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**HEAL**

# Appendices

## Systematic Mapping Review of Australian Research on Climate Change and Health Interventions

National Health and Climate Strategy | Action 7.2



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# Appendix 1. Detailed methods

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## Overview and rationale

The systematic mapping review followed the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) method, which has been previously used in both 'mapping' and 'scoping' reviews. Systematic mapping reviews identify, describe and catalogue the broader evidence available to address policy questions, but typically extract only descriptive information about the studies and do not synthesise study findings nor include a quality or risk of bias assessment.

The review sought to describe, collate and catalogue the research that has been carried out in the broad field of climate change adaptation, mitigation and co-benefits within and outside of the Australian health system, without synthesising the results of studies focusing on specific interventions. Appendix 2 details the inclusion and exclusion criteria for primary studies and reviews.

## Searching and selection

Search terms for the bibliographic database searches were developed collaboratively by the HEAL Review Team and the National Health Sustainability and Climate Unit. Appendix 3 includes a complete list of finalised search terms. The search was conducted on 1st March 2024 via Medline, Scopus, and Google Scholar. This process was complemented with manual searches of peer-reviewed literature cited in MJA-Lancet Countdown Reports on Health and Climate Change in Australia (2018-2024) and other reviews.

The complete screening and selection process is outlined in the PRISMA diagram in Appendix 4. All screening of the peer-reviewed scientific literature, using the inclusion and exclusion criteria outlined in Appendix 2, was carried out by two reviewers independently, with a third reviewer resolving any disagreements.

## Analysis

Key features of the original research studies were extracted, focusing on the study design and methods, setting and/or population, and health or environmental outcomes of articles that met the inclusion criteria. Articles were described under four pre-defined themes: (1) health system decarbonisation, (2) health system adaptation, vulnerability and resilience, (3) health co-benefits of climate change mitigation outside the health system, and (4) adaptation and resilience interventions to protect health outside the health system.

## Critical appraisal

Quality and risk of bias assessment is not typically included in systematic mapping reviews, since there is no synthesis of results and it is difficult to assess external validity (i.e. generalisability). However, the robustness of different aspects of the original research studies (e.g. number of participants, suitability of study design) were critically appraised using the Quality Assessment with Diverse Studies (QuADS) tool.

Two reviewers scored the studies independently and an average score was calculated for each study. Within each theme (1-4), original research studies were grouped for similar interventions and the overall quality of studies was appraised for each group. The QuADS tool was initially tested with a small number of papers to ensure consistency in the interpretation of criteria.

Included systematic, scoping, rapid or narrative reviews were not formally scored, but the number and type of reviews available in each theme were discussed (1-4).

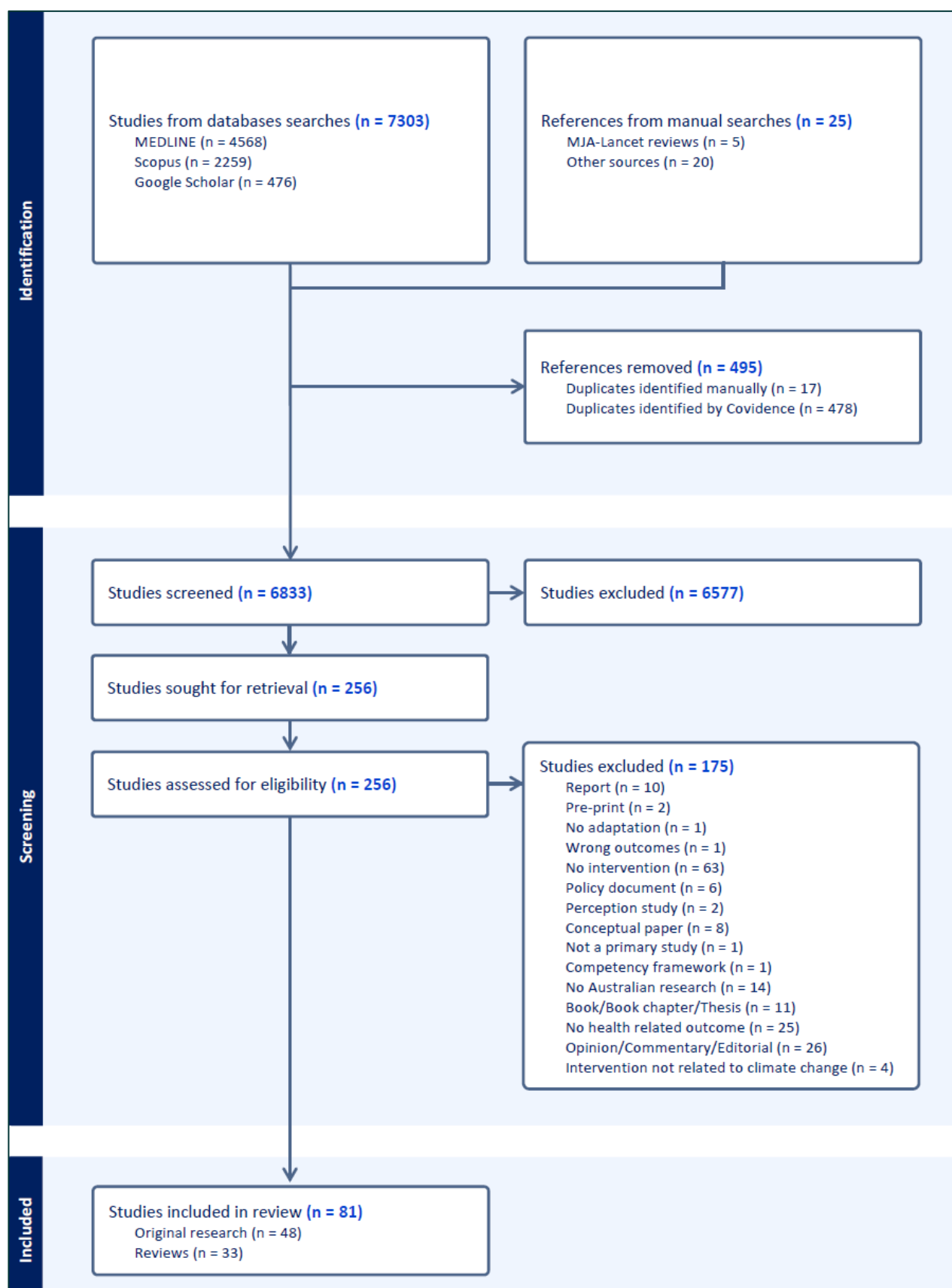
# Appendix 2. Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
<ul style="list-style-type: none"><li>• Original research studies (quantitative or qualitative), case studies, systematic, scoping, rapid and narrative reviews published from 2008 to 2023 on any of the following:</li><li>• Health system adaptation and resilience, including health care, aged care and public health (i.e. health protection and health promotion, and related data, surveillance and intelligence)</li><li>• Health system decarbonisation, including facilities, built environment, energy, water, travel, transport, medicines, anaesthetics, procurement, supply chain, food, nutrition, waste, medical technologies, procedures and disease pathways, medical and healthcare specialties, modes of healthcare delivery, and circular economy principles and practices</li><li>• First Nations, connection to and caring for Country, traditional land and sea management techniques, cultural burning relevant to carbon emission mitigation, health and wellbeing impacts and adaptation</li><li>• Climate and health education, training, learning and development on mitigation, emissions reduction, resilience or adaptation</li><li>• Health co-benefits of mitigation in other sectors, including housing and the built environment, energy, transport, farming and agriculture</li><li>• Adaptation in other sectors (including housing and the built environment, energy, transport, farming and agriculture) to address the health impacts of climate change</li></ul>	<ul style="list-style-type: none"><li>• Climate change mitigation and adaptation research not specifically focusing on Australia</li><li>• Climate change and health impacts research that does not involve study of proposed or implemented interventions</li><li>• Research on climate change adaptation and mitigation in sectors outside the health system which is not directly referring to health outcomes</li><li>• Health system research that does not directly refer to climate change adaptation, resilience or decarbonisation</li><li>• Opinion articles or editorials</li><li>• Conference proceeding</li><li>• Experimental animal studies</li><li>• Grey literature (i.e. studies not published in a peer-reviewed scientific journal)</li></ul>

# Appendix 3. Database search terms

Search #	Search concept	Search terms
#1	Climate change	(climate OR environment* OR global) NEAR/3 (change OR warming OR sustainab*) OR heat* OR flood* OR drought* OR bushfire* OR wildfire* OR "forest fire"
#2	Adaption / mitigation / resilience	adaptation OR decarbon* OR emission* OR energy OR green* OR mitigat* OR resilien* OR vulnerab*
#3	Strategies / policies / interventions	"case stud*" OR intervention* OR intelligence OR measure* OR polic* OR promotion OR protection OR standard* OR strateg* OR surveillance OR tracking
#4	Health & wellbeing	"aged care" OR behav* OR communit* OR environment* OR health OR disease OR wellbeing OR "health equit*" OR "health inequit*" OR "health equalit*" OR "health inequalit*" OR "health care" OR hospital OR OR "primary care" OR co-benefit*
#5	Australian setting	Australia* OR "Australian Capital Territory" OR "New South Wales" OR "Northern Territory" OR Queensland* OR "South Australia*" OR Tasmania* OR Victoria* OR "Western Australia*" OR "First Nation*" OR Aboriginal OR Indigenous OR Torres Strait
#6		#1 AND #2 AND #3 AND #4 AND #5
		Date limiter 2008-

# Appendix 4. PRISMA diagram





## Appendix 5. Theme 1 study characteristics: health system decarbonisation

Primary studies (N = 13)			Reviews (N = 5)		
Characteristic	Count	Reference	Characteristic	Count	Reference
Year of publication			Year of publication		
2013 or prior	3	(McGain et al. 2010); (McGain et al. 2012); (Ellis et al. 2013)	2013 or prior	1	(Pencheon et al. 2009)
2014 – 2016	0		2014 – 2016	1	(McGain and Naylor 2014)
2017 – 2019	3	(McGain et al. 2017); (Davis et al. 2018); (Charlesworth and Jamieson 2019)	2017 – 2019	1	(Wyssusek et al. 2019)
2020 – 2024	7	(McAlister et al. 2020); (McAlister et al. 2022); (Talbot et al. 2022); (Wyssusek et al. 2022); (McAlister et al. 2023); (Breth-Petersen et al. 2024); (Davies et al. 2024)	2020 – 2024	2	(Duindam 2022); (Liu et al. 2023)
Study location – state*			Geographical focus		
Australia, NZ, US, UK	1	(Charlesworth and Jamieson 2019)	Australia	2	(Duindam 2022); (Liu et al. 2023)
Australia & NZ	1	(Talbot et al. 2022)	Global	3	(Pencheon et al. 2009); (McGain and Naylor 2014); (Wyssusek et al. 2019)
Australia, US, UK	1	(Davies et al. 2024)			
ACT	0				
NSW	3	(McAlister et al. 2022); (McAlister et al. 2023);			

Primary studies (N = 13)			Reviews (N = 5)		
Characteristic	Count	Reference	Characteristic	Count	Reference
		(Breth-Petersen et al. 2024)			
NT	0				
QLD	1	(Wyssusek et al. 2022)			
SA	0				
TAS	1	(Ellis et al. 2013)			
VIC	6	(McGain et al. 2010); (McGain et al. 2012); (McGain et al. 2017); (Davis et al. 2018); (McAlister et al. 2020); (McAlister et al. 2022)			
WA	0				
Study location within Australia			Review period		
Metropolitan	9	(McGain et al. 2010); (McGain et al. 2012); (McGain et al. 2017); (Davis et al. 2018); (McAlister et al. 2020); (McAlister et al. 2022); (Wyssusek et al. 2022); (McAlister et al. 2023); (Breth-Petersen et al. 2024)	2010 onwards	1	(Duindam 2022)
Regional/remote	1	(Ellis et al. 2013)	1990-2013	1	(McGain and Naylor 2014)
Unclear/anywhere	3	(Charlesworth and Jamieson 2019); (Talbot et al. 2022); (Davies et al. 2024)	1992-2018	1	(Wyssusek et al. 2019)
			2017-2021	1	(Liu et al. 2023)
			Unspecified	1	(Pencheon et al. 2009)
Context			Context		

Primary studies (N = 13)			Reviews (N = 5)		
Characteristic	Count	Reference	Characteristic	Count	Reference
Hospital operating theatre	1	(McGain et al. 2012)	Hospitals operating theatre	1	(Wyssusek et al. 2019)
Hospital pathology	2	(McAlister et al. 2020); (McAlister et al. 2023)	Healthcare pathology	0	
Hospitals anaesthesia & analgesia	5	(McGain et al. 2010); (McGain et al. 2017); (Wyssusek et al. 2022); (Breth-Petersen et al. 2024); (Davies et al. 2024)	Hospitals anaesthesia & analgesia	1	(Liu et al. 2023)
Hospital dialysis unit	1	(Talbot et al. 2022)	Healthcare (hospital)	1	(McGain and Naylor 2014)
Hospital ureteroscopy	1	(Davis et al. 2018)	Healthcare (non-hospital)	1	(Duindam 2022)
Hospital diagnostic imaging	1	(McAlister et al. 2022)	Healthcare (general)	1	(Pencheon et al. 2009)
Healthcare travel	1	(Ellis et al. 2013)			
Healthcare (general)	1	(Charlesworth and Jamieson 2019)			
Study type			Study type		
Before & After (uncontrolled)	2	(McAlister et al. 2023); (Wyssusek et al. 2022)	Narrative review	4	(Duindam 2022); (Pencheon et al. 2009); (Liu et al. 2023); (Wyssusek et al. 2019)
Qualitative (interviews)	2	(Charlesworth and Jamieson 2019); (Breth-Petersen et al. 2024)	Systematic review	1	(McGain and Naylor 2014)
Cross-sectional survey	2	(Ellis et al. 2013); (Talbot et al. 2022)	Scoping or other review	0	
Life cycle assessment	7	(McGain et al. 2010); (McGain et al. 2012); (McGain et al. 2017); (Davis et al. 2018); (McAlister et al. 2020); (McAlister et al. 2022); (Davies et al. 2024)			
Randomised controlled trial	0				

Primary studies (N = 13)			Reviews (N = 5)		
Characteristic	Count	Reference	Characteristic	Count	Reference
Types of intervention			Types of intervention		
Ideas for potential interventions to achieve environmental benefits in healthcare	1	(Charlesworth and Jamieson 2019)	Priority areas for action to decarbonise healthcare	1	(Duindam 2022)
Comparison of single-use and reusable medical equipment	4	(McGain et al. 2010); (McGain et al. 2012); (McGain et al. 2017); (Davis et al. 2018)	Interventions to mitigate the environmental impacts of hospital care	1	(McGain and Naylor 2014)
Telehealth	1	(Ellis et al. 2013)	Local initiatives to reduce energy, water increase active transport	1	(Pencheon et al. 2009)
Sustainability practices (e.g., energy, water use, waste)	2	(Talbot et al. 2022); (Breth-Petersen et al. 2024)	Nitrous oxide use reduction, gas capture and destruction options	1	(Liu et al. 2023)
Multicomponent intervention on anaesthetic gases	1	(Wyssusek et al. 2022)	Operating room green initiatives (e.g., energy saving, reprocessing)	1	(Wyssusek et al. 2019)
Hospital policy to restrict routine pathology tests	2	(McAlister et al. 2020); (McAlister et al. 2023)			
Potential changes in hospital diagnostic imaging	1	(McAlister et al. 2022)			
Potential substitution of intravenous for oral paracetamol	1	(Davies et al. 2024)			

