil and Downton, 2002) and yet globally, the health sector contributes to 4.4% of net global carbon emissions, an amount equivalent

to the fifth largest carbon emitter on the planet (Karliner et al., 2019). This significant contribution to the world's carbon footprint causes harm to the population and planet though contributing to pollution and global warming which impacts health outcomes (Steffen et al., 2017; CSIRO, 2019; Royal Commission into National Natural Disaster Arrangements, 2020; Haines et al., 2006).

In Australia, it is estimated that the healthcare system contributes to 7.2% of Australia's total CO_2 emissions (Malik et al., 2018). This is equivalent to the total carbon footprint of all the activities (travel, transport, housing, electricity, gas, food, entertainment and purchases) of 7% of Australia's population, the entire population of South Australia (Malik et al., 2018). Australia, along with Canada, Switzerland and the United States are the top healthcare carbon emitters per capita (Karliner et al., 2019) with Australia the 10th largest total healthcare carbon emitter globally.

Evidence from the NHS highlights the importance of tracking the full impact of healthcare provision, comprehensively and with a broad scope (Tennison et al., 2021). Such healthcare footprinting disaggregates emissions by type of clinical activity, as well as per unit of healthcare provision, which facilitates identification of mitigation interventions. Contribution of different sectors to the NHS greenhouse gas emissions in 2019 are reflected in Figure 5.

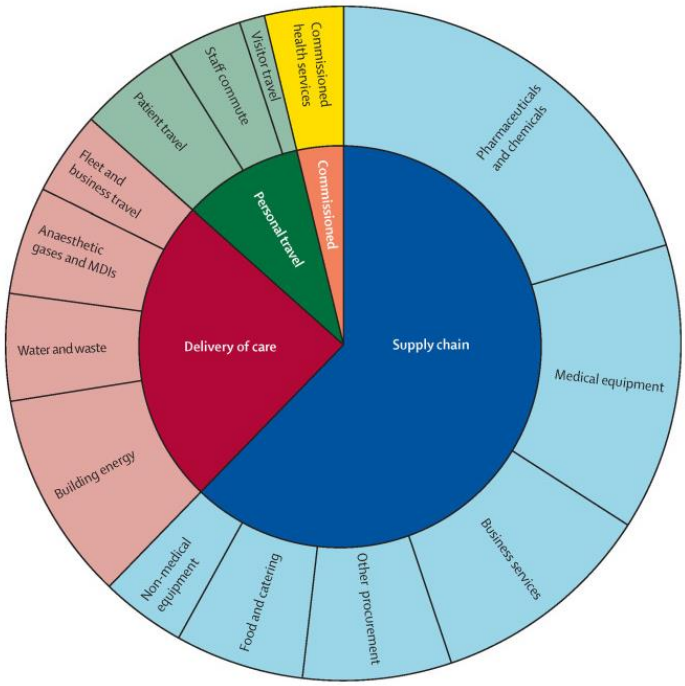

Figure 5: The contribution of different sectors to emissions, NHS England, 2019 (reproduced from Tennison, et al., 2021).

Pressure from the healthcare workforce to address the impacts of climate change on health, and to build the resilience of the Australian health system is increasing (CAHA, 2017; AMA and Doctors for the Environment, 2021).

In 2017, the Climate and Health Alliance (CAHA), together with over thirty Australian health and medical organisations including peak bodies and medical colleges, developed a Framework for National Strategy Climate, Health and Wellbeing for Australia (CAHA 2017). The framework provided key policy recommendations that could be taken at the national, state and local level to support Australia in delivering sustainable economic, social, and environmental benefits for Australians, as well as meeting international obligations in relation to the Paris Agreement (CAHA, 2017).

While some progress has been made towards implementation of climate and health strategies and policies (for example State of Queensland, 2018; WA Health, 2020) within state governments and

individual health organisations (Sydney North Health Network, 2020), progress on a national scale has been slow (Zhang et al., 2020; Duckett et al., 2020).

COVID- 19 has demonstrated how a significant health threat can also present a reform opportunity with governments and health leaders able to rapidly re-evaluate and redesign innovative systems that deliver improvements for driving value and sustainability on a scale that has not previously been possible (AHHA, 2020b). Indeed, climate change more broadly 'may yet provide the greatest global health opportunity of the 21st century' (Wang and Horton, 2015). However, for this opportunity to be realised, Australian governments, policymakers and health leaders will need to commit to transitioning towards a green and resilient health system. Action to reduce the carbon footprint of the healthcare system must be a key priority to ensure the future prosperity of populations and the planet.

3 Incorporating climate change impacts in the value equation and the implementation of VBHC

Building climate change resilience into models and systems of health care will require attention to both patient level processes and the different framework requirements at each level of the system. The strategic framework for value-based health care transformation (Teisberg et al., 2020) provides a guide for supporting the consideration of climate change and its impacts into health care (Figure 6).

Figure 6: Strategic framework for Value based health care implementation (reproduced from Teisberg, et al. 2020).