Primary studies (N = 13)			Reviews (N = 5)		
Characteristic	Count	Reference	Characteristic	Count	Reference
Outcome measures*			Outcome measures		
Greenhouse gas emissions (CO <sub>2</sub> e)	10	(Ellis et al. 2013); (McGain et al. 2010); (McGain et al. 2012); (McGain et al. 2017); (Davis et al. 2018); (McAlister et al. 2020); (McAlister et al. 2022); (Wyssusek et al. 2022); (McAlister et al. 2023); (Davies et al. 2024)	Greenhouse gas emissions (CO <sub>2</sub> e)	4	(McGain and Naylor 2014); (Duindam 2022); (Pencheon et al. 2009); (Liu et al. 2023);
Financial costs	6	(McGain et al. 2010); (McGain et al. 2012); (McGain et al. 2017); (Wyssusek et al. 2022); (McAlister et al. 2023); (Davies et al. 2024)	Financial costs	1	(Wyssusek et al. 2019)
Water	4	(McGain et al. 2010); (McGain et al. 2012); (McGain et al. 2017); (Talbot et al. 2022)	Water, waste	2	(McGain and Naylor 2014); (Wyssusek et al. 2019)
Other (e.g., staff reported practices, travel, energy)	4	(Ellis et al. 2013); (Charlesworth and Jamieson 2019); (Talbot et al. 2022); (Breth-Petersen et al. 2024)	Other (e.g. hospital design, energy, travel, procured goods, staff behaviour)	1	(McGain and Naylor 2014)
Data sources*			Data sources*		
Healthcare leaders / doctors	3	(Charlesworth and Jamieson 2019); (Talbot et al. 2022); (Breth-Petersen et al. 2024)	Grey literature – published reports and policy documents	1	(Pencheon et al. 2009)
Directly collected data or from life cycle inventories	6	(McGain et al. 2010); (McGain et al. 2012); (McGain et al. 2017); (Davis et al. 2018); (McAlister et al. 2020); (McAlister et al. 2022)	Published peer review literature	4	(McGain and Naylor 2014); (Wyssusek et al. 2019); (Duindam 2022); (Liu et al. 2023)
Routinely collected hospital data	3	(McAlister et al. 2023); (Wyssusek et al. 2022); (Davies et al. 2024)	Hospital data	1	(Liu et al. 2023)
Population survey	1	(Ellis et al. 2013)			

Primary studies (N = 13)			Reviews (N = 5)		
Characteristic	Count	Reference	Characteristic	Count	Reference
First Nations focus			First Nations focus		
Yes	0		Yes	0	
Partial	1	(McAlister et al. 2023)	Partial	0	
No / Unclear	12	(McGain et al. 2010); (McGain et al. 2012); (Ellis et al. 2013); (McGain et al. 2017); (Davis et al. 2018); (Charlesworth and Jamieson 2019); (Talbot et al. 2022); (Wyssusek et al. 2022); (Breth-Petersen et al. 2024); (McAlister et al. 2020); (McAlister et al. 2022); (Davies et al. 2024)	No	5	(Pencheon et al. 2009); (McGain and Naylor 2014); (Wyssusek et al. 2019); (Duindam 2022); (Liu et al. 2023)

\*Each study could contribute to more than one category

## Appendix 6. Theme 2 study characteristics: health system adaptation, vulnerability and resilience

Primary studies (N=14)			Reviews (N=10)		
Characteristic	Count	Reference		Count	Reference
Year of publication			Year of publication		
2013 or prior	3	(Patrick and Capetola 2011); (van Beurden et al. 2011); (Walker 2009)	2013 or prior	2	(Walker et al. 2011); (Blashki et al. 2011)
2014 – 2016	1	(Nitschke et al. 2016)	2014 – 2016	0	
2017 – 2019	4	(Nitschke et al. 2017); (Patrick and Kingsley 2019); (Kildea et al. 2018); (Williams et al. 2019)	2017 – 2019	1	(Vu et al. 2019)
2020 – 2024	6	(Marfori et al. 2020); (Williams et al. 2022); (Mohtady Ali et al. 2022); (de Souza et al. 2023); (Knezevic et al. 2023); (McLean et al. 2022)	2020 – 2024	7	(Palinkas et al. 2020); (Hu et al. 2022); (Crandon et al. 2022); (Lokmic-Tomkins et al. 2023); (Walter et al. 2024); (Zurynski et al. 2024); (Xu et al. 2023)
Study location – state*			Geographical focus		
Australia	1	(Patrick and Kingsley 2019)	Australia	2	(Blashki et al. 2011); (Xu et al. 2023)
ACT	0		Global	3	(Hu et al. 2022); (Lokmic-Tomkins et al. 2023); (Zurynski et al. 2024)
NSW	2	(van Beurden et al. 2011); (Knezevic et al. 2023)	Developed countries	1	(Vu et al. 2019)
NT	1	(de Souza et al. 2023)	Unclear	4	(Palinkas et al. 2020); (Crandon et al. 2022); (Walker et al. 2011); (Walter et al. 2024)

Primary studies (N=14)			Reviews (N=10)		
Characteristic	Count	Reference		Count	Reference
QLD	3	(Kildea et al. 2018); (McLean et al. 2022); (Mohtady Ali et al. 2022)			
SA	4	(Williams et al. 2019); (Williams et al. 2022); (Nitschke et al. 2016); (Nitschke et al. 2017)			
TAS	1	(Marfori et al. 2020)			
VIC	3	(Walker 2009); (Patrick and Capetola 2011); (Williams et al. 2019)			
WA	0				
Study location type			Number of Australian studies		
City	7	(Williams et al. 2022); (Nitschke et al. 2016); (Nitschke et al. 2017); (Kildea et al. 2018); (de Souza et al. 2023); (Mohtady Ali et al. 2022); (McLean et al. 2022)	0 – 4	3	(Lokmic-Tomkins et al. 2023); (Hu et al. 2022); (Crandon et al. 2022)
Rural / Regional / Remote	4	(Marfori et al. 2020); (Knezevic et al. 2023); (van Beurden et al. 2011); (Williams et al. 2019)	5 – 10	2	(Zurynski et al. 2024); (Vu et al. 2019)
Unclear / Anywhere	3	(Walker 2009); (Patrick and Capetola 2011); (Patrick and Kingsley 2019)	Unclear	5	(Walter et al. 2024); (Walker et al. 2011); (Palinkas et al. 2020); (Blashki et al. 2011); (Xu et al. 2023)
Study type			Study type		
Before & After (uncontrolled)	1	(Nitschke et al. 2016)	Narrative review	4	(Lokmic-Tomkins et al. 2023); (Crandon et al. 2022); (Palinkas et al. 2020); (Blashki et al. 2011)
Case report	1	(de Souza et al. 2023)	Systematic review	4	(Vu et al. 2019); (Hu et al. 2022); (Walker et al. 2011); (Zurynski et al. 2024)



Primary studies (N=14)			Reviews (N=10)		
Characteristic	Count	Reference		Count	Reference
Cohort	1	(Kildea et al. 2018)	Scoping or other review	2	(Walter et al. 2024); (Xu et al. 2023)
Qualitative (content analysis, interviews, focus groups, document evaluation)	5	(Walker 2009); (Knezevic et al. 2023); (Marfori et al. 2020); (Patrick and Capetola 2011); (Mohtady Ali et al. 2022)			
Course evaluation	1	(McLean et al. 2022)			
Cost-benefit analysis	1	(Williams et al. 2022)			
Cross-sectional survey	3	(van Beurden et al. 2011); (Williams et al. 2019); (Patrick and Kingsley 2019) (plus interviews)			
Randomised controlled trial	1	(Nitschke et al. 2017)			
Climate hazard*			Climate hazard*		
Any / Extreme weather events	6	(Walker 2009); (van Beurden et al. 2011); (Patrick and Capetola 2011); (Patrick and Kingsley 2019); (McLean et al. 2022); (Mohtady Ali et al. 2022)	Any / Extreme weather events	6	(Crandon et al. 2022); (Walker et al. 2011); (Xu et al. 2023); (Palinkas et al. 2020); (Walter et al. 2024); (Blashki et al. 2011)
Bushfire	2	(Marfori et al. 2020); (Knezevic et al. 2023)	Bushfire	4	(Walker et al. 2011); (Hu et al. 2022); (Zurynski et al. 2024); (Xu et al. 2023)
Flood	2	(Kildea et al. 2018); (Knezevic et al. 2023)	Flood	3	(Walker et al. 2011); (Zurynski et al. 2024); (Xu et al. 2023)
Drought	0		Drought	1	(Xu et al. 2023)
Heat	5	(Nitschke et al. 2016); (Nitschke et al. 2017); (de Souza et al. 2023); (Williams et al. 2019); (Williams et al. 2022)	Heat	3	(Vu et al. 2019); (Hu et al. 2022); (Xu et al. 2023); (Lokmic-Tomkins et al. 2023)

Primary studies (N=14)			Reviews (N=10)		
Characteristic	Count	Reference		Count	Reference
Types of intervention			Types of intervention		
Psychosocial / Emotional support	1	(Knezevic et al. 2023)	Any intervention to mitigate the impacts of climate hazard	3	(Palinkas et al. 2020); (Vu et al. 2019); (Walker et al. 2011)
Education / Training	2	(McLean et al. 2022); (Mohtady Ali et al. 2022)	Any intervention to adapt to climate hazard	4	(Walter et al. 2024); (Zurynski et al. 2024); (Blashki et al. 2011); (Xu et al. 2023)
Landscaping	1	(de Souza et al. 2023)	Digital Health Technology	1	(Lokmic-Tomkins et al. 2023)
Health promotion	2	(Patrick and Capetola 2011); (Patrick and Kingsley 2019)	Vulnerability assessment	1	(Hu et al. 2022)
Heat warning system	4	(Williams et al. 2019); (Williams et al. 2022); (Nitschke et al. 2016); (Nitschke et al. 2017)	Community psychological resilience	1	(Crandon et al. 2022);
Model of care	1	(Kildea et al. 2018)			
Primary health care framework	1	(Walker 2009)			
Public health messaging	1	(Marfori et al. 2020)			
Systems thinking	1	(van Beurden et al. 2011)			
Health outcomes*			Health outcomes*		
Healthcare costs or utilisation	2	(Williams et al. 2022); (Nitschke et al. 2016)	Healthcare utilisation	1	(Hu et al. 2022)
Mortality	1	(Nitschke et al. 2016)	Mortality	2	(Blashki et al. 2011); (Xu et al. 2023)
Health-related behaviour, knowledge, awareness	4	(Nitschke et al. 2017); (Knezevic et al. 2023); (Williams et al. 2019); (Marfori et al. 2020)	Health-related behaviour, knowledge, awareness	1	(Vu et al. 2019)

Primary studies (N=14)			Reviews (N=10)		
Characteristic	Count	Reference		Count	Reference
Morbidity	1	(Nitschke et al. 2017)	Healthcare responsiveness / effectiveness	2	(Lokmic-Tomkins et al. 2023); (Vu et al. 2019)
Psychological impact	2	(Kildea et al. 2018)	Mental health	3	(Crandon et al. 2022); (Blashki et al. 2011); (Xu et al. 2023)
Wellbeing	1	(de Souza et al. 2023)	Infectious diseases	2	(Blashki et al. 2011); (Xu et al. 2023)
Not specified	6	(Patrick and Kingsley 2019); (Patrick and Capetola 2011); (van Beurden et al. 2011); (McLean et al. 2022); (Walker 2009); (Mohtady Ali et al. 2022)	Work health and safety	1	(Zurynski et al. 2024)
			None/ unclear	3	(Palinkas et al. 2020); (Walter et al. 2024); (Walker et al. 2011)
First Nations focus			First Nations focus		
Yes	0		Yes	1	(Walker et al. 2011)
Partial	1	(de Souza et al. 2023)	Partial	1	(Xu et al. 2023)
No	13	(Knezevic et al. 2023); (Marfori et al. 2020); (Patrick and Kingsley 2019); (Patrick and Capetola 2011); (Kildea et al. 2018); (Williams et al. 2019); (Williams et al. 2022); (Nitschke et al. 2016); (Nitschke et al. 2017); (van Beurden et al. 2011); (McLean et al. 2022); (Walker 2009); (Mohtady Ali et al. 2022)	No	8	(Zurynski et al. 2024); (Hu et al. 2022); (Vu et al. 2019); (Walter et al. 2024); (Palinkas et al. 2020); (Crandon et al. 2022); (Lokmic-Tomkins et al. 2023); (Blashki et al. 2011)

\*Each study could contribute to more than one category

## Appendix 7. Theme 3 study characteristics: health co-benefits of climate change mitigation outside the health system

Primary studies (N=4)			Reviews (N=3)		
Characteristic	Count	Reference		Count	Reference
Year of publication			Year of publication		
2013 or prior	1	(Burgess et al. 2009)	2013 or prior	1	(Giles-Corti et al. 2010)
2014 – 2016	0		2014 – 2016	1	(Willand et al. 2015)
2017 – 2019	1	(Schultz et al. 2018)	2017 – 2019	1	(Delany-Crowe et al. 2019)
2020 – 2024	2	(Haddad et al. 2020); (Ridoutt et al. 2021)	2020 – 2024	0	
Study location – state*			Geographical focus		
Australia	1	(Ridoutt et al. 2021)	Australia	1	(Delany-Crowe et al. 2019)
ACT	0		Global	2	(Giles-Corti et al. 2010); (Willand et al. 2015)
NSW	0		High-income countries	0	
NT	3	(Burgess et al. 2009); (Schultz et al. 2018); (Haddad et al. 2020)	Unclear	0	
QLD	0				
SA	0				

Primary studies (N=4)			Reviews (N=3)		
Characteristic	Count	Reference		Count	Reference
TAS	0				
VIC	0				
WA	1	(Schultz et al. 2018)			
Study location type			Number of Australian studies		
City	1	(Haddad et al. 2020)	0 – 4	1	(Willand et al. 2015)
Rural / Regional / Remote	2	(Burgess et al. 2009); (Schultz et al. 2018)	5 – 10	0	
Unclear / Anywhere	1	(Ridoutt et al. 2021)	Unclear	2	(Delany-Crowe et al. 2019); (Giles-Corti et al. 2010)
Study type			Study type		
Health impact assessment	1	(Haddad et al. 2020)	Narrative review	0	
Case report	0		Systematic review	0	
Cohort	0		Scoping or other review	3	(Giles-Corti et al. 2010); (Delany-Crowe et al. 2019); (Willand et al. 2015)
Survey analysis	1	(Ridoutt et al. 2021)			
Qualitative	2	(Burgess et al. 2009); (Schultz et al. 2018)			
Climate hazard*			Climate hazard*		
Any / Extreme weather events	3	(Burgess et al. 2009); (Schultz et al. 2018); (Ridoutt et al. 2021)	Any / Extreme weather events	1	(Giles-Corti et al. 2010)