3.1 Understanding shared climate-related health needs of patients

A value-based approach to health care organises care around segments of patients with a shared set of health needs (Teisberg, et al., 2020). For example, patient segments can be used to deliver targeted programs of integrated care to patients with high levels of needs (for example, cardiovascular disease in vulnerable populations); or in whole populations, can support more

comprehensive health strategies by ensuring that the health care needs of population groups in their entirety are considered (for example, the social, economic, health and environmental needs of patients).

In Australia, adverse health outcomes which occur as a result of exposure to climate hazards, extreme weather conditions or shifts in the timing and spatial distribution of infectious disease create patient segments (Navi, et al., 2017) around specific populations, bounded areas, or large populations (AIHW 2011) (for example bushfires, floods, heat related hospital admission, mosquito borne diseases). Patient segmentation must also consider the multidimensional inequalities that contribute to vulnerabilities (Navi et al., 2017).

There is also a shift to better understand climate-related health needs of patient segments. For example, during the summer of 2019-2020 bushfires the Australian National University commenced longitudinal research to assess the impact of poor air quality related to bushfires in the Canberra, NSW South Coast and South East NSW regions, on the health and well-being of pregnant women, new mothers and their babies (Australian National University Medical School, 2020). Aboriginal and Torres Strait Islander women and their babies were a particular focus due to the severe impact on this group within the region. With the COVID-19 pandemic following shortly after, research was expanded to take into consideration the impacts of this crisis as well.

3.2 Designing solutions to improve climate-related health outcomes and costs

Designing and delivering care that provides a comprehensive solution to meet the needs of patient segments requires teams that not only address the clinical needs of patients but also consider their non-clinical needs; which when left unmet, undermine the health outcomes that can be achieved by patients (Teisberg, et al. 2020). For example, designing solutions that disregard the carbon footprint of health care and the threats of climate change will undermine any improved wellbeing from health co-benefits such as cleaner air, increased physical activity and improved diets (Milner et al., 2020).

However, designing solutions to reduce the carbon footprint also requires reform of care pathways so that the hospital is only used where health care cannot be safely delivered closer to home (Tomson, 2015). For example, in communities vulnerable to drought, care pathways may also consider the inclusion of community support and mental health services within primary care (Blashki et al., 2007).

Life cycle assessments provide a method for estimating the environmental footprint of a product or service from extraction of raw material, through material processing, manufacturing, assembly, transportation, use and end-of-life. This approach is particularly important in areas like pathology, where, for example, sustainability actions (for example, waste reduction through avoid, reduce, reuse and recycle) are limited by factors such as infection control. A life cycle assessment identifies that the main opportunities lie in changing clinician behaviours to avoid and reduce unnecessary testing (McAlister, et al. 2020).

Value based health care provides an opportunity to explore care pathways, and their components, that will identify innovative strategies aimed at both improving climate-related health outcomes and reducing the impacts of the health system on the environment, for todays and future generations.

3.2.1 Eliminating low-value care

Identifying and eliminating low value care is one component of this. In Australia, low value care is recognised as that unnecessary care which:

- duplicates or promotes redundant testing, treatments and procedures,
- lacks evidence, and has the potential to cause harm and
- costs of the intervention do not provide proportional added benefits (de Vries et al., 2016; Chalmers et al., 2018).

While the volume of low value care differs between countries, regions, healthcare providers, practices and diseases, it has been estimated that up to 30% of resources spent on health care is wasted on avoidable complications, unnecessary treatments, or administrative inefficiencies (EIT Health 2020; McAlister et al., 2018; Chalmers 2018; Kool et al., 2020; Oakes et al 2019). Given that the environmental and public health costs of climate change are rising (Watts et al. 2020), targeting and reducing low value care through consideration of ecological and environmental costs will be essential (Scott and Duckett, 2015).

3.2.2 Supply chains and procurement

A value-based health care approach to procurement utilises a collaborative approach, considers care quality, patient impact and outcomes in its methodology and specifications; as well as the consideration of risk, beyond the cost of the goods, services or solutions purchased (Deloitte, 2020). It can provide the health system with a mechanism to evaluate the carbon footprint of care pathways across sectors, and shift to sustainable procurement practices.

However, the majority of hospital emissions, almost 90%, come from indirect sources of carbon production including purchasing through supply chains and the embodied carbon within the goods and services procured (Malik et al., 2018). As a result, it can be difficult, but not impossible for health services to measure total greenhouse gas emissions of care pathways and to exert control over emissions incurred along the value chain (Hensher and McGain, 2020). In an effort to protect health and reduce hospitalisations, the NHS adopted a multiyear plan to reduce carbon emissions (NHS, 2020a). Since 1990, this strategy has resulted in a 26% decrease in its carbon footprint, although the primary contributor to this reduction was from building emissions (that is, shifting to lower-carbon energy sources) rather than the redesign of health care (Tennison et al., 2020). However, it has also demonstrated that the collective purchasing power within health care, together with the adoption of sustainable procurement policies, strategies and practices, can reduce carbon emissions, including through supply chain responsibilities, and improve population health outcomes (Health Care Without Harm, 2018).

Health services in Australia are demonstrating how sustainable strategies can work in practice. For example, in 2020, Ambulance Victoria, set a target to source 100% of its energy needs from

renewable energy sources by 2025. To achieve this, they embarked on a formal partnership with local government organisations outside of health and led by Procurement Australia, to employ a Power Purchasing Agreement[3] that allowed them to switch to energy sourced from renewable sources instead of coal (Ambulance Victoria 2020). This resulted in a 7% reduction in overall emissions when Ambulance Victoria switched its high electricity use sites to energy supplied from renewable sources.

Disruption to the global supply of PPE as a consequence of the COVID-19 pandemic has also highlighted the importance of strong procurement and supply chain partnerships (WHO, 2020b). Global border closures, reliance on just-in-time supply and insufficient national stockpiles resulted in governments and organisations pivoting to local manufacturing options (Sarkis, 2020; Department of Industry, Science, Energy and Resources, n.d.). The ability to make rapid changes to the supply chain illustrates that it is both practical and feasible for the Australian health system to partner with local industry to develop less energy intensive supply chain solutions that are agile and responsive to specific local needs.

Localised production has important implications for environmental sustainability, including:

- a reduction in the need for global transportation-resulting in a reduction in carbon emissions,
- over-production and therefore material consumption can be reduced,
- the life of products can be extended as components can be replaced or improved on-demand (Sarkis, 2020; Holmstrom and Gutowski, 2017).

However, constraints such as the need to build redundant capacity and capabilities and which result in wasted resources and energy, also need to be considered (Sarkis, 2020).

3.2.3 Technological innovation

Innovation in healthcare is a complex element in the context of sustainability. On the one hand it is critical to driving value and sustainability through facilitating new approaches for delivering care more effectively and efficiently. On the other hand, it can be hugely resource intensive, costly (financially, environmentally and socially) (Falivena and Palozzi, 2019) and wasteful if new technology drives overdiagnosis and overtreatment without improving health outcomes (Hofmann, 2015).

In Australia, health technology has been defined as including (IHPA 2019):

- new medicines;
- diagnostics, devices, equipment and supplies;
- medical and surgical procedures;
- support systems; and

[3] an agreement between an independent power generator and a purchaser for the sale and supply of energy. Often at a fixed price that will not change for the term of the agreement (Environment NSW, nd).

- organisational and managerial systems used in prevention, screening, diagnosis, treatment and rehabilitation.

The opportunities for technology to mitigate the effects of climate change on health are extensive. For example, wearable technologies with advances in sensor technology and computational modelling can allow air quality to be monitored in real-time (Editor, 2021), providing an early warning system for those who are vulnerable to pollution. In this regard, the value-based health care framework enables the introduction of climate health related technologies into care pathways for specific patient segments, who will gain value and improved health outcomes from their use.

Other precision medicine technologies such as genomics, biotechnology, and artificial intelligence (AI) also lend themselves to a value-based approach to care. These technologies can place patients as the focus, and through data generation and the advanced analytics required to interpret it, care is shifted to prevention, personalisation and precision (Mesko 2017).

While the potential for improving health outcomes using precision medicine is significant, the associated data storage and resource-intensive machine learning algorithms can also generate substantial carbon emissions (Editor, 2021). Therefore, environmental adaption and mitigation strategies employed by the Australian healthcare system should promote shifting towards 'Green AI' which utilises lower-energy hardware and ensures that the tracking of energy consumption and carbon emissions is transparent (Schwartz, et al. 2020).

A value-based approach to health care can also guide the introduction of virtual healthcare solutions such as telehealth in care pathways. The use of telehealth has been shown to reduce the carbon footprint of health care, although the extent of reduction is highly context specific and ranging between 0.70-372 kg CO_2 emissions per consultation (Purohit, et al. 2021). The care pathway for specific patient segments can be evaluated through the value equation incorporating both the impact of the health outcomes and costs of telehealth solutions. For example, the impacts of synchronous (realtime) versus asynchronous (store and forward) communications, or telephone versus video consultations, and carbon footprint costs, which have been shown to be highly dependent on medical specialty, geography, transport infrastructure, population density, have been demonstrated to vary significantly (Purohit, et al. 2021).

The deployment of health technology in Australia should address the relevant elements of sustainability and value that capture immediate health outcomes and wider benefits arising from the implementation of innovative technologies.

Box 5: Health Technology Assessments

Health technology assessments (HTA) are used to systematically evaluate the properties and effects of a health technology by assessing the quality, safety, efficacy, effectiveness and cost-effectiveness, and are an important enabler of value-based health care (Department of Health 2019). Australia has been regarded as a world leader in the field (Department of Health and Ageing 2009), but there have been calls to expand these assessments to comprehensively examine environmental impacts (Marsh, et al. 2016). This would require consideration of the entire life cycle of the technology, from acquisition of raw materials and the materials and energy used in manufacturing processes, to associated packaging and resulting waste, but also in the context of implications of resources throughout care pathways (Marsh, et al. 2016; Unwin, 2020).