Primary studies (N=4)			Reviews (N=3)		
Characteristic	Count	Reference		Count	Reference
Bushfire	0		Bushfire	0	
Flood	0		Flood	0	
Drought	0		Drought	1	(Delany-Crowe et al. 2019)
Heat and heatwaves	1	(Haddad et al. 2020)	Heat	1	(Willand et al. 2015)
Types of intervention*			Types of intervention		
Indigenous land management	2	(Burgess et al. 2009); (Schultz et al. 2018)	Residential energy efficiency	1	(Willand et al. 2015)
Cooling technologies	1	(Haddad et al. 2020)	Urban transport	1	(Giles-Corti et al. 2010)
Urban greening	1	(Haddad et al. 2020)	Water management	1	(Delany-Crowe et al. 2019)
Heathy diets	1	(Ridoutt et al. 2021)			
Outcome measure*			Outcome measure*		
Heat-related health	1	(Haddad et al. 2020)	Health equity	1	(Delany-Crowe et al. 2019)
Mortality & morbidity	1	(Burgess et al. 2009)	Mortality & morbidity	2	(Willand et al. 2015); (Giles-Corti et al. 2010)
Health & wellbeing	1	(Schultz et al. 2018)	Health & wellbeing	1	(Delany-Crowe et al. 2019)
Greenhouse gas emissions (CO <sub>2</sub> e)	1	(Ridoutt et al. 2021)			
First Nations focus			First Nations focus		
Yes	2	(Burgess et al. 2009); (Schultz et al. 2018)	Yes	0	
Partial	0		Partial	1	(Delany-Crowe et al. 2019)

Primary studies (N=4)			Reviews (N=3)		
Characteristic	Count	Reference		Count	Reference
No	2	(Haddad et al. 2020); (Ridoutt et al. 2021)	No	2	(Willand et al. 2015); (Giles-Corti et al. 2010)

\*Each study could contribute to more than one category

## Appendix 8. Theme 4 study characteristics:

Primary studies (N=17)			Reviews (N=9)		
Characteristic	Count	Reference		Count	Reference
Year of publication			Year of publication		
2013 or prior	4	(Hansen et al. 2011); (Hart et al. 2011); (Rigby et al. 2011); (Tomerini et al. 2011)	2013 or prior	1	(Harley et al. 2011)
2014 – 2016	1	(Chen et al. 2014)	2014 – 2016	1	(Pitman et al. 2015)
2017 – 2019	0		2017 – 2019	0	
2020 – 2024	12	(Cowlshaw et al. 2023); (Dufty 2022); (Wheeler et al. 2021); (O'Donnell et al. 2020); (Seale et al. 2023); (Qi et al. 2021); (Santamouris et al. 2020); (Varghese et al. 2020); (Sadeghi et al. 2022); (Quilty et al. 2023); (Longman et al. 2023); (McGill et al. 2024)	2020 – 2024	7	(Adnan et al. 2022); (Charlson et al. 2021); (Desai and Zhang 2021); (Vien et al. 2024); (Jay et al. 2021); (Zhao et al. 2022); (Heaney et al. 2021)
Study location – state*			Geographical focus		
Australia	2	(Seale et al. 2023); (Varghese et al. 2020)	Australia	2	(Adnan et al. 2022); (Harley et al. 2011)
ACT	0		Global	7	(Charlson et al. 2021); (Desai and Zhang 2021); (Pitman et al. 2015); (Vien et al. 2024); (Jay et al. 2021); (Zhao et al. 2022); (Heaney et al. 2021)
NSW	9	(Dufty 2022); (Hart et al. 2011); (McGill et al. 2024); (Wheeler et al. 2021); (Rigby et al. 2011); (Qi et al. 2021); (Santamouris et al. 2020); (Sadeghi et al. 2022); (Longman et al. 2023)			
NT	1	(Quilty et al. 2023)			



Primary studies (N=17)			Reviews (N=9)		
Characteristic	Count	Reference		Count	Reference
QLD	1	(Tomerini et al. 2011)			
SA	2	(Hansen et al. 2011); (O'Donnell et al. 2020)			
TAS	0				
VIC	2	(Cowlshaw et al. 2023); (Chen et al. 2014)			
WA	0				
Study location type			Number of Australian studies		
City	7	(Dufty 2022); (Hansen et al. 2011); (Wheeler et al. 2021); (Chen et al. 2014); (Qi et al. 2021); (Santamouris et al. 2020); (Sadeghi et al. 2022)	0 – 4	1	(Desai and Zhang 2021)
Rural / Regional / Remote	6	(Cowlshaw et al. 2023); (Hart et al. 2011); (McGill et al. 2024); (Rigby et al. 2011); (Tomerini et al. 2011); (Longman et al. 2023)	5 – 10	1	(Vien et al. 2024); (Zhao et al. 2022)
Unclear / Anywhere	4	(O'Donnell et al. 2020); (Seale et al. 2023); (Varghese et al. 2020); (Quilty et al. 2023)	> 10	3	(Adnan et al. 2022); (Charlson et al. 2021); (Heaney et al. 2021)
			Unclear	4	(Pitman et al. 2015); (Jay et al. 2021); (Harley et al. 2011)
Study type			Study type		
Health impact assessment	3	(Tomerini et al. 2011); (Chen et al. 2014); (Sadeghi et al. 2022)	Narrative review	3	(Jay et al. 2021); (Zhao et al. 2022); (Harley et al. 2011)
Environmental / Social / Economic impact assessment	2	(Qi et al. 2021); (Santamouris et al. 2020)	Systematic review	2	(Adnan et al. 2022); (Pitman et al. 2015)

Primary studies (N=17)			Reviews (N=9)		
Characteristic	Count	Reference	Characteristic	Count	Reference
Case report	2	(Dufty 2022); (Hart et al. 2011)	Scoping or other review	4	(Charlson et al. 2021); (Desai and Zhang 2021); (Vien et al. 2024); (Heaney et al. 2021)
Time-series analysis	1	(Quilty et al. 2023)			
Intervention trial	1	(Wheeler et al. 2021)			
Interviews, focus groups, surveys, workshops	7	(Hansen et al. 2011); (O'Donnell et al. 2020); (Rigby et al. 2011); (Seale et al. 2023); (McGill et al. 2024); (Varghese et al. 2020); (Longman et al. 2023)			
Randomised Controlled Trial	1	(Cowlshaw et al. 2023)			
Climate hazard*			Climate hazard*		
Any / Extreme weather events	2	(Cowlshaw et al. 2023); (Longman et al. 2023)	Any / Extreme weather events	4	(Charlson et al. 2021); (Desai and Zhang 2021); (Pitman et al. 2015); (Zhao et al. 2022)
Bushfire	3	(McGill et al. 2024); (O'Donnell et al. 2020); (Longman et al. 2023)	Bushfire	2	(Vien et al. 2024); (Heaney et al. 2021)
Air pollution	2	(Wheeler et al. 2021); (Seale et al. 2023)	Flood	0	
Flood	1	(Longman et al. 2023)	Drought	0	
Drought	3	(Hart et al. 2011); (Rigby et al. 2011); (Longman et al. 2023)	Mosquito borne disease	1	(Harley et al. 2011)
Mosquito borne disease	1	(Tomerini et al. 2011)	Heat	2	(Adnan et al. 2022); (Jay et al. 2021)
Heat and heatwaves	8	(Dufty 2022); (Hansen et al. 2011); (Chen et al. 2014); (Qi et al. 2021); (Santamouris et al. 2020); (Varghese et al. 2020); (Sadeghi et al. 2022); (Quilty et al. 2023)			

Primary studies (N=17)			Reviews (N=9)		
Characteristic	Count	Reference		Count	Reference
Types of intervention			Types of intervention		
Community-based psychosocial program	5	(Cowlshaw et al. 2023); (Hart et al. 2011); (McGill et al. 2024); (O'Donnell et al. 2020); (Rigby et al. 2011); (Longman et al. 2023)	Any intervention to mitigate / adapt to the impacts of climate change	3	(Charlson et al. 2021); (Desai and Zhang 2021); (Zhao et al. 2022)
Heat or smoke refuge	2	(Dufty 2022); (Wheeler et al. 2021)	Green infrastructure	1	(Pitman et al. 2015)
Facemasks	1	(Seale et al. 2023)	Risk communication	2	(Vien et al. 2024); (Heaney et al. 2021)
Mosquito control	1	(Tomerini et al. 2011)	Communicable Disease Control	1	(Harley et al. 2011)
Heat-health warnings / Heat protective behaviours	2	(Hansen et al. 2011); (Quilty et al. 2023)	Urban heat mitigation / adaptation	2	(Adnan et al. 2022); (Jay et al. 2021)
Urban cooling (greening / cool materials)	4	(Chen et al. 2014); (Qi et al. 2021); (Santamouris et al. 2020); (Sadeghi et al. 2022)			
Work health and safety	1	(Varghese et al. 2020)			
Health outcomes*			Health outcomes*		
Heat-related health / mortality / morbidity	8	(Dufty 2022); (Hansen et al. 2011); (Chen et al. 2014); (Qi et al. 2021); (Santamouris et al. 2020); (Varghese et al. 2020); (Sadeghi et al. 2022); (Quilty et al. 2023)	Heat-related health / mortality / morbidity	2	(Adnan et al. 2022); (Jay et al. 2021)
Mental health	5	(Cowlshaw et al. 2023); (Hart et al. 2011); (O'Donnell et al. 2020); (Rigby et al. 2011); (Longman et al. 2023)	Mental health	1	(Charlson et al. 2021)
Children's wellbeing and resilience	1	(McGill et al. 2024)	Mortality / Morbidity	2	(Desai and Zhang 2021); (Zhao et al. 2022)
Mosquito borne disease	1	(Tomerini et al. 2011)	Infectious diseases	1	(Harley et al. 2011)

Primary studies (N=17)			Reviews (N=9)		
Characteristic	Count	Reference		Count	Reference
Air pollution exposure	2	(Wheeler et al. 2021); (Seale et al. 2023)	Air pollution exposure	2	(Vien et al. 2024); (Heaney et al. 2021)
			Human / ecosystem health	1	(Pitman et al. 2015)
First Nations focus			First Nations focus		
Yes	2	(Rigby et al. 2011); (Quilty et al. 2023)	Yes	0	
Partial	1	(Longman et al. 2023)	Partial	1	(Charlson et al. 2021)
No	14	(Dufty 2022); (Hansen et al. 2011); (Chen et al. 2014); (Qi et al. 2021); (Santamouris et al. 2020); (Varghese et al. 2020); (Cowlshaw et al. 2023); (Hart et al. 2011); (O'Donnell et al. 2020); (McGill et al. 2024); (Tomerini et al. 2011); (Wheeler et al. 2021); (Seale et al. 2023); (Sadeghi et al. 2022)	No	8	(Harley et al. 2011); (Pitman et al. 2015); (Adnan et al. 2022); (Desai and Zhang 2021); (Vien et al. 2024); (Jay et al. 2021); (Zhao et al. 2022); (Heaney et al. 2021)

\*Each study could contribute to more than one category

# Appendix 9. Included primary research studies

Reference	Study type & Climate impact	Site(s) & Setting	Aim(s)	Intervention(s)	Key findings & Effectiveness
Theme 1: Health system decarbonisation					
(Breth-Petersen et al. 2023)	<u>Study type:</u> Interviews <u>Climate impact:</u> NA	<u>Site(s):</u> Four public hospitals in Western Sydney, Australia <u>Setting:</u> Hospitals	To understand anaesthetists' perspectives on the carbon footprint of anaesthesia and views on shifting towards more environmentally sustainable options.	Evidence-based clinical behaviour change techniques (BCTs) to promote sustainable practice in anaesthesia.	<u>Key findings:</u> Barriers to the wider use of greener anaesthetic agents were identified across all components of the COM-B model: capability (clinician skills and experience, uncertainty around state of the evidence); opportunity (social and professional norms, time and resource pressures); and motivational factors (personal beliefs, habitual clinical behaviour). A sense of responsibility and guilt was reported by several participants as a key motivation for selecting lower emission alternatives.  <u>Effectiveness:</u> Effective
(Charlesworth and Jamieson 2019)	<u>Study type:</u> Semi-structured, in-depth interviews <u>Climate impact:</u> NA	<u>Site(s):</u> Australia, UK, US, NZ <u>Setting:</u> Healthcare	Seek healthcare thought leaders' views about a future environmentally sustainable health system.	Potential ideas for future interventions: adopting an anticipatory approach to healthcare using predictive analytics and using the size and influence of the health sector to effect wider health and environmental benefits.	<u>Key findings:</u> Information communication technology (ICT) was identified as a 'key enabler'. Traditional 'green' initiatives will be insufficient to decarbonise health systems. An anticipatory approach using predictive analytics, adopting anchor institution strategies and using the size and influence of the health sector to effect wider societal change may be important in a low-carbon system of care.  <u>Effectiveness:</u> Not assessed

Reference	Study type & Climate impact	Site(s) & Setting	Aim(s)	Intervention(s)	Key findings & Effectiveness
(Davies et al. 2024)	<u>Study type:</u> Retrospective LCA: comparison of oral vs IV paracetamol  <u>Climate impact:</u> NA	<u>Site(s):</u> USA, UK, and Australian hospitals (10 hospitals from Australia)  <u>Setting:</u> Hospital	Estimate GHG emissions associated with intravenous (IV) and oral formulations of paracetamol used in the perioperative period.	Oral paracetamol for intravenous paracetamol in perioperative period.	<u>Key findings:</u> Intravenous paracetamol has 12-fold greater life-cycle carbon emissions than the oral tablet form. Glass vials have higher greenhouse gas emissions than plastic vials.  <u>Effectiveness:</u> Effective
(Davis et al. 2018)	<u>Study type:</u> LCA: evaluation of financial and environmental costs  <u>Climate impact:</u> NA	<u>Site(s):</u> Austin Hospital, Melbourne, Australia  <u>Setting:</u> Hospital	Evaluate and compare the environmental impact of single-use flexible ureteroscopes with reusable flexible ureteroscopes.	Single-use and re-usable ureteroscope	<u>Key findings:</u> The environmental costs of single-use and reusable flexible ureteroscopes were comparable.  <u>Effectiveness:</u> Inconclusive
(Ellis et al. 2013)	<u>Study type:</u> Cross-sectional survey  <u>Climate impact:</u> NA	<u>Site(s):</u> King Island, Tasmania  <u>Setting:</u> Healthcare general	Quantify the travel conducted by people from one rural area in Australia to access health care, and to calculate the associated carbon emissions.	Telehealth	<u>Key findings:</u> The 134.64 t CO <sub>2</sub> e associated with accessing health care (511 health care travel events) for the 12 months of the study period for the participants of King Island represents, in offsets, growing 20 trees for 30 years.  <u>Effectiveness:</u> Not assessed
(McAlister et al. 2020)	<u>Study type:</u> Prospective LCA  <u>Climate impact:</u> NA	<u>Site(s):</u> Austin Hospital and Sunshine Hospital, Melbourne	Estimate the carbon footprint of five common hospital pathology tests: full blood examination; urea and electrolyte levels; coagulation profile; C-reactive protein	Reducing unnecessary pathology tests.	<u>Key findings:</u> Opportunities to reduce the carbon footprint of pathology testing are limited. The carbon footprint of common pathology tests was dominated by those of sample collection and phlebotomy. The greatest environmental benefit can be achieved by reducing unnecessary testing.

Reference	Study type & Climate impact	Site(s) & Setting	Aim(s)	Intervention(s)	Key findings & Effectiveness
		<u>Setting:</u> Hospital	concentration; and arterial blood gases.		<u>Effectiveness:</u> Not assessed
(McAlister et al. 2022)	<u>Study type:</u> Prospective LCA <u>Climate impact:</u> NA	<u>Site(s):</u> St George Hospital, Sydney and Footscray Hospital, Melbourne <u>Setting:</u> Hospital	Estimate the carbon footprint of five common imaging modalities within an Australian public hospital setting: computerised tomography (CT), magnetic resonance imaging (MRI), ultrasound (US), chest X-ray (CXR), and mobile CXR (MCXR)	Reducing unnecessary medical imaging or ordering low-impact imaging, reducing standby of scanners, and increasing utilisation rates.	<u>Key findings:</u> Magnetic resonance imaging (MRI) and computerised tomography (CT) have large carbon footprints compared to the “traditional” imaging modalities of X-rays and ultrasound. The majority of MRI’s and CT’s large carbon footprints are due to electricity use, and in particular, their standby power use. <u>Effectiveness:</u> Not assessed
(McAlister et al. 2023)	<u>Study type:</u> Comparison of pathology billing records <u>Climate impact:</u> Carbon emission	<u>Site(s):</u> St George Hospital, Sydney <u>Setting:</u> Hospital pathology	To measure the impact of an intervention to reduce unnecessary testing on pathology collections and associated carbon emissions and pathology costs.	Policy to limit testing to Mondays and Thursdays and posters promoting the policy change (e.g. ‘Twice weekly ordering’ and ‘More is not always better’).	<u>Key findings:</u> The Division of Medicine contributes to 20% of hospital pathology activity, and if a similar 10% reduction was achieved over the whole hospital, annual savings would be approximately 1300 kg CO2e, and \$500 000. Extrapolated nationally, 16 this could lead to savings in the vicinity of 135 000 kg CO2e and \$56 million. <u>Effectiveness:</u> While other studies have shown comparable reductions of 11–12% due to interventions reducing unnecessary pathology testing, this study is the first to estimate the associated reduction in greenhouse gas emissions.
(McGain et al. 2010)	<u>Study type:</u> LCA: evaluation of financial and environmental costs	<u>Site(s):</u> Western Hospital, Melbourne, Victoria <u>Setting:</u>	To test three hypotheses: 1) single-use trays are more expensive than reusable trays, 2) the life cycle of reusable trays produces less CO2 and consumes less water than	Reusable Anaesthesia Trays	<u>Key findings:</u> The annual savings for a six-operating-theatre hospital converting from single-use to reusable plastic trays would be at least \$2500 and 70,000 litres of water, but only marginal savings in CO2 emissions. <u>Effectiveness:</u>

Reference	Study type & Climate impact	Site(s) & Setting	Aim(s)	Intervention(s)	Key findings & Effectiveness
	<u>Climate impact:</u> NA	Hospital	single-use trays, and 3) adding two cotton gauzes and a paper towel increases the financial and environmental costs.		The financial and environmental savings of a hospital converting to reusable trays are important. It seems difficult to justify persisting with single-use drug trays, particularly with added cotton gauze.
(McGain et al. 2012)	<u>Study type:</u> LCA: evaluation of financial and environmental costs  <u>Climate impact:</u> NA	<u>Site(s):</u> Western Hospital, Melbourne, Victoria  <u>Setting:</u> Hospital	To examine the life cycles of reusable and single-use central venous catheter kits used to aid the insertion of single-use, central venous catheters in operating rooms.	Reusable and single-use central venous catheter kits	<u>Key findings:</u> The reusable central venous catheter insertion kits were less expensive than were the single-use kits  <u>Effectiveness:</u> The environmental costs of the reusable kit were considerably greater than those of the single-use kit.
(McGain et al. 2017)	<u>Study type:</u> LCA: evaluation of financial and environmental costs  <u>Climate impact:</u> NA	<u>Site(s):</u> Melbourne, Victoria  <u>Setting:</u> Hospital	Define the environmental and financial consequences of five scenarios: (1) the current practice at Hospital 1 of using reusable anaesthetic circuits, face masks, 'Proseal' VR LMAs, and direct and video-laryngoscope blades and handles; (2) changing the practice at Hospital 1 to that occurring at Hospital 2 of using disposable anaesthetic circuits, and single-use face masks, LMAs, and direct laryngoscope blades, retaining reusable direct laryngoscope handles and	Reusable anaesthetic equipment	<u>Key findings:</u> For an Australian hospital with six operating rooms, converting from single-use to reusable anaesthetic equipment saved more than AUD \$30000 per annum, but increased the CO2 emissions by almost 10%. The CO2 offset is highly dependent on the power source mix, while water consumption is greater for reusable equipment.  <u>Effectiveness:</u> Reusable anaesthetic equipment saved costs, but increased CO2 emissions and water consumption.



Reference	Study type & Climate impact	Site(s) & Setting	Aim(s)	Intervention(s)	Key findings & Effectiveness
			reusable video-laryngoscopes; (3) replacing all reusable with single-use / disposable anaesthetic equipment; (4) from Scenario 1, replacing only reusable with single-use face masks; (5) from Scenario 1, replacing only reusable with single-use direct laryngoscope blades.		
(Talbot et al. 2022)	<p><u>Study type:</u> Cross-sectional survey</p> <p><u>Climate impact:</u> NA</p>	<p><u>Site(s):</u> 132 dialysis facilities within Australia and New Zealand</p> <p><u>Setting:</u> Hospital - dialysis facilities</p>	What are the current environmental sustainability practices implemented within dialysis facilities in Australia and New Zealand?	Evaluation of sustainability practices within dialysis care (environmental strategy; building infrastructure and energy use, water, waste management; transport; procurement practices; paper use; and climate change preparedness).	<p><u>Key findings:</u> Environmental sustainability practices, education, and improvements are currently not prioritized in the 132 dialysis facilities. A minority of facilities reported having an environmental sustainability strategy in place (44 of 132)</p> <p><u>Effectiveness:</u> Effectiveness of environmental sustainability practices within dialysis facilities not evaluated - just uptake. The study's revelation of limitations does indicate the evaluation of the procedure/methodology adopted by the authors. Limitations such as compromises in the design of survey, only 33% of dialysis services in Australia and New Zealand responded, responders were volunteers, and the nature of the survey limited the quantitative data collection.</p>
(Wyssusek et al. 2022)	<p><u>Study type:</u> Quality improvement reports (before &amp; after)</p>	<p><u>Site(s):</u> Department of anaesthesia and perioperative Medicine, Royal</p>	Assess and evaluate the impact of sustainability interventions on the environmental and financial cost of inhaled anaesthetic gas use, specifically focusing on reducing	Behavioural changes (raising awareness through meetings, posters, and presentations; updates on CO <sub>2</sub> reduction achievements and financial savings; use of low fresh	<p><u>Key findings:</u> (1) Quality improvement (QI) strategies in anaesthetic practices aimed to reduce carbon emissions through behavioural and system changes; (2) Behavioural changes included raising awareness of environmental impacts, promoting regional anaesthesia and Total Intravenous Anaesthesia (TIVA), and encouraging low</p>

Reference	Study type & Climate impact	Site(s) & Setting	Aim(s)	Intervention(s)	Key findings & Effectiveness
	<u>Climate impact:</u> Greenhouse gas emissions	Brisbane and Women's Hospital (RBWH) in Australia  <u>Setting:</u> Hospital	medical carbon emissions. The research aimed to guide future initiatives and research in reducing carbon emissions from healthcare practice, particularly in the context of anaesthesia	gas flows and end-tidal control) and system changes (phasing out desflurane vaporisers; upgrading intravenous pumps and anaesthetic machines; implementing automated control of anaesthetic concentrations; configuring machines to recirculate sampling gas; setting defaults for low gas with volatile anaesthetics) to reduce the environmental impact of volatile anaesthetics.	fresh gas flows; (3) System changes involved equipment upgrades, automated anaesthetic concentration control, and configuring machines for efficient gas usage; (4) Despite a slight increase in sevoflurane bottle purchases from 1191 to 1525 bottles in 2019, followed by a decrease to 1264 bottles by the end of 2021 (representing a 6.13% overall increase), the study underscored the environmental impact of volatile anaesthetics and stressed the importance of sustainable healthcare practices in reducing carbon emissions.  <u>Effectiveness:</u> Effective: Key findings included a drastic decrease in desflurane use at the Royal Brisbane and Women's Hospital, with the number of desflurane bottles decreasing significantly from 800 bottles in 2016 to 35 bottles in 2021. Additionally, the study reported a shift towards desflurane-sparing techniques, highlighting an evolution in practice towards more sustainable anaesthetic practices.

## Theme 2: Health system adaptation, vulnerability and resilience

(de Souza et al. 2023)	<u>Study type:</u> Case study  <u>Climate impact:</u> Heat	<u>Site(s):</u> Royal Darwin Hospital (RDH), Northern Territory of Australia.  <u>Setting:</u> Hospital	To outline specific efforts undertaken to create climate-resilient, culturally safe spaces for staff and patients at RDH and to examine how successful responses have been developed through a staff-led process.	H3 Project (Healthy Patients, Workforce and Environment), a phased implementation of low-cost, biophilic landscaping within the constraints of legacy campus infrastructure, funding restrictions and seasonal weather conditions.	<u>Key findings:</u> Substantial cooling impacts and improved local biodiversity, and hospital campus aesthetics. Biophilic design offers low-cost adaptation of legacy health infrastructure to climate change that promotes biodiversity, wellbeing and a relationship of reciprocal nurturing between campus users and the environment. This case study set in the harsh climatic environment of the Northern Territory provides a platform for improving cultural safety and hospital health outcomes for First Nations Australians, while promoting Indigenous knowledge and leadership in climate
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Reference	Study type & Climate impact	Site(s) & Setting	Aim(s)	Intervention(s)	Key findings & Effectiveness
					adaptation and mitigation efforts in the healthcare system.  <i>Effectiveness:</i> Effective
(Kildea et al. 2018)	<i>Study type:</i> Cohort study  <i>Climate impact:</i> Flood	<i>Site(s):</i> Major tertiary hospital in South Brisbane  <i>Setting:</i> Hospital, community	Does midwifery group practice (MGP) care, compared to standard care (SC), protect pregnant women from the mental health impact (anxiety and depression) of flood in the post-partum period?	Continuity of care through the antenatal, intrapartum, and postpartum periods from MGP to SC.	<i>Key findings:</i> Objective flood-related hardship and subjective stress increased with increasing standard care, women in the MGP (continuity) group appeared to be protected to some degree from both the objective and subjective aspects of their flood experiences.  <i>Effectiveness:</i> Effective
(Knezevic et al. 2023)	<i>Study type:</i> Exploratory-descriptive qualitative study  <i>Climate impact:</i> Bushfire, flood	<i>Site(s)</i> Illawarra Shoalhaven Local Health District, New South Wales  <i>Setting:</i> Local community centre	(1) What were the experiences and perspectives of healthcare staff who participated in the Wellness Warriors intervention? (2) What knowledge and skills did participating staff gain from the intervention?	Wellness Warriors intervention (healthcare staff training to provide emotional and peer support to colleagues in the aftermath of a disaster).	<i>Key findings:</i> Healthcare staff developed deep listening skills and the ability to connect with others and confront the core of their concerns. The intervention also strengthened the faith of the participants in their leadership.  <i>Effectiveness:</i> Effective
(Marfori et al. 2020)	<i>Study type:</i> Interviews	<i>Site(s):</i> Huon Valley region, Hobart,	(1) To understand the level of concern about the impacts of smoke on well-being. (2) To investigate	Public health messaging related to smoke during the 2019 wildfires in Tasmania, and evaluation of	<i>Key findings:</i> Social media played a crucial role in disseminating information, but diverse communication channels were needed. Concerns about timeliness and effectiveness

Reference	Study type & Climate impact	Site(s) & Setting	Aim(s)	Intervention(s)	Key findings & Effectiveness
	<u>Climate impact:</u> Wildfires	Tasmania, Australia  <u>Setting:</u> households affected by the 2019 wildfires	how information about smoke and health was received and understood. (3) To assess if public health information influenced individual actions and behaviour. (4) To determine the acceptability of using portable HEPA cleaners for managing poor indoor air quality during the wildfires.	effectiveness of HEPA cleaners to improve residential indoor air quality during extreme episodes of air pollution caused by the wildfires.	of interventions arose led to some individuals relocating before official advice. HEPA cleaners accepted to reduce personal symptoms and seek reassurance.  <u>Effectiveness:</u> Effective: HEPA cleaners were generally well-accepted by participants and perceived to be a potentially practical intervention during the 2019 wildfire incident in Tasmania.
(McLean et al. 2022)	<u>Study type:</u> Qualitative analysis  <u>Climate impact:</u> Climate change	<u>Site(s):</u> Bond University, Gold Coast, Australia  <u>Setting:</u> University (medical program)	To answer the question: Did this planetary health assignment, designed to engage teams of learners to “take action” on a pressing global issue (climate change), meet the intended outcomes?	Educational program (planetary health integrated across a five-year medical curriculum).	<u>Key findings:</u> The planetary health assignment, as part of longitudinal planetary health curriculum integration, supports students to not just be global citizens but also to be planetary citizens, developing the knowledge, skills, values, and attitudes to tackle the Code Red crisis that all of Earth’s inhabitants are facing  <u>Effectiveness:</u> Outcomes evaluated via practical implications route, but effectiveness questioned on whether it meet the intended outcomes.
(Mohtady Ali et al. 2022)	<u>Study type:</u> Case-study  <u>Climate impact:</u> Disaster resilience	<u>Site(s):</u> Gold Coast and Brisbane, Queensland  <u>Setting:</u> Hospital	How can hospital managers and decision makers improve HCWs’ disaster resilience?	Health Care Workers’ (HCWs) disaster education and training regarding disaster planning and preparedness.	<u>Key findings:</u> The ‘HCWs Resilience Toolkit’ encourages mindfulness amongst leaders, managers, and policymakers supporting four priority HCWs’ needs: wellness, education, resources, and communication.  <u>Effectiveness:</u> HCWs Resilience Toolkit proposed but not evaluated
(Nitschke et al. 2017)	<u>Study type:</u>	<u>Site(s):</u>	What is the efficacy of heat-health messages,	An information pack comprising: (1) information	<u>Key findings:</u>

Reference	Study type & Climate impact	Site(s) & Setting	Aim(s)	Intervention(s)	Key findings & Effectiveness
	Randomized Controlled Trial (RCT)  <u>Climate impact:</u> Heat	Adelaide, Australia  <u>Setting:</u> Community	based on known risk factors in South Australia, which are sent out at the beginning of summer and their health impact on older people?	sheet on how to deal with extreme heat conditions; (2) a "Top Tips Heat-Health Card"; (3) the South Australia Health Department's "Extreme Heat Booklet - a guide to coping and staying healthy in the heat"; (4) three South Australia Health advice factsheets	Little difference between intervention and control groups regarding modifying behaviours during heat, but air conditioner use, application of wet cloth to the body, and confidence in adequacy of information needed to beat the heat was significantly higher in the intervention group. Significant reduction in the incidence of heat stress in the intervention group compared to the control group.  <u>Effectiveness:</u> Effective
(Nitschke et al. 2016)	<u>Study type:</u> Ecological study (case-series)  <u>Climate impact:</u> Heat	<u>Site(s):</u> Adelaide  <u>Setting:</u> Hospital, emergency department, ambulance service	Did heat wave warning system (HWS) reduce morbidity and mortality during the study period?	HWS activated by the State Emergency Service of Adelaide, on advice by the Bureau of Meteorology	<u>Key findings:</u> Significantly lower (59%) cardiac-related call-outs, (30%) renal, and (56%) heat-related emergency presentations in 2014 compared to 2009. Mortality was not reduced in 2014.  <u>Effectiveness:</u> Effective in reducing morbidity but not mortality.
(Patrick and Capetola 2011)	<u>Study type:</u> Individual and group interviews; document evaluation  <u>Climate impact:</u> Climate change (heatwaves)	<u>Site(s):</u> Victoria  <u>Setting:</u> Healthcare	What health promotion practice in Victorian health care settings address climate change and sustainability issues?	Interventions from 5 case studies to address food, transport, heatwaves, women's health, nature, mental health, and resilience.	<u>Key findings:</u> To identify ongoing and planned health-sector lead action and initiatives to boost resilience, mitigation of and adaptation to climate change.  <u>Effectiveness:</u> Not assessed