While some progress is being made globally, for example in Canada (Polisena et al., 2018), Sweden and the UK (Marsh et al., 2016), further work is required on the data, and methods to capture and synthesise it as part of an HTA (Marsh, et al. 2016; Marsh et al., 2017).

3.2.4 Promoting preventative health and primary care

Hospitals are the most resource intensive element of the Australians healthcare system, accounting for nearly 45% of Australia's health care carbon contribution (Malik et al., 2018). Strengthening programs of preventative health in primary care will assist in reducing avoidable hospitalisations, keeping people out of hospitals, and reducing healthcare's carbon footprint.

Primary care interventions that prevent health conditions from occurring (for example exercising to avoid obesity related disease), delaying their onset (for example establishing an appropriate diet to control blood sugar in diabetics), and reducing their severity (for example routine eye exams to detect and treat early diabetic retinopathy) are essential to maintaining good health and at an aggregate level can be viewed as an effective way to address fiscal, environmental and health system pressures (AHHA, 2020a; AHHA, 2021; Martin et al., 2020; Simoens, 2012).

The role of primary care providers as trusted authorities, combined with their broad geographical distribution and close community relationships affords primary care significant social capital to leverage behaviour change on issues of health and climate (Walker et al., 2011). However, this will require:

- capitalising on and better supporting the primary care sector;
- incentivising and monitoring initiatives that encourage climate change public health surveillance, behaviour change and social prescribing that offers purposeful activities, remote monitoring and strengthen preventive health action; and
- educating communities on the direct and indirect impact of climate and health, building community resilience, and reducing the burden on high resource and emission intensive health care services; and
- connecting with social supports such as housing (including with appropriate cooling technologies) for patients vulnerable to the health effects of extreme heat, cold and air pollutants (Malik et al., 2018; Xie et al., 2018; Maller and Strengers, 2011).

Therefore, efforts by the primary care sector to reduce carbon emissions not only protect against the impacts of climate change on the health system in its entirety, but also have the co-benefit of reducing pollution and producing long-term health benefits such as reducing respiratory and cardiovascular diseases (AIHW 2020c; WHO, 2017).

3.2.5 Improving waste management

Clinical waste, that is waste resulting from all clinical activities in any health service setting that has the potential to cause injury, infection or offence, is a necessary by-product of health care (EPA Victoria, 2009; WHO, 2018b; AMA, 2019). It is crucial for the protection of human health that this is disposed of in an effective and safe way (EPA Victoria, 2009).

However, in Australia and internationally, a significant proportion of unnecessary waste produced by healthcare services represents both lost value and opportunity and results in an economic, social, and environmental cost to society. For example, the use of PPE during the COVID-19, in particular, has driven a significant increase in plastic pollution (Adyel 2020) and impacted global sustainable development goals.

Nevertheless, health services are beginning to acknowledge the value of sustainability measures and adopt creative solutions to reduce and recycle waste (Global Green and Healthy Hospitals, 2019). For example, in Australia, the Melbourne Health Central Production Kitchen, which prepares meals for patients at the Royal Melbourne Hospital as well as other metropolitan health services, sees surplus meals donated to an emergency food relief charity (Oz Harvest). This initiative has resulted in the removal of 9.125 tonnes of food diverted from landfill a year, accounting for an estimated reduction of 17 tonnes of $C0_2$ greenhouse gas emissions from food in landfill and has an approximate financial saving of $3,000 per annum in landfill costs (Global Green and Healthy Hospitals, 2019). The initiative has also produced social benefits through improving the wellbeing of the meal recipients.

3.3 Integrated teams to address climate-related impacts

Within the Australian healthcare system, patients are often required to move between health care service providers (public or private entities, diagnostic services, surgical units, rehabilitation services, social services) within one cycle of care (Saunders et al., 2019). In addition, these disparate health services may be funded by different levels of government or non-government organisations, have limited data sharing ability, or they may not realise the benefits in communicating and working collaboratively (Department of Health, 2018). Such disjointedness results in additional cost to the patient and system, promotes duplicated effort, resource waste and impacts the sustainability of the healthcare system as the requirement for multiple types of care across numerous cycles of care continues to grow.

In some areas of Australia, climate change related increases in temperature have created a potential health care workforce shortage (Pendrey et al., 2021), which will disproportionally affect vulnerable populations (Western Australia Health, 2020; Black et al., 2011; Pendrey et al., 2021). This means that at-risk populations and people with complex health and social needs particularly in rural and remote areas, are faced with additional challenges in accessing health care because of health

workforce recruitment and retention difficulties to these communities; often resulting in the need to travel to access services (AIHW, 2019).

In value-based health care, multifaceted solutions are developed through dedicated teams that draw from an array of disciplines (Teisberg, et al. 2020). Effective implementation requires a shift away from hospital centric and medical visions for improving care and involves better coordination and integration with social and community services (Nuno-Solnis, 2019).

In Canada, coordinated, integrated care has been found to be effective in reducing emergency department admissions and healthcare costs for patients with complex or ongoing conditions (Hudon et al., 2018). In Australia integrated care has the capacity to increase service delivery efficiency, decrease costs, improve equity in uptake of service, improve health literacy and self-care, increase satisfaction with care, improve relationships between patients and their care providers, and improve the ability to respond to health-care crises.

However, models of integrated care that work in metropolitan areas cannot be directly implemented in rural and remote communities (Productivity Commission, 2017), where the healthcare needs and capacities of these populations vary depending on geographical, demographic, socioeconomic and cultural factors. In addition, as climate change continues to impact the diverse ecosystems and environmental vulnerabilities across Australia, the implications, and requirements for both the healthcare workforce and their communities will continue to evolve (Bell 2011).

Regional models of integrated care will provide greater support for solo practitioners, enable a team-based working environment offering peer support, mentorship and supervision for care providers, and build capacity for training and pathways for new health professionals. Local health professionals and the community are able to work together to determine new priorities and ways of working that are responsive to local needs, increase access to services and have a greater focus on community health needs by encouraging people to adopt climate safe behaviours.

Achieving this will require (Productivity Commission, 2017):

- a regional approach to effective change management, locally managed with executive and clinical leadership and a commitment across the workforce;
- data collected and used for coordinated care with transparent measures of performance; and incentives aligned to promote an integrated approach.

For example, the Kooweerup Regional Health Service in Victoria Australia has taken a proactive lead on building resilience within its organisation and fostering trust among the local community through an integrated team-based approach to care services, as well as advocating for climate adaptation policies at the local level and more broadly at state and national levels (Kooweerup nd).

However, given the complexities involved in sustaining consideration of how climate change impacts health over time, ongoing leadership attention will be necessary. Internationally, the introduction of sustainability officers into health service organisations has assisted leadership to help make sense of

the environment, facilitate team engagement and education, and connect with relevant internal and external stakeholders, as well as bringing environmental insight back to the health system. For example, in the NHS, the Chief Sustainability Officer has been instrumental in developing an action plan that commits the NHS to becoming carbon neutral in its own operations by 2040, and to drive emissions reductions in its suppliers and partners (NHS, 2020). In Australia, health service organisations are increasingly seeing value in establishing sustainability committees and officers, with the objective of integrating sustainability frameworks into system-wide requirements and demonstrating to the workforce that environmental, economic and social concerns are important (McGain and Kayak, 2010).

Enhancing overall system sustainability through improving systems efficiency and workforce satisfaction, increasing cost efficiency and reducing resource costs are important aspects of integrated care and can be achieved by supporting the healthcare workforce to work to the top of their scope of practice within healthcare teams (Productivity Commission, 2015). Additional value to the system occurs when care providers are enabled to be allocated to the tasks where they add the most value. For example, chronic disease management is a key responsibility for primary healthcare services in Australia yet improving outcomes for patients with chronic disease is not always achieved. General practice pharmacists are pharmacists integrated into a primary care team who provide clinical services to improve quality use of medications for the practice population (Shaw, 2020); as well as enhancing medicines management, facilitating the identification of issues of overprescribing, unnecessary treatments, and duplicated care (Shaw, 2020). Given that pharmaceuticals are the second highest health care emission producer within the health sector contributing to 19% of health sectors emissions (Malik et al., 2018), this model also represents an option to help reduce the impact of pharmaceuticals on healthcare's carbon footprint.

Integrated care provides patient centred, holistic and cost-effective care that facilitates local and systems sustainability through consideration of, and accountability to the environment. Integration within and beyond healthcare will be prerequisite to this work.

3.3.1 Funding models

The application of sustainability to healthcare funding models is motivated by principles of economics, social consideration and the environment, and is particularly challenging in its complexity.

Provider payment reform has been identified as an important element in the pursuit of value-based healthcare, both because financial incentives have been shown to influence provider behaviour, and because fee-for-service and activity-based payment models (the predominant models used in Australia) are not well aligned to value- based health care (Cattel and Eijkenaar, 2019). These payment models, while incentivising technical efficiency, can encourage overprovision, maintain fragmentation and discourage prevention, all which are also not well aligned to environmental sustainability.

Payment models that focus on both underuse of high value care and overuse of low value care will be important in incentivising value and reducing the carbon footprint of the health system.

Stimulating not only high-quality care, but multidisciplinary coordination, cost-conscious behaviour and prevention, payment models will require a combination of:

- global base payments, essentially a form of bundled payment constructed at a higher level than that of conditions or treatments, with risk sharing arrangements; and
- explicit quality incentives

A range of financial incentives, similar to those used in other sectors will be important for encouraging the incorporation of environmental measures into blended payments for value-based health care. These include low-interest financing, tax incentives and seed funding to support innovation (WHO, 2017).