Reference	Study type & Climate impact	Site(s) & Setting	Aim(s)	Intervention(s)	Key findings & Effectiveness
(Patrick and Kingsley 2019)	<u>Study type:</u> Survey and interviews  <u>Climate impact:</u> Climate change and environmental degradation	<u>Site(s):</u> All Australian states and territories  <u>Setting:</u> NA	(1) What health promotion and sustainability programmes exist in Australia? (2) Do ecological models guide these programmes and their evaluation approaches? (3) What are the barriers and enablers to evaluating such initiatives?	Health promotion and sustainability programmes	<u>Key findings:</u> Evaluations mostly conducted in-house by programme staff, but also by research academics and evaluation consultants. Surveys most commonly used for evaluations, followed by qualitative approaches like interviews, case studies and administering focus groups. Enablers of programme evaluation were 'interest from the community, agency, partners, team'; 'knowledge and awareness of key health and sustainability issues'; and 'programme champions'. Barriers were resource constraints' and 'competing priorities'.  <u>Effectiveness:</u> Not assessed
(van Beurden et al. 2011)	<u>Study type:</u> Survey and meetings  <u>Climate impact:</u> Climate change	<u>Site(s):</u> 16 core Sustain Northern Rivers region organisations, New South Wales  <u>Setting:</u> Regional communities	How can health promotion teams effectively establish and support regional collaborations among organizations to address climate change, facilitating the emergence of multiple strategies tailored to the specific needs of each region?	Engagement with strategies to improve transport options, food security and energy sustainability.	<u>Key findings:</u> A highly connected network of organisations emerged and rapidly evolved to collaborate for action on climate change between 2005-2009. There were significant improvements in network density, centralisation, clustering and reciprocity, with member organisations collaborating on a broad range of strategies.  <u>Effectiveness:</u> Health Promotion can play a vital role in fostering regional collaborations to enhance community resilience to impacts of climate change.
(Walker 2009)	<u>Study type:</u> Discussion paper  <u>Climate impact:</u>	<u>Site(s):</u> Victoria, Australia  <u>Setting:</u> Primary health care	Discussion of primary health care principles and how they might translate into coping, adaptation and mitigation activities within the primary health care sector based on	Storylines: (1) adaptation: rising cost of carbon; (2) climate change: rising temperature and heatwaves; (3) emergency: extreme weather event (flood); (4) mental health:	<u>Key findings:</u> Storylines can be used in community education, with health promotion workers and community members jointly developing a storyline as an early step in a community action project.  <u>Effectiveness:</u>

Reference	Study type & Climate impact	Site(s) & Setting	Aim(s)	Intervention(s)	Key findings & Effectiveness
	Climate change		predictions for climate change in Victoria.	community stress; (5) mitigation: greening health services.	Unclear: primary health care response to climate change requires very little in terms of new kinds of interventions. Rather it is a question of applying familiar interventions to a new problem.
(Williams et al. 2019)	<u>Study type:</u> Survey <u>Climate impact:</u> Heatwaves	<u>Site(s):</u> Regional (non-metropolitan) areas in South Australia and Victoria <u>Setting:</u> Households	To assess householders' perspectives and responses to heat and heat-health warnings, including their awareness, recall, and behaviours in managing extreme heat events.	Heat-health warnings and their effectiveness in promoting protective behaviours among the public in response to extreme heat events.	<u>Key findings:</u> Warnings were viewed as appropriate, but impact on behaviour varied with concerns raised about public complacency if warnings are seen as common sense. Women showed greater concern than men, and older age groups had lower risk perceptions. Continuous evaluation and tailored communication strategies were recommended to enhance effectiveness of heat-health warnings and address public health risks during heatwaves. <u>Effectiveness:</u> Inconclusive: warnings were well received, but their effectiveness in driving substantial behavioural changes was not clearly demonstrated.
(Williams et al. 2022)	<u>Study type:</u> Cost-benefit analysis (including interviews with key informants) <u>Climate impact:</u> Extreme heatwaves	<u>Site(s):</u> Adelaide, South Australia <u>Setting:</u> NA	To provide a descriptive cost-benefit evaluation for an Australian heat-health warning system (HHWS) intervention, focusing on the economic implications of the HHWS in South Australia.	The intervention measures implemented under the South Australian Heat Health Warning System (HHWS) included public heat warnings, health advisories, and targeted support for vulnerable groups during extreme heat events. The HHWS aimed to provide early warnings and advice to the public to reduce heat-related health risks and enhance preparedness for heatwaves.	<u>Key findings:</u> Estimated cost for a one-week activation of the HHWS was AU\$593,000. Compared to potential savings based on reduced healthcare utilization during extreme heat events, the benefit-cost ratio ranged from 2.0 to 3.3 (cost-effectiveness). HHWSs are crucial and cost-effective public health responses to heatwaves. <u>Effectiveness:</u> Effective: HHWS intervention was effective in reducing the health impacts of heatwaves and mitigating the associated risks.

Reference	Study type & Climate impact	Site(s) & Setting	Aim(s)	Intervention(s)	Key findings & Effectiveness
Theme 3: Health co-benefits of climate change mitigation action outside the healthcare system					
(Burgess et al. 2009)	<u>Study type:</u> Multivariate regression analysis  <u>Climate impact:</u> NA	<u>Site(s):</u> Arnhem Land, Northern Territory  <u>Setting:</u> Indigenous community	Investigate the associations between participation in caring for country and health outcomes relevant to excess Indigenous morbidity and mortality.	Six core activities in caring for country: time on country; burning of annual grasses; gathering of food and medicinal resources; ceremony; protecting sacred areas; and producing artwork.	<u>Key findings:</u> Preliminary empirical epidemiological support for: (1) the Indigenous assertion that caring for country may deliver health gains through social, cultural and behavioural pathways; and (2) Indigenous requests to conduct research on workable solutions based on social and cultural determinants of health.  <u>Effectiveness:</u> Caring for Country was associated with better nutrition, more frequent physical activity and fewer chronic disease risk factors and diagnoses.
(Haddad et al. 2020)	<u>Study type:</u> Health Impact Assessment (simulation study)  <u>Climate impact:</u> Heat	<u>Site(s):</u> Darwin, Australia  <u>Setting:</u> Municipal	What are the impacts of urban heat mitigation measures on building cooling energy needs, peak electricity demand and health?	Increased greenery, application of cooling materials on pavements and roofs, water spray system, shading, and green roofs (used individually and in combination) on urban overheating.	<u>Key findings:</u> Urban greenery reduces the annual cooling load of residential buildings by 2.6%; cool roofs and pavements by 5.8%; combination of greenery, cool roofs and pavements, and urban shading by 7.2%. Application of cool materials reduces the annual excess hospital admissions from 40.14 to 27.51; greenery reduces it to 34.67; and combining solutions reduces it to 24.49 per 100,000 population. Combination of shading, greening, and cooling materials saves 9.66 excess deaths per year per 100,000 population.  <u>Effectiveness:</u> Effective
(Ridoutt et al. 2021)	<u>Study type:</u> Survey analysis  <u>Climate impact:</u>	<u>Site(s):</u> Australia  <u>Setting:</u> Communities	Assess greenhouse gas emissions associated with Australian adult diets obtained from the Australian Health Survey, and alternative diets	Recommended diet based on the Australian dietary guidelines	<u>Key findings:</u> Dietary climate footprints averaged 3.4 kg CO <sub>2</sub> e per person per day, with total energy intake explaining around one quarter of the variation. Energy dense and nutrient-poor discretionary foods contributed around one third.



Reference	Study type & Climate impact	Site(s) & Setting	Aim(s)	Intervention(s)	Key findings & Effectiveness
	NA		consistent with the Australian dietary guidelines.		<u>Effectiveness:</u> A diet consistent with current Australian dietary guidelines had a 42% lower climate footprint.
(Schultz et al. 2018)	<u>Study type:</u> Focus groups, interviews  <u>Climate impact:</u> NA	<u>Site(s):</u> Northern Territory and Western Australia  <u>Setting:</u> 4 Indigenous communities	How Indigenous Australians in remote regions experience high levels of wellbeing despite poor health statistics, and how services could more effectively enhance both health and wellbeing?	Indigenous land management (ILM)	<u>Key findings:</u> ILM provides opportunities for promoting both individual and community health and wellbeing through empowerment, healthier behaviours, use of Indigenous languages and knowledge transmission across generations.  <u>Effectiveness:</u> Not formally evaluated, but ILM promoted wellbeing through strengthening sense of identity and relationships, empowering people, providing access to traditional foods and physical activity, limiting access to alcohol, and strengthening and promoting collaboration of community organisations.

#### Theme 4: Adaptation and resilience interventions to protect health in sectors outside the healthcare system

(Chen et al. 2014)	<u>Study type:</u> Health impact assessment (two-scale modelling approach)  <u>Climate Impact:</u> Indoor heat stress	<u>Site(s):</u> Melbourne (5 buildings facing north, east, south and west)  <u>Setting:</u> Residential buildings	Investigate the role of urban vegetation in reducing heat related mortality in the city of Melbourne, Australia.	Increase of urban vegetation in Melbourne CBD.	<u>Key findings:</u> Average seasonal summer temperatures can be reduced in the range of around 0.5 and 2°C if the city were replaced by vegetated suburbs and parklands, respectively. With the limited buildings and local meso-climates investigated in this study, around 5-28% and 37-99% reduction in heat related mortality rate have been estimated by doubling the city's vegetation.  <u>Effectiveness:</u> Not determined
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Reference	Study type & Climate impact	Site(s) & Setting	Aim(s)	Intervention(s)	Key findings & Effectiveness
(Cowlisshaw et al. 2023)	<u>Study type:</u> Randomised Controlled Trial (RTC)  <u>Climate impact:</u> Disasters (bushfires, drought)	<u>Site(s):</u> Rural or regional Victoria  <u>Setting:</u> Disaster affected regions of rural or regional Victoria	To investigate the efficacy of the Skills for Life Adjustment and Resilience (SOLAR) program delivered by trained community members to residents of disaster affected regions in Australia.	SOLAR program: a brief, trauma-informed, skills-based psychosocial programme that can be delivered by trained lay community members vs 5-week self-help programme (control).	<u>Key findings:</u> SOLAR led to significantly lower levels of anxiety and depression, and PTSD symptom severity between pre- and post-intervention, relative to the Self-Help condition, while controlling for scores at intake. These differences were not statistically different at follow-up. The SOLAR program was associated with large effect size improvements in posttraumatic stress symptoms over time.  <u>Effectiveness:</u> Moderately effective
(Dufty 2022)	<u>Study type:</u> Case study  <u>Climate impact:</u> Heat	<u>Site(s):</u> Blacktown, Sydney  <u>Setting:</u> Community	Develop a strategy for enabling Council-owned public amenities to provide refuges from extreme heat for vulnerable residents	Heat refuge strategy	<u>Key findings:</u> The interviews were part of the stakeholder engagement to craft the heat strategy.  <u>Effectiveness:</u> Not assessed
(Hansen et al. 2011)	<u>Study type:</u> Interviews, focus groups  <u>Climate Impact:</u> Heat	<u>Site(s):</u> Adelaide  <u>Setting:</u> Diverse settings	What are the stakeholders' views of factors influencing the ability of older persons to adapt to hot conditions, and what are the barriers to adaptation based on recent experience?	Heat-health warnings / Heat protective behaviours	<u>Key findings:</u> Susceptibility of older persons to heat was analysed to revolve around: (1) physiological issues;( 2) socio-economic issues; (3) psychological issues; (4) adaptive strategies. Socio-economic issues were very influential in shaping behaviours, as were concerns about power costs when using air conditioning. Publicly cooled spaces can provide a cool environment without costs concerns but can be problematic due to the lack of care facilities and transport to and from the centres in the heat.  <u>Effectiveness:</u> Not assessed

Reference	Study type & Climate impact	Site(s) & Setting	Aim(s)	Intervention(s)	Key findings & Effectiveness
(Hart et al. 2011)	<p><u>Study type:</u> Case report</p> <p><u>Climate impact:</u> Drought (but model also used for floods, fire, climate change and economic downturn)</p>	<p><u>Site(s):</u> Rural NSW (9 sites over regional NSW)</p> <p><u>Setting:</u> Community (including health, local service networks and partner agencies)</p>	To describe how the Rural Adversity Mental Health Program was introduced in 2007 to raise awareness of drought-related mental health needs and help address these needs in rural and remote NSW.	NSW Government funded Rural Adversity Mental Health Program (RAMHP), involving raising mental health literacy, organising community social events, and disseminating drought related information.	<p><u>Key findings:</u> The RAMHP was accepted in communities as a mechanism for enhancing capacity and resilience during prolonged drought. The core program, which was targeted at all communities facing prolonged drought, was readily able to be adapted to the needs of specific groups, such as older farmers, Aboriginal people, and school students. Responding effectively to the mental health implications of prolonged drought requires long-term interventions that can evolve as community needs change, including when drought breaks.</p> <p><u>Effectiveness:</u> Evaluated and effective according to authors; however, evaluation based primarily on immediate feedback rather than measuring medium-term outcomes (in part, due to planning and financial limitations imposed by annual (rather than longer-term) program funding).</p>
(Longman et al. 2023)	<p><u>Study type:</u> Online workshops.</p> <p><u>Climate impact:</u> Drought, bushfire, and floods.</p>	<p><u>Site(s):</u> Rural NSW (3 areas that experienced extreme weather-related events including drought, bushfire, and floods)</p> <p><u>Setting:</u> Rural communities</p>	What participants perceived to be effective at building resilience to the mental health impacts of climate change and the necessary components of success of community resilience building	Community activities that build resilience to the mental health and wellbeing impacts of climate change (i.e. provision of general community-led support; community-focused climate action, including inclusive and democratic resilience and adaptation planning; and collective politically-focused climate action.	<p><u>Key findings:</u> Taking action together can build social and relational capital, engender feelings of belonging and increase informal social connectedness, while simultaneously helping communities prepare for the impacts of climate change.</p> <p><u>Effectiveness:</u> Not assessed</p>

Reference	Study type & Climate impact	Site(s) & Setting	Aim(s)	Intervention(s)	Key findings & Effectiveness
(McGill et al. 2024)	<p><u>Study type:</u> Cross-sectional</p> <p><u>Climate Impact:</u> Bushfire</p>	<p><u>Site(s):</u> Rural NSW</p> <p><u>Setting:</u> Schools and pre-schools</p>	What is the impact of the Bushfire Recovery Program's psychosocial groups on children's wellbeing and resilience?	Psychological interventions supporting children's recovery from bushfires.	<p><u>Key findings:</u> High levels of endorsement by children: children learnt to talk to and trust adults, share thoughts and experiences with others, recognise they were not alone in their experiences. Parents strongly agreed that their child(ren) knew who to talk to and trusted adults and understood that changes happen in life. The facilitators' ratings were lower than that of parents.</p> <p><u>Effectiveness:</u> The programme was effective and had positive impacts on children in the areas of coping, expression of emotions, well-being, and peer connections.</p>
(O'Donnell et al. 2020)	<p><u>Study type:</u> Surveys and interviews</p> <p><u>Climate Impact:</u> 2015 Sampson Flat or Pinery bushfires</p>	<p><u>Site(s):</u> South Australia (Country South Australia Primary Health Network (CSAPHN), the Northern Health Network (NHN), and the Australian Red Cross)</p> <p><u>Setting:</u> Emergency services</p>	To describe the development and pilot testing of an internationally developed, brief, and scalable psychosocial intervention that targets distress and poor adjustment following disaster and trauma.	The Skills fOr Life Adjustment and Resilience (SOLAR) program, a skills-based intervention, deliverable by community-based or frontline health or disaster workers with little or no formal mental health training, piloted with 15 Australian bushfire survivors.	<p><u>Key findings:</u> This study provides preliminary evidence that the SOLAR program is an accessible, brief, and scalable psychosocial intervention that can be delivered by trained frontline workers, including volunteers, professional, and paraprofessional health or disaster workers. The pilot also provided preliminary evidence that SOLAR is acceptable to disaster survivors in the Australian context, with all participants who were eligible to participate completing all five sessions of SOLAR, and all who responded to open-ended questions.</p> <p><u>Effectiveness:</u> Found that after training, coaches demonstrated improvements in knowledge and confidence in delivering the intervention and were able to implement the intervention in a safe manner that was acceptable to participants, providing support for the intervention's feasibility. Limitations like lack of gender or culture influenced treatment response, lack of input on the difficulty level from the coaches and the utilisation of</p>

Reference	Study type & Climate impact	Site(s) & Setting	Aim(s)	Intervention(s)	Key findings & Effectiveness
					traditional formulae for calculation of the dRM, which can overestimate the magnitude of effects due to unequal variances.
(Qi et al. 2021)	<u>Study type:</u> Sensitivity analysis  <u>Climate Impact:</u> Heat	<u>Site(s):</u> Leppington, Sydney  <u>Setting:</u> Community	To develop a model integrating environmental, social, and economic impact assessment and sensitivity analysis, which considers multiple objectives holistically and enables the key planning and design variables for Urban heat mitigation techniques (UHMTs) to be identified.	Applicable urban heat mitigation techniques (greenery and cool materials).	<u>Key findings:</u> Change of pavement colour from black to white reduced average air temperature, land surface temperature, heat-related mortality, energy bills and productivity loss by 0.65°C, 6.38°C, 4.43%, 4.15%, and 1.27%, respectively, while it increased outdoor thermal comfort index by 0.13°C.  <u>Effectiveness:</u> This assessment model allows governments and decision makers to identify the weight of multiple objectives based on their policy goals and priorities, ensuring the high-performance UHMTs selected will meet their demands.
(Quilty et al. 2023)	<u>Study type:</u> Environmental epidemiology  <u>Climate impact:</u> Heat	<u>Site(s):</u> Northern Territory, Australia  <u>Setting:</u> Unclear	Compare non-Indigenous and Indigenous societies in a tropical environment and explore the relative importance of physiological, sociocultural, and technological and infrastructural adaptations to heat.	Physiological adaptation to heat.	<u>Key findings:</u> Improved understanding of the holistic impact of urban heat mitigation techniques (UHMTs) on context-based mitigation performance, supporting decision making related to urban heat mitigation and cooling cities and communities.  <u>Effectiveness:</u> This study suggests that social and cultural adaptations to increasing hot weather are potentially powerful mechanisms for protecting human health.
(Rigby et al. 2011)	<u>Study type:</u> Focus groups  <u>Climate Impact:</u> Drought	<u>Site(s):</u> Rural centres across NSW (6 sites over regional NSW)  <u>Setting:</u>	To report Aboriginal communities' views of how prolonged drought in rural NSW has affected their social and emotional well-being, and of possible adaptive strategies.	Consultative forums were convened across rural NSW under the NSW Health Rural Adversity Mental Health Program.	<u>Key findings:</u> The findings of the study reported that drought was affecting Aboriginal well-being in six related ways: damaging traditional culture; skewing the population profile in smaller centres; exacerbating underlying grief and trauma; undermining livelihoods and participation; aggravating socioeconomic disadvantage; and

Reference	Study type & Climate impact	Site(s) & Setting	Aim(s)	Intervention(s)	Key findings & Effectiveness
		Aboriginal Communities			<p>creating a context for behaviour that brings shame to culture.</p> <p><u>Effectiveness:</u> The limitations identified in the study offers a critical analysis. The authors of the study believed that the Senior employees from larger agencies were overrepresented while grassroots-level workers and those from smaller agencies, remote-dwelling people and Aboriginal community participants were underrepresented, limiting the generalisability of our findings.</p>
(Sadeghi et al. 2022)	<p><u>Study type:</u> Universal Thermal Comfort Index (UTCI) simulations, and Health impact assessment (HIA)</p> <p><u>Climate impact:</u> Heatwaves</p>	<p><u>Site(s):</u> Sydney Greater Metropolitan Region (GMR), across 10 weather stations.</p> <p><u>Setting:</u> Urban environment</p>	<p>To develop an exposure-response method to quantify the impact of urban greening strategies on human heat balance and predict their benefits on population health.</p> <p>Objectives: (1) predict the impact of greening adaptation strategies on urban heat in the Sydney GMR; (2) quantify cooling benefits of greening adaptation strategies on a human heat stress thermal physiology model and demonstrate their spatial variation throughout the Sydney GMR during a typical heatwave episode; (3) estimate the heat-related health impacts of adaptation strategies during a typical heatwave</p>	<p>Three urban greening infrastructure strategies aimed at mitigating urban heat in the Sydney GMR.</p>	<p><u>Key findings:</u> (1) Developed a Heat Health Impact (HHI) method using Universal Thermal Climate Index (UTCI) to assess green infrastructure benefits; (2) analysed greening scenarios' effects on urban heat and human physiology; (3) showed that urban greening reduced UTCI by up to 1.7°C, with significant cooling observed in western and coastal areas; (4) health impact up to 11.7 fewer heat-related deaths per day during heatwaves with greening interventions; (5) emphasis on integrating green infrastructure into climate strategies for urban resilience and public health protection.</p> <p><u>Effectiveness:</u> Evaluated and effective; implementation of urban greening infrastructure led to a significant reduction in heat-related mortality. Urban Cooling Effect (UCE) calculated under different greening scenarios showed a notable cooling impact on urban heat levels and human thermal physiology. However, the study was restricted to a single heatwave episode which may not capture the long-term effects of urban greening</p>

Reference	Study type & Climate impact	Site(s) & Setting	Aim(s)	Intervention(s)	Key findings & Effectiveness
(Santamou ris et al. 2020)	<u>Study type:</u> Experimental and numerical impact assessment  <u>Climate Impact:</u> Urban heat island effect (overheating)	<u>Site(s):</u> Greater Sydney area, specifically the Local Government Area of the City of Parramatta in Western Sydney, Australia  <u>Setting:</u> Urban environment	To assess the impact of regional overheating on urban sustainability and quantify potential sustainability improvements through the implementation of optimized heat mitigation technologies in the City of Parramatta, Western Sydney, Australia	Eight mitigation scenarios involving the use of reflective materials, additional greenery, irrigation to enhance evapotranspiration, and various combinations of these measures to mitigate urban overheating.	interventions on population health and heat-related mortality over different seasons or years.  <u>Key findings:</u> It found that during heatwaves, temperatures in Western Sydney, particularly in Parramatta, rise significantly compared to coastal areas. Mitigation measures such as increasing albedo, planting trees, and enhancing evapotranspiration showed promise in reducing ambient temperatures and mitigating urban heat island effects. Implementing these strategies could improve energy demand, indoor environmental quality, and decrease heat-related health issues. The research underscores the importance of sustainable urban planning to address urban overheating and enhance cities' resilience to climate change, emphasizing proactive measures to mitigate urban heat island effects and improve overall urban sustainability.  <u>Effectiveness:</u> Effective: The outcomes of the evaluation indicated that the mitigation scenarios, which included various strategies such as increasing albedo, planting additional trees, and enhancing evapotranspiration, showed promising results in reducing ambient temperatures and addressing urban heat island effects. These measures were found to have the potential to improve energy demand, indoor environmental quality, vulnerability, survivability, and heat-related mortality and morbidity in the urban environment.
(Seale et al. 2023)	<u>Study type:</u>	<u>Site(s):</u>	This study aims to utilise a qualitative approach to	Use of facemasks.	<u>Key findings:</u>

Reference	Study type & Climate impact	Site(s) & Setting	Aim(s)	Intervention(s)	Key findings & Effectiveness
	RCT of mask use based on phone interviews  <u>Climate Impact:</u> Wildfire smoke	Communities across Australia.  <u>Setting:</u> Community (residents of bushfire-prone areas)	understand the current reality around mask use and the factors influencing people to (or not to) wear a mask during bushfire events.		The interview responses and data analysis helped the authors to identify four themes: “Limited past experiences with masks for bushfires”; “My favourite strategy is avoidance”; “Relying on visual triggers for use”, “We need a kick-start to get people to use masks”.  <u>Effectiveness:</u> Not assessed
(Tomerini et al. 2011)	<u>Study type:</u> Health impact assessment based on RRV disease notification data, and survey on mosquito control  <u>Climate Impact:</u> Mosquito borne disease: Ross River Virus (RRV)	<u>Site(s):</u> 73 QLD local governments in sub-tropical coastal; tropical coastal; subtropical inland; and temperate inland regions.  <u>Setting:</u> Community	The aim of this study was to investigate the relationship between different mosquito management strategies and the incidence of RRV in 4 climatic regions in Queensland, Australia.	Different programs for mosquito borne disease mitigation.	<u>Key findings:</u> The study's findings indicated that mosquito control is an effective public health intervention to reduce mosquito-borne disease; The long-term RRV disease rates were lower in areas where the mosquito control program included pre-emptive (rather than reactive) surveillance based on an extensive (rather than incomplete) knowledge of mosquito habitats, and where treatment of both saltwater and freshwater habitats (compared to only saltwater habitats, in coastal areas) occurred.  <u>Effectiveness:</u> Mosquito control is an effective public health intervention to reduce mosquito-borne disease.
(Varghese et al. 2020)	<u>Study type:</u>	<u>Site(s):</u>	(1) Investigate the types of heat-related injuries and	Preventive measures, including a range of control	<u>Key findings:</u>



Reference	Study type & Climate impact	Site(s) & Setting	Aim(s)	Intervention(s)	Key findings & Effectiveness
	<p>Cross-sectional survey</p> <p><u>Climate impact:</u> Heat stress or hot weather</p>	<p>Nation-wide online survey (Australia)</p> <p><u>Setting:</u> Health and safety representatives</p>	<p>their associated risk factors in Australian workplaces during hot weather. (2) Describe and assess the prevention measures adopted for outdoor and indoor workers in relation to heat-related injuries. (3) Examine the existing levels of training, policies, and guidelines related to heat stress in Australian workplaces.</p>	<p>strategies such as education and training, personal protection, administrative controls, and engineering controls.</p>	<p>Despite legal requirements for safe thermal work environments, heat stress training availability is limited, with only 35% of representatives reporting its presence. Specific Work Health and Safety (WHS) legislation addressing hot weather work is lacking nationwide, highlighting the need for comprehensive prevention approaches. Barriers to prevention include worker awareness gaps, insufficient training, and organizational issues. Workplaces employ preventive measures like providing Personal Protective Equipment (PPE), sunscreen, and cool drinking water. The study underscores the importance of hot weather policies, heat stress training, and control measures to reduce heat exposure risks. Understanding workplace risk factors is essential for effective prevention strategies. The research stresses the preventable nature of heat-related illnesses and injuries, advocating for enhanced workplace safety standards, education, and resources to safeguard workers from heat stress and associated health issues.</p> <p><u>Effectiveness:</u> Inconclusive: As the study did not directly assess the impact or outcomes of the interventions against heat stress, it is inconclusive to determine the effectiveness of the interventions based on the information available in the paper.</p>
(Wheeler et al. 2021)	<p><u>Study type:</u> Intervention trial</p> <p><u>Climate Impact:</u> Extreme air pollution</p>	<p><u>Site(s):</u> Port Macquarie library in New South Wales, Australia</p> <p><u>Setting:</u> Public library</p>	<p>(1) To evaluate the potential for a public building to serve as a cleaner indoor air shelter during smoke events. (2) To assess the efficacy of installing HEPA cleaners within a smaller room inside the library area.</p>	<p>Utilizing a large public building, specifically the Port Macquarie library, as a cleaner indoor air shelter during episodes of elevated fire smoke pollution. Additionally, portable HEPA cleaners were installed in a smaller</p>	<p><u>Key findings:</u> Indoor air quality inside the library was significantly cleaner compared to outdoor air, with an average reduction of 70% in outdoor-generated PM<sub>2.5</sub> concentrations. Additionally, installing HEPA cleaners in a smaller media room within the library further reduced PM<sub>2.5</sub> levels by 17% compared to the main library.</p> <p><u>Effectiveness:</u></p>

Reference	Study type & Climate impact	Site(s) & Setting	Aim(s)	Intervention(s)	Key findings & Effectiveness
	events / bushfires			room within the library to further improve indoor air quality by reducing PM <sub>2.5</sub> concentrations.	Effective: proved effectiveness of use of public buildings as 'clean indoor air shelters' and the use of HEPA filters to improve indoor air quality during extreme smoke events. The findings suggested that operating appropriately sized HEPA cleaners in indoor spaces can lead to substantial reductions in PM <sub>2.5</sub> concentrations, providing a cleaner indoor air environment and potentially protecting public health during episodes of elevated smoke emissions.