3.4 Climate-related health outcomes and costs in the value equation

Consideration of climate-related impacts on health outcomes and costs are implicit within the value equation described by Porter and Teisberg (2006).

3.4.1 Outcome indicators

The development of outcome indicators is required to comprehensively measure the climate-related health outcomes of populations (including human health vulnerability to climate change), monitor trends over time and analyse the effectiveness of interventions implemented (Briggs, 1999). Despite progress in Europe and North America to develop climate-related health indicators, Australia is yet to establish and implement a comprehensive framework of indicators that reflect the climate-related health impacts unique to the Australian environment (Navi, et al. 2017).

In Australia, the variability of risk factors for different regions, and a lack of data on exposure to environmental hazards and health outcomes, particularly at a local level has contributed to many aspects of the health effects of the environment not being systematically evaluated, as well as uncertainty about causality (Navi et al., 2017; AIHW, 2020; AIHW, 2011). Progress in this area is further hampered by information and data silos both within and between the sectors, around how matters relating to human health and the natural and built environments are monitored and managed (Johnson, et al. 2018; AIHW 2020). The development of environmental health indicators of climate change in Australia will also be important to monitoring the progress of the sustainable development goals (Navi et al., 2017).

The limited data to inform climate-related health outcomes is exacerbated by the general lack of consolidated primary healthcare data in Australia. However, individual providers of primary healthcare often hold significant information on the services provided to patients, the conditions for which they are being treated and the progression of patients' recovery or further deterioration of their condition.

In 2018, the AIHW was funded to develop a National Primary Health Care Data Asset (NPHCDA) (AIHW, 2019b). While the Asset provides an immediate opportunity to move our health system in a direction that can better inform our understanding of population health, patient journeys through the healthcare system, and to focus on the outcomes that patients value most (AIHW, 2021), in the

medium to longer term, a national minimum dataset for primary healthcare should be pursued. Consolidation to inform population health could be facilitated through the contribution of climate-related health data to a primary healthcare national minimum dataset that provides common data standards and reporting frameworks.

Climate-related health outcomes should cover not just general practice but the entire primary care landscape, for example, specialists, pharmacy, allied health, dental, palliative care, community nursing, mental health, alcohol and other drugs, maternal and child health.

Box 6: Air quality, monitoring health related outcomes and value based healthcare

Australian states and territories are responsible for population health surveillance; and have developed strategies that reflect their respective priorities for monitoring climate-related health outcomes at a local level (for example NSW Health 2011; WA Health 2020). For example, air quality and its impact on health has been a particular focus of health organisations as a result of the 2019-2020 bushfire season.

In New South Wales, air quality monitoring and health alerts have been made available for the general population, as well as providing additional health information to groups who may be more sensitive to air pollution (NSW Health 2020). Populations vulnerable to poor air quality, for example, people with lung or heart disease, children, older adults, pregnant women and people who work outdoors, could become an identified patient segment within a value-based approach to health care; with specific health outcomes resulting from climate-related changes to air quality measured and solutions for improving those health outcomes developed and monitored.

3.4.2 Outcomes in clinical practice

Routine clinical practice cannot support review of the large outcome datasets typically used in clinical research, so outcome clusters by patient segment need to be developed that reflect the outcomes that matter most to those patients (Teisburg et al., 2020). There are calls from both health professionals and people in the community wanting to understand the impact of the climate hazards on their health, in real-time and predictive (Vardoulakis et al., 2020).

The International Consortium of Health Outcomes Measurement (ICHOM) is a recognised international entity focused on ‘defining global Standard Sets of outcome measures that matter most to patients and driving adoption and reporting of these measures to create better value’ (ICHOM n.d.). Standard Sets are developed for specific conditions through a consortium of experts and patient representatives in the field. Explicit consideration of climate-related impacts is not apparent; however, they are also not excluded.

The development of a COVID-19 Standard set is the first that considers a disease attributed in part to altered climate conditions and importantly, as with all Standard Sets, includes measurements of outcomes that reflect the social and economic dimensions of sustainability (Figure 7). That is through outcome measures of social functioning such as productivity and feelings of loneliness and isolation (ICHOM 2020a).

Figure 7: The ICHOM Standard Set for COVID-19. (ICHOM, 2020).

More explicit recognition of climate-related health impacts in standards for health data, clinical documentation and statistical aggregation has been advocated. For example, there have been calls for the inclusion of climate-related psychiatric conditions in the International Classification of Diseases (ICD)(Moffic, 2020). In ICD-10, there is currently only the potential to reflect a health diagnosis to have a climate-basis through coding of '(Z55-Z65) Persons with potential health hazards related to socioeconomic and psychosocial circumstances'. However, this does not reference the terms 'natural environment' or 'climate' (WHO 2019). In ICD-11, which has yet to be implemented but has been publicly released to support preparations for implementation, coding appears even less specific, with the option of (QF4Y) 'Other specified factors influencing health status or contact with health services' (WHO,2020c).

3.4.3 The carbon footprint cost

As investment in health care increases around the world, the potential for increasing harm to health from pollution and environmental change also increases. Therefore, there is a pressing need to understand the costs associated with the carbon footprint of health care.