## Appendix 10. Included reviews

Reference	Review type & Climate impact	Australian studies included & Setting	Aim(s)	Intervention(s)	Key findings & Effectiveness
MJA-Lancet Countdown					
(Zhang et al. 2018)	<p><u>Study type:</u> Perspective</p> <p><u>Climate impact:</u> Climate change impacts, exposures, and vulnerability.</p>	<p><u>Australian studies included:</u> NA</p> <p><u>Setting:</u> Not defined</p>	Understanding of and suite of health and wellbeing-related responses to the impacts of climate.	Climate change health mitigation and adaptation indicators	<p><u>Key findings:</u> Australia is vulnerable to the impacts of climate change on health, and policy inaction in this regard threatens Australian lives.</p> <p><u>Effectiveness:</u> Not assessed</p>
(Beggs et al. 2019)	<p><u>Study type:</u> Perspective</p> <p><u>Climate impact:</u> Wildfire, heatwaves, and flood</p>	<p><u>Australian studies included:</u> NA</p> <p><u>Setting:</u> NA</p>	The report aims to assess the impacts of climate change on Australian health and also evaluate the inaction policies. Covers 31 indicators divided into five broad sections: climate change impacts, exposures and vulnerability; adaptation, planning and resilience for health; mitigation actions and health co-benefits; finance and economics; and public and political engagement	Climate change health mitigation and adaptation indicators	<p><u>Key findings:</u> The report tracks progress on health and climate change in Australia across 31 indicators divided into five broad domains: (1) climate change impacts, exposures and vulnerability; (2) adaptation, planning and resilience for health; (3) mitigation actions and health co-benefits; (4) finance and economics; and (5) public and political engagement.</p> <p><u>Effectiveness:</u> Not assessed</p>

Reference	Review type & Climate impact	Australian studies included & Setting	Aim(s)	Intervention(s)	Key findings & Effectiveness
(Zhang et al. 2020)	<p><u>Study type:</u> Perspective</p> <p><u>Climate impact:</u> Heatwaves, bushfire, air pollution (airborne particulates); extreme events (e.g., flooding, cyclones, hail, tornadoes) are included.</p>	<p><u>Australian studies included:</u> Not specified</p> <p><u>Setting:</u> NA</p>	The report focuses on the Australia's 2019-20 Black Summer and evaluates bushfire adaptation strategies to better equip the communities for future instances. Focused on flooding.	Climate change health mitigation and adaptation indicators	<p><u>Key findings:</u> Substantial increases in both fire risk and population exposure to bushfires are having an impact on Australia's health and economy. As a result of the "Black Summer" bushfires, the monthly airborne particulate matter (PM<sub>2.5</sub>) concentrations in NSW and the ACT in December 2019 were the highest of any month in any state or territory over the period 2000–2019 at 26.0 µg/m<sup>3</sup> and 71.6 µg/m<sup>3</sup> respectively, and insured economic losses were \$2.2 billion. In addition, the study found a 50% increase in scientific publications and a doubling of newspaper articles on the topic in Australia in 2019 compared with 2018.</p> <p><u>Effectiveness:</u> Not assessed</p>
(Beggs et al. 2021)	<p><u>Study type:</u> Perspective</p> <p><u>Climate impact:</u> Heat, bushfires, and other indicators</p>	<p><u>Australian studies included:</u> Not specified</p> <p><u>Setting:</u> NA</p>	The report provides an update on the full suite of indicators and highlights two new indicators: "Heat impact on physical and sporting activities", and Bushfire adaptation" to better equip the communities for future instances.	Climate change health mitigation and adaptation indicators	<p><u>Key findings:</u> The collaboration tracks the links between public health and climate change across about 40 indicators in five domains: (1) climate change impacts, exposures and vulnerability; (2) adaptation, planning and resilience for health; (3) mitigation actions and health co-benefits; (4) economics and finance; and (5) public and political engagement.</p> <p><u>Effectiveness:</u> Not assessed</p>
(Beggs et al. 2022)	<p><u>Study type:</u> Perspective</p> <p><u>Climate impact:</u> Wildfire, heatwave,</p>	<p><u>Australian studies included:</u> Not specified</p> <p><u>Setting:</u></p>	Track progress on an extensive suite of indicators.	Climate change health mitigation and adaptation indicators	<p><u>Key findings:</u> We track progress on an extensive suite of indicators across these five domains, accessing, assessing and presenting the latest data and further refining and developing our analyses. The study tracks progress in various domains related to health and climate change, including (1) climate change impacts,</p>

Reference	Review type & Climate impact	Australian studies included & Setting	Aim(s)	Intervention(s)	Key findings & Effectiveness
	bushfires, rising sea level, and carbon emissions	National focus or NA			exposures, and vulnerability; (2) adaptation, planning, and resilience for health; (3) mitigation actions and health co-benefits; (4) economics and finance; (5) and public and political engagement.  <u>Effectiveness:</u> Not assessed
(Beggs et al. 2024)	<u>Study type:</u> Perspective <u>Climate impact:</u> Bushfire, drought, heatwaves	<u>Australian studies included:</u> Not specified <u>Setting:</u> National focus or NA	The report aims to assess the sustainability requirements needed in Australia's health care sector.	Climate change health mitigation and adaptation indicators	<u>Key findings:</u> We track progress on an extensive suite of indicators across these five domains, accessing, assessing and presenting the latest data and further refining and developing our analyses.  <u>Effectiveness:</u> Not assessed
Theme 1: Health system decarbonisation					
(Duindam 2022)	<u>Study type:</u> Narrative review <u>Climate impact:</u> Greenhouse gas emissions	<u>Australian studies included:</u> Not specified <u>Setting:</u> Healthcare clinics	Identify progress on healthcare clinics' engagement and contribution to the wider sustainability agenda through decarbonising their activities. Review the most important factors identified in the literature to decarbonising healthcare clinics. Produce a practical, evidenced based guide or set of recommendations for healthcare clinics to assist with transitioning their businesses.	Decarbonising healthcare interventions	<u>Key findings:</u> The common themes that emerged on what healthcare clinics can focus on to reduce their emissions footprint most efficiently are: energy, waste, behaviours/attitudes, and procurement/supply chain.  <u>Effectiveness:</u> Inconclusive

Reference	Review type & Climate impact	Australian studies included & Setting	Aim(s)	Intervention(s)	Key findings & Effectiveness
(Liu et al. 2023)	<u>Study type:</u> Narrative review  <u>Climate impact:</u> Greenhouse gas, nitrous oxide	<u>Australian studies included:</u> Not specified  <u>Setting:</u> Hospital, emergency services, primary care, anaesthesia / analgesia	How do different prevention strategies aimed at mitigating the effects of nitrous oxide contribute to improving environmental quality and public health?	Nitrous oxide waste gas capture, destruction, oxidation, reducing use, legislation to minimize residual gas in cylinders, education, and awareness programs.	<u>Key findings:</u> In Australia, nitrous oxide is widely used in birthing suites, paediatric and adult operating theatres, and emergency departments, as well as dental, skin care, and veterinary clinics. However, minimal data are available on total nitrous oxide emissions from anaesthesia practices in Australia.  <u>Effectiveness:</u> Evaluated and effective, as the review provides opportunities to reduce nitrous oxide emissions, mainly by waste destruction, nitrous oxide gap minimization, use reduction, and raising awareness.
(McGain and Naylor 2014)	<u>Study type:</u> Systematic review  <u>Climate impact:</u> Hospital design; energy; water; travel; procured goods; waste; staff behaviour	<u>Australian studies included:</u> Not specified  <u>Setting:</u> Hospitals	What hospital environmental sustainability has been studied?	Interventions to mitigate the environmental impacts of hospital care	<u>Key findings:</u> There remain significant gaps in the evidence base on hospital sustainability.  <u>Effectiveness:</u> Not assessed
(Pencheon et al. 2009)	<u>Study type:</u> Narrative review  <u>Climate impact:</u> NA	<u>Australian studies included:</u> Not specified  <u>Setting:</u>	(1) to explore the role of the healthcare sector, particularly health professionals and organizations, in responding to the challenges posed by	(1) Energy efficient upgrades (energy and water-efficient infrastructure); (2) promotion of active transport (transport access guides for cycling paths,	<u>Key findings:</u> While the study discusses the significance of addressing climate change as a global health threat, it does not provide detailed outcome measures or evaluations of the effectiveness of the interventions discussed. Overall, the review advocates for proactive measures to combat climate change,

Reference	Review type & Climate impact	Australian studies included & Setting	Aim(s)	Intervention(s)	Key findings & Effectiveness
		Healthcare sector	climate change; (2) to discuss the need for changes in current practices to reduce carbon emissions within the healthcare sector, drawing examples from the National Health Service (NHS) in the United Kingdom and area health services (AHSs) in New South Wales, Australia; and (3) to understand how the healthcare sector can contribute to mitigating climate change and promoting sustainability through strategic approaches and initiatives.	walking routes from rail stations, bus stop locations, and bus frequencies).	<p>reduce carbon footprints, and safeguard the health and well-being of populations in the face of environmental challenges.</p> <p><u>Effectiveness:</u> Inconclusive: There is no explicit mention of an evaluation of the effectiveness of the interventions discussed. The focus is on highlighting the response of the healthcare sector to climate change, efforts to reduce carbon emissions, and initiatives to promote sustainability within healthcare facilities. While the review emphasizes the importance of taking action to address the health risks associated with climate change, it does not provide specific details on the evaluation of the effectiveness of the interventions.</p>
(Wyssusek et al. 2019)	<p><u>Study type:</u> Narrative review</p> <p><u>Climate impact:</u> NA</p>	<p><u>Australian studies included:</u> 84</p> <p><u>Setting:</u> Hospitals operating theatres</p>	(1) quantify and qualify current operating room (OR) waste; (2) understand existing practices of waste segregation in ORs in Australia, and how these compare with international practices; (3) investigate best practices in waste management initiatives; (4) understand the financial implication of these initiatives; and (5) determine potential barriers to greening initiatives and	Different environmental initiatives (interventions) and economic evaluations, for example: energy saving interventions and reprocessing of single use devices, a Lean Six Sigma methodology, Green Operating Room Committee, switching to reusable sharps containers (and many more).	<p><u>Key findings:</u> The findings of the study detail the composition of healthcare waste, current and leading OR waste management practices, financial benefits and implication of such strategies and the barriers preventing the implementation of healthcare waste management initiatives. The study believes that the success of an intervention is determined by its benefit to the healthcare system and sustainability over time.</p> <p><u>Effectiveness:</u> Effective in terms of economics (e.g., amount saved per year), exemplified with combination of energy saving interventions and reprocessing of single use</p>

Reference	Review type & Climate impact	Australian studies included & Setting	Aim(s)	Intervention(s)	Key findings & Effectiveness
			how these can be improved.		devices could save \$US 5 billion over 5 years. Less emphasis on climate related assessment.
Theme 2: Health system adaptation, vulnerability and resilience					
(Blashki et al. 2011)	<p><u>Study type:</u> Narrative review</p> <p><u>Climate impact:</u> Heatwaves, fire risk, infectious diseases, poor air quality, and the mental health impacts</p>	<p><u>Australian studies included:</u> Not specified</p> <p><u>Setting:</u> Health system</p>	The aim was to focus on the responses of the Australian health system to health risks from climate change, and in particular how best to prepare health services for predicted health risks from heat waves, bushfires, infectious diseases, diminished air quality, and the mental health impacts of climate change.	Principles of health system responses to climate change.	<p><u>Key findings:</u> Preparing the health system for climate change requires investment in personnel, infrastructure, and coordination. This needs to be done even in the context of uncertainty about the extent and nature of specific climate change effects on health. Key characteristics of a climate change–prepared health system are flexibility, robustness, and strategically allocated resources. Long term planning will require close collaboration with the non-health sectors as part of a nationwide adaptive response.</p> <p><u>Effectiveness:</u> Not assessed</p>
(Crandon et al. 2022)	<p><u>Study type:</u> Narrative review</p> <p><u>Climate impact:</u> Climate change</p>	<p><u>Australian studies included:</u> 0 - 4</p> <p><u>Setting:</u> Not specified</p>	To provide an overview of the current evidence to inform the mental health field's response to climate change and recovery.	<p>Community psychological resilience:</p> <ol style="list-style-type: none"> <li>1. Community preparedness and response</li> <li>2. Sustainable change and advocacy</li> <li>3. Education and awareness</li> </ol>	<p><u>Key findings:</u> Highlights the prevalence and determinants of mental health issues associated with climate change, climate anxiety in children and adolescents, and the use of psychotropic drugs in relation to heat-related hospitalization risks. Vulnerable populations, such as those with psychosis, dementia, or substance misuse, are particularly susceptible to temperature-related deaths. Emphasis on the importance of psychological resilience and community coping strategies to address climate-related mental health impacts effectively. It underscores the complex interplay between climate change and mental health, urging targeted interventions and expanded research efforts to mitigate these challenges.</p>



Reference	Review type & Climate impact	Australian studies included & Setting	Aim(s)	Intervention(s)	Key findings & Effectiveness
					<u>Effectiveness:</u> Unclear: narration of how climate change might affect mental health.
(Hu et al. 2022)	<u>Study type:</u> Systematic review  <u>Climate impact:</u> Heat, dust storms, forest fires	<u>Australian studies included:</u> 4  <u>Setting:</u> Not specified	(1) To systematically evaluate the epidemiological evidence on climate change adaptation measures for asthmatic children; (2) understand current knowledge gaps; and (3) propose future research directions in this field.	Vulnerability assessment.	<u>Key findings:</u> A non-significant trend towards a positive association was observed between forest fires and childhood asthma; (2) Dust storms were associated with increased asthma emergency room visits in children aged ≤ 5 years; (3) male children and children aged 0-4 and 5–9 years had more emergency room visits during periods of extreme heat.  <u>Effectiveness:</u> Not assessed
(Lokmic-Tomkins et al. 2023)	<u>Study type:</u> Narrative review  <u>Climate impact:</u> Bushfire, flood	<u>Australian studies included:</u> None (but studies from Australia mentioned in narrative synthesis)  <u>Setting:</u> Not specified	To examine Digital Health Technologies (DHTs), their advantages and liabilities DHTs confer in the likelihood of climate-related disasters, their prior planning requirements, infrastructural requirements, and vulnerabilities in delivering effective care to the affected populations.	DHTs for supporting healthcare to populations affected by disaster.	<u>Key findings:</u> During the Australian bushfires, emergency evacuation instructions sent via digital messaging were effective, but electronic health records (EHTs) were underutilised. During 2022 floods, the Australian EHTs served residents in flood-affected areas in areas such as telehealth appointments, and e-prescribing.  <u>Effectiveness:</u> Inconclusive: the perceptions of affected community members of DHT effectiveness is yet to be assessed; requirements for optimization of quality healthcare delivery have also not been assessed.
(Palinkas et al. 2020)	<u>Study type:</u> Narrative review  <u>Climate impact:</u>	<u>Australian studies included:</u> Not specified  <u>Setting:</u>	Describe the types and characteristics of mental health services and interventions for the prevention and treatment of mental and behavioural	(1) Universal and selective interventions; (2) indicated interventions; (3) treatment interventions.	<u>Key findings:</u> Some of the mental health impacts and services employed in response to these impacts will cut across acute and extreme events, subacute events, and events which permanently alter the physical environment. Some interventions are specific to each

Reference	Review type & Climate impact	Australian studies included & Setting	Aim(s)	Intervention(s)	Key findings & Effectiveness
	Extreme weather (hurricanes, floods, droughts, wildfires, heatwaves)	Not specified	health problems associated with climate change events.		<p>type of event. The services which currently target acute and extreme weather events will likely be effective in responding to the mental health consequences of longer duration events.</p> <p><u>Effectiveness:</u> Not assessed</p>
(Vu et al. 2019)	<p><u>Study type:</u> Systematic review</p> <p><u>Climate impact:</u> Heatwaves</p>	<p><u>Australian studies included:</u> 7</p> <p><u>Setting:</u> Community frontline healthcare services, primary care, and community organizations</p>	To identify current measures in mitigating the adverse effects of extreme heat events in older populations. Specifically, to examine older people's perceptions and behaviours against existing heatwave prevention measures, categorize and analyse those measures using the Ottawa Charter for Health Promotion framework, and highlight gaps in existing heat action plans. The study also aimed to establish the need for a more coordinated approach to address the potential public health dilemma posed by extreme heat events affecting older populations.	Heat Action Plans (HAPs) to mitigate the adverse effects of extreme heat events on older populations (raise awareness, improve vulnerability perception, and promote protective behaviours).	<p><u>Key findings:</u> (1) Older adults were aware of heat risks but often did not perceive themselves as vulnerable; (2) HAPs have reduced mortality and improved behaviours, but confusion remains about specific actions during heatwaves, and causal relationships with outcomes are unclear; (3) more proactive support from healthcare and community personnel is needed to prevent heat-related illnesses among older individuals, enhanced social support and community-based approaches can strengthen resilience; (4) ongoing efforts are essential to improve heat health prevention, better evaluation of HAPs, improved stakeholder coordination, and further research to assess intervention impacts on health outcomes.</p> <p><u>Effectiveness:</u> Inconclusive: HAPs successful in reducing mortality and morbidity rates and improving adaptive behaviours among older populations; however, lack of clear causal relationships between individual components of HAPs and specific health outcomes suggests that further research and refinement in methodology are needed to determine the true effectiveness of these interventions.</p>