The carbon footprint of care aligns to some extent with the costs identified in the value equation. For example, if a hip replacement lasts three years instead of 15 years, not only are patient outcomes reduced, but the health care system must also expend additional resources to maintain the patient's health in the future (Porter and Lee, 2013). These additional costs are financial, from the readmission for another hip replacement and the associated rehabilitation, as typically captured in the value equation. However, social costs can also be identified. For example, reduced productivity, as well as ecological costs, for example, from the additional health care that is high emission-producing, energy-intensive and waste-creating.

Value-based health care approaches can support sustainable health care reform through the carbon footprint of services being explicitly identified as a cost when evaluating pathways of care. Leadership in this area has been demonstrated within the NHS UK where guidance to understand the environmental impacts of different aspects of healthcare treatment pathways has been provided (Penny, et al. 2015). For example, the use of anaesthetic gases in surgical pathways has been identified as a significant contributor to the carbon footprint, and there have been a range of interventions implemented to reduce this as a dominant contributor to emissions (Whiting, et al. 2020).

Assessment of the carbon footprint of other specific care pathways has included cataract surgery (Morris, et al. 2013) and renal services (Connor, et al. 2010). With 53.8% and 72% of emissions attributable to procurement (Morris et al., 2013; Connor et al., 2010), sustainability was considered in the design of care pathways such that emissions reduction could be achieved across all components of healthcare, including the procurement sector, as well as saving costs and improving patient care.

Nonetheless, addressing the carbon footprint in health care requires whole-of-service and whole-of-system approaches that consider, for example, the design of shared infrastructure and waste disposal processes, so that the impacts from value-based health care efforts within individual pathways of care can be amplified. In the UK, measures of the carbon footprint include the direct emissions of sources on site, indirect emissions from purchased energy, indirect emissions across the full supply chain, and the emissions from patient and visitor travel (NHS, 2020).

Achievements in reducing the NHS carbon footprint were first driven by phasing out chlorofluorocarbon propellants in inhalers, reducing reliance on coal and oil for onsite heating, and technological improvements that resulted in reductions in supply chain emissions from pharmaceuticals, chemicals and gases; and then by reduced emissions from electricity as the UK grid decarbonised (Tennison, et al. 2021). Such sustainability efforts are yet to focus on optimising how clinical care is delivered, which will require selection of less carbon-intensive and resource-intensive care, but important also health promotion and disease prevention programs to reduce the overall demand for health (Tennison, et al. 2021).

In Australia, the carbon footprint of different subsets of health care has been examined (Malik, et al 2018). As of 2021, consideration of the findings has yet to be incorporated into a national vision for sustainable health care. Despite this, there has been work at the state level to address the carbon footprint of health care. For example, in 2009 in Victoria a baseline for estimating the environmental impact of the Victorian public health care system was established (DHHS Victoria 2018), improving the environmental performance of the health system became one of the strategic directions in the Victorian Governments environmental sustainability in health care strategy (DHHS Victoria 2018) and there has been a recent commitment to reduce the state's greenhouse gas emissions by 50% by 2030 (Victorian State Government 2021).

3.4.4 Reporting climate-related outcomes and cost

Comprehensive data and data collection systems are necessary for reporting climate related outcomes and costs and are essential for building the case for health systems to take steps aimed at reducing the carbon footprint through engaging staff, ensuring accountability and recognising improvement (Charlesworth, et al. 2018).

In value-based health care, standardised collection and reporting of the outcomes and costs of healthcare is an effective way to drive improvements in value. It allows health services to track progress over time and facilitates benchmarking between clinicians and services (ICHOM 2020b). Public reporting of health outcomes can also stimulate services to improve quality, having been promoted as a mechanism for increasing transparency, enabling patients to make informed choices about their health care (Campanella, et al. 2016) and improving accountability (Prang, et al. 2021).

Health services should be supported to collect and report climate-related outcomes and costs of health care.

3.5 Partnerships

A value-based approach to health care creates opportunities to expand partnerships between health services and all the other individuals and entities involved in contributing to patients having better health outcomes (Teisberg, 2020). The increasing variety in partnerships may be 'defining the new normal in healthcare', extending the continuum of care, improving coordination and producing synergies (Land 2017).

Safe and high-quality care in a sustainable system requires effective partnerships with patients and consumers (ACSQHC 2014). At the level of the individual, this may include supporting and encouraging consumers in their own care to recognise and mitigate the impacts of climate change. At the care pathway and service level, this may include involving consumers in the design of services to recognise, mitigate and adapt to the impacts of climate change.

Identification of patient and population segments and an understanding of their needs will guide exploration of partners who will be critical across the care pathway. Each care provider involved in a care pathway will also engage with and be influenced by a range of stakeholders who may also be important partners to explore. These may include researchers, suppliers, policy-makers, funders, businesses, entrepreneurs, investors and government.

For example, the outcomes that can be achieved through partnerships to develop innovative solutions to complex issues such as natural and human-induced disasters and climate change has been demonstrated in South West Victoria with a partnership of local government, large and small rural health services, community service organisations, disability providers, mental health services, neighbourhood houses, bush nursing centres and Aboriginal health services (McCann, et al. 2016). The partnership collaborated through a network governance model with a broad range of agencies across education and training, employment, justice, regulation, financial services and policing, at the state and community level, critical in disaster preparedness, response and recovery.

Climate change and health research generally has been defined by epidemiological, quantitative methodologies, however, research that focuses on health policy, health economics and more directly on the structure and function of the health system will also be crucial in evaluating priority needs and supporting decision-making in response to specific health threats as a consequence of climate change. Partnerships will need to be established, not just between researchers and health services, but including sectors such as urban design, energy and water security, and transport to understand the data and identify potential solutions. However, for these inter-sectoral partnerships to be effective, a common language of terms with agreed and shared meanings, will be needed to overcome the knowledge silos that currently exist. A glossary of terms to support partnerships for climate and health in Australia has been developed (Zhang et al., 2021).

The need for investment in collaborative, multi-sector, multidisciplinary research has also been recognised by the National Health and Medical Research Council through the 2021 NHMRC Special Initiative in Human Health and Environmental Change (NHMRC 2021). However, research for climate and health should be further supported for the long term.

For partnerships to take shared action with enhanced capacity, coordination and leadership on climate change and health initiatives, appropriate governance and funding arrangements will need to be established (CAHA 2017). Australian, state and territory government commitment to shared action on long-term health system reform, such as through joint planning and funding pools at a local level, should enable such partnerships to be formed (Council on Federal Financial Relations 2020).

4 Recommendations

Recommendation 1. That environmental sustainability be encompassed in the national vision and strategy for outcomes-focused, value-based health care in Australia. The vision must:

- recognise the significant contribution of health care to Australia's carbon footprint as a cost within the value equation; but also
- view the natural environment as more than just a resource that serves humans and, rather, recognise the complex interactions and interdependencies between species (including humans) and the natural environment to maintain health and equity; and
- include a deliberate focus on those populations who are most vulnerable to the impacts of climate change.

Recommendation 2. That strong leadership is demonstrated across the health system through:

- a commitment to achieve net zero emissions;
- cross-sector and inter-agency partnerships formed at regional, state and national levels to enhance capacity, coordination and leadership in achieving commitments to climate change mitigation and adaptation; and
- the appointment of sustainability officers to support health services, in collaboration with clinical leaders within services.

Recommendation 3. That data-driven improvements in the health outcomes of individuals and populations are enabled through:

- climate-related health outcome data being standardised, and collection embedded in regional, state and territory and national environmental health surveillance systems;
- life cycle assessments of the carbon footprint of health services, including both direct and indirect sources across the full supply chain, being explicitly identified as a cost within the value equation when evaluating pathways of care; and
- health services being supported to collect and report climate-related outcomes and costs of health care in order to track patient and population progress over time and to facilitate benchmarking between clinicians, services and regions.

Recommendation 4. That health services are supported in the implementation of value-based health care through effective partnership governance models and the pooling of funding to:

- identify the climate-related health needs of the populations they serve, with particular focus on those populations most vulnerable to climate change;
- collaborate across the full supply chain to conduct life cycle assessments of the carbon footprint of care pathways; and
- collaborate to design care pathways that optimise patient outcomes and minimise the impact on the climate, including through reducing low value care, the effective and sustainable adoption of health technology and virtual care models, preventative health action, shifts in products and services to lower carbon alternatives, shifts in care from high-emitting hospitals to primary care models where care is provided closer to home, and improvements in waste reduction and management.

Recommendation 5. That health workforce strategies and plans:

- recognise the impact climate change will have on exacerbating health workforce shortages, particularly in rural and remote areas and already vulnerable communities, and the role value-based health care can have in facilitating the design of care models with safe, effective and innovate use of the workforce;
- ensure education and training for all health professionals incorporates the impact of climate on health; and
- support profession-specific leadership in identifying actions to reduce carbon emissions and address climate-related health outcomes, and the sharing of best practice within and between professions, with a focus on value.

Recommendation 6. That funding models are introduced to incentivise environmental sustainability, including:

- low-interest loans, tax incentives and seed funding to support innovation at all levels of health system funding;

- exploring blended provider-payment models where explicit quality incentives incorporate environmental measures; and
- explicit requirements for health technology assessment applications to include results from environmental impact assessments along with impacts on health outcomes and costs.

Recommendation 7. That there is ongoing support for climate and health research that:

- provides a strong evidence base to support health sector sustainability including research that measures the footprint of health care items (for example tests, devices, drugs, surgeries) and pathways of care using process-based life cycle assessments
- is able to identify patterns within the health system and its policies, structures and effectiveness for better management of climate change in an economic, rigorous manner; and
- supports partnerships within health and between health and other relevant sectors to ensure translation and support decision-making in response to climate health threats.

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