Reference	Review type & Climate impact	Australian studies included & Setting	Aim(s)	Intervention(s)	Key findings & Effectiveness
(Walker et al. 2011)	<p><u>Study type:</u> Systematic review</p> <p><u>Climate impact:</u> Environmental disasters (droughts, storms, and floods); other hazards (heat, water &amp; air pollution, vector-borne and food-borne infectious diseases).</p>	<p><u>Australian studies included:</u> Not specified</p> <p><u>Setting:</u> Not specified</p>	To explore the literature where key concepts in primary health care and health promotion are applied to the issue of climate change. The study discussed health promotion principles and intervention strategies for addressing climate change mitigation and adaptation within the primary health care sector.	Health communication, community building, and settings approaches (examples drawn from literature on community resilience and summer heat).	<p><u>Key findings:</u> (1) Climate change disproportionately affects vulnerable groups such as low-income individuals, the elderly, Indigenous Australians, and those in poor-quality housing; (2) interventions should promote health equity, climate stabilization, and poverty eradication while addressing specific needs of vulnerable populations; (3) multi-level interventions targeting individuals, households, populations, and communities are essential for greater impact; (4) advocacy actions are crucial for promoting policy changes and community initiatives to address climate change.</p> <p><u>Effectiveness:</u> Inconclusive: no explicit mention of evaluation of the effectiveness of the intervention measures.</p>
(Walter et al. 2024)	<p><u>Study type:</u> Integrative review</p> <p><u>Climate impact:</u> Extreme weather events</p>	<p><u>Australian studies included:</u> Not specified</p> <p><u>Setting:</u> Not specified</p>	To provide insights into approaches for addressing Climate Change Adaptation (CCA) in the context of public health in Australia. Objectives: (1) to conduct an integrative review to capture a comprehensive understanding of tools, frameworks, guidance material, or methods relevant to CCA and appropriate for preventative public health measures; and (2) to	Tools, frameworks, and guidance material suitable for CCA	<p><u>Key findings:</u> Australia is not adequately prepared to manage the adverse health impacts of climate change, putting the population at risk. The review identified a lack of effective adaptation strategies in Australia and underscored the urgent need for proactive measures to address the complex health risks associated with climate change. It recommended undertaking a National Adaptation Plan process, improving understanding of managing health risks, and strengthening the public health system to build health resilience, particularly for vulnerable populations.</p>

Reference	Review type & Climate impact	Australian studies included & Setting	Aim(s)	Intervention(s)	Key findings & Effectiveness
			explore key themes that can assist in bridging knowledge-action gaps in the context of Australian CCA for public health.		<u>Effectiveness:</u> Inconclusive: no specific evaluation of the effectiveness of any intervention or adaptation measure.
(Xu et al. 2023)	<u>Study type:</u> Scoping review  <u>Climate impact:</u> Heatwaves, wildfires, and droughts.	<u>Australian studies included:</u> Not specified  <u>Setting:</u> Not specified	To illustrate spatiotemporal patterns of selected climate-related environmental extremes across Australia during the past two decades and summarise climate adaptation measures and actions that have been taken by the national, state/territory, and local governments.	Adaptations to heat, bushfires, floods and drought; adaptation to climate-sensitive infectious diseases; adaptation to the impacts of climate change on Indigenous health.	<u>Key findings:</u> Significant impacts of climate-related environmental extremes on the health and well-being of Australians.  <u>Effectiveness:</u> Not assessed
(Zurynski et al. 2024)	<u>Study type:</u> Systematic review  <u>Climate impact:</u> Hurricanes, wildfires, floods	<u>Australian studies included:</u> 7  <u>Setting:</u> Not specified	To answer what are the health workforce impacts of climate-related events; and how are health systems preparing their workforces to respond to climate change impacts.	Responses to climate change-related events and preparations suggested to ensure the workforce is readily equipped for such events.	<u>Key findings:</u> Four impact themes were identified: (1) absenteeism; (2) psychological impacts; (3) system breakdown, and (4) unsafe working conditions. Six responses and preparations themes: (1) training/skill development; (2) workforce capacity planning; (3) interdisciplinary collaboration; (4) role flexibility; (5) role incentivisation, and (6) psychological support.  <u>Effectiveness:</u> Effective
Theme 3: Health co-benefits of climate change mitigation action outside the healthcare system					
(Delany-Crowe et al. 2019)	<u>Study type:</u> Review (document analysis)	<u>Australian studies included:</u>	To analyse the policy landscape in Australia.	Water management.	<u>Key findings:</u> A lack of comprehensive frameworks to address all drivers of climate change, and weaknesses in the management of waterways and marine ecosystems,

Reference	Review type & Climate impact	Australian studies included & Setting	Aim(s)	Intervention(s)	Key findings & Effectiveness
	<u>Climate impact:</u> Drought	178 strategic policies and Acts.  <u>Setting:</u> Not specified			still pose serious risks to the future of the natural environment and human well-being. Australian environmental risks were compounded by weak national leadership.  <u>Effectiveness:</u> Not assessed
(Giles-Corti et al. 2010)	<u>Study type:</u> Mini review  <u>Climate impact:</u> Any	<u>Australian studies included:</u> Not specified  <u>Setting:</u> NA	(1) What are the health benefits and co-benefits of investing in active transportation; (2) how do different policy options which aim to create healthy, socially, and environmentally sustainable communities compare.	Active transportation.	<u>Key findings:</u> Active transportation was associated with: (1) reduced premature mortality, improved respiratory health, reduced cardiovascular disease, obesity, and diabetes; (2) safer neighbourhoods, and reduction in public nuisance and crime, and marginalisation of vulnerable subgroups; and (3) reduction in traffic congestion and greenhouse gases emissions.  <u>Effectiveness:</u> Not assessed
(Willand et al. 2015)	<u>Study type:</u> Realist review  <u>Climate impact:</u> Indoor heat stress	<u>Australian studies included:</u> 2  <u>Setting:</u> Housing	To explain the impacts of residential energy efficiency interventions on householder health, focusing on exploring pathways through which energy efficiency measures influence health outcomes, including cardiovascular, respiratory, mental, and social health; and to identify mediating factors, contextual issues, and the dynamic nature of outcomes related to energy	Housing interventions for warmth and energy efficiency, including thermal retrofits, upgrades, and comprehensive refurbishments to create warmer and drier living environments.	<u>Key findings:</u> Interventions improving warmth and reducing humidity in winter were linked to benefits for cardiovascular and respiratory health. Positive effects on mental and social well-being were noted, often independent of energy cost savings, due to the enriched meaning of a comfortable home. While evidence of negative health impacts from inadequate ventilation was uncommon, it remains a concern that should not be overlooked. Ensuring warm homes during winter was identified as a critical factor for improving physiological, psychological, and social health outcomes.

Reference	Review type & Climate impact	Australian studies included & Setting	Aim(s)	Intervention(s)	Key findings & Effectiveness
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efficiency improvements in households.

**Effectiveness:**  
Mixed: effectiveness evaluated based on various factors and while the interventions showed positive impacts, challenges in establishing clear associations between intervention categories and outcomes across the programs remain.

Theme 4: Adaptation and resilience interventions to protect health in sectors outside the healthcare system

(Adnan et al. 2022)	<p><u>Study type:</u> Systematic review</p> <p><u>Climate impact:</u> Heat</p>	<p><u>Australian studies included:</u> 107</p> <p><u>Setting:</u> Urban</p>	To provide a systematic and overarching review of the different components of heatwave vulnerability (e.g., exposure, sensitivity, and adaptive capacity) in Australia.	Urban heat exposure assessments, mitigation strategies, heat adaptation measures.	<p><b>Key findings:</b> Green infrastructures are regarded as a sustainable intervention in mitigating heatwave impacts due to their multifaceted benefits. Extreme temperature impacts in various Australian cities can be reduced by adopting water sensitive urban design; the use of high albedo surface areas (as well as reflective and radiative cooling materials), when used at the local (building construction) scale, can increase the reflectance of solar radiation, and mitigate any potential heating effects. In terms of heat adaptation, thermal comfort-based urban planning can enhance heat adaptation. High temperature warning systems have already proven to be efficient in limiting occupational injuries in various Australian cities.</p> <p><b>Effectiveness:</b> Not assessed</p>
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(Charlson et al. 2021)	<p><u>Study type:</u> Scoping review</p> <p><u>Climate impact:</u> Heat, humidity,</p>	<p><u>Australian studies included:</u> 34</p> <p><u>Setting:</u> Any</p>	To assess the available literature related to climate change and mental health across the World Health Organisation's five global research priorities for protecting human health from climate change.	Any Interventions to mitigate/adapt to climate change.	<p><b>Key findings:</b> (1) A community development model, incorporating elements of health promotion, education, and early intervention, was accepted and considered effective in helping rural communities build capacity and resilience in the face of chronic drought-related hardship, but did not measure the intervention's impact on the mental health status of participants; (2)</p>
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Reference	Review type & Climate impact	Australian studies included & Setting	Aim(s)	Intervention(s)	Key findings & Effectiveness
	rainfall, drought, wildfires, and floods				<p>90% of rural health service managers perceived climate change as likely to impact mental health and highlighted the important role of rural health services in education and advocacy on climate change's health impacts; (3) community gardens improved social connectedness and mental and physical health.</p> <p><u>Effectiveness:</u> Inconclusive</p>
(Desai and Zhang 2021)	<p><u>Study type:</u> Scoping review</p> <p><u>Climate impact:</u> Floods, hurricanes, heat waves, droughts, poor air quality, water salinity, heavy snowfall, blizzards</p>	<p><u>Australian studies included:</u> 3</p> <p><u>Setting:</u> Any</p>	To better understand climate change and women's health to support the development and implementation of climate change strategies and actions.	Strategies to enhance local adaptive capacity to climate change, with more input from women's perspectives regarding management at household levels, Government assistance to women living in areas prone to extreme climatic effects, such as droughts.	<p><u>Key findings:</u> Women are more negatively affected by droughts and heat waves due to their roles in society and nutritional and physiological requirements during periods of menstruation and pregnancy. Pregnant women are physically more vulnerable because of immune system changes due to hormonal alterations and are also sensitive to changes in temperatures. They are also more susceptible to infectious diseases and poor pregnancy outcomes.</p> <p><u>Effectiveness:</u> Effective</p>

Reference	Review type & Climate impact	Australian studies included & Setting	Aim(s)	Intervention(s)	Key findings & Effectiveness
(Heaney et al. 2021)	<p><u>Study type:</u> Scoping review</p> <p><u>Climate impact:</u> Bushfire smoke</p>	<p><u>Australian studies included:</u> 20</p> <p><u>Setting:</u> Community (urban, rural and remote)</p>	To assess the evidence regarding optimal public communication strategies used in smoke-related disaster scenarios to inform the public health and emergency services on the best practices to connect with and empower populations to avoid exposure to bushfire smoke.	Communication techniques utilised to disseminate health warnings to at-risk subgroups and the general population during bushfires and other natural disasters.	<p><u>Key findings:</u> Social media, television, and radio are among the most common information sources utilised in bushfire smoke events. Message style, content, and method of delivery can directly influence message uptake and behaviour modification. Age, rurality, and geographical location influence information source preferences.</p> <p><u>Effectiveness:</u> Not assessed</p>
(Harley et al. 2011)	<p><u>Study type:</u> Narrative review</p> <p><u>Climate impact:</u> Mosquito borne disease</p>	<p><u>Australian studies included:</u> Not specified</p> <p><u>Setting:</u> Population health</p>	Current situation and potential future climate change impacts on respiratory, diarrheal, and vector-borne diseases in Australia.	Health promotion and education, surveillance, early warning systems.	<p><u>Key findings:</u> Decreased influenza and rotavirus incidence, but incidence of Salmonella was projected to increase in Australia. The significance of climate change effects on vector-borne diseases was disputed.</p> <p><u>Effectiveness:</u> Not assessed</p>



Reference	Review type & Climate impact	Australian studies included & Setting	Aim(s)	Intervention(s)	Key findings & Effectiveness
(Jay et al. 2021)	<p><u>Study type:</u> Narrative review</p> <p><u>Climate impact:</u> Heat</p>	<p><u>Australian studies included:</u> Not specified</p> <p><u>Setting:</u> Global community</p>	To describe how a future reliance on air conditioning is unsustainable and further marginalises the communities most vulnerable to the heat and show that a more holistic understanding of the thermal environment at the landscape and urban, building, and individual scales supports the identification of numerous sustainable opportunities to keep people cooler.	Heat reduction strategies (from personal cooling strategies to green cities).	<p><u>Key findings:</u> (1) Evidence-based cooling strategies during heat extremes and hot weather are urgently needed to cope with the health risks associated with the inevitable trajectory of climate change; (2) air conditioning is set to become the most widely adopted heat reduction strategy worldwide, yet it is unaffordable for many of the most vulnerable, financially and environmentally costly, and leaves many defenceless from extreme heat during power outages; (3) strategies at the landscape and urban (e.g., blue and green spaces) and building (e.g., changing materials and natural ventilation) levels can greatly augment society's adaptive capacity to heat extremes and hot weather; (4) effective cooling solutions can be adopted at the individual level, even in low-resource settings, which are more sustainable than air conditioning, and focus on cooling the person to relieve physiological heat strain, as opposed to cooling the surrounding environment; (5) heat action plans that are robust, evidence-based, well communicated, and informed by real-time surveillance provide optimal health protection.</p> <p><u>Effectiveness:</u> Urban ventilation pathways are especially effective when combined with blue and green infrastructure. Effectiveness of natural cross ventilation is dependent on orientation and window locations. Parks with elevated shading canopies are more effective urban climate moderators than unshaded grass-covered terrain. Self-dousing is effective up to at least 47°C. Reflective pavements and wall coatings are less effective due to the reflected solar radiation absorbed by buildings and pedestrians.</p>

Reference	Review type & Climate impact	Australian studies included & Setting	Aim(s)	Intervention(s)	Key findings & Effectiveness
(Pitman et al. 2015)	<p><u>Study type:</u> Systematic review</p> <p><u>Climate impact:</u> Urban heat island effect (temperature); extreme weather events (floods, storms, extreme winds, and rainfall); climate change impacts on air quality and biodiversity.</p>	<p><u>Australian studies included:</u> Not specified</p> <p><u>Setting:</u> Urban environments and communities</p>	To explore the role of Green Infrastructure in delivering multiple environmental, social, and economic values and services to urban communities.	Green Infrastructure: strategic planning and implementation of green spaces and water systems within cities to provide multiple benefits, such as temperature reduction, improved air quality, enhanced biodiversity, and better water management.	<p><u>Key findings:</u> By implementing strategic intervention measures and leveraging the benefits of Green Infrastructure, cities can better adapt to climate change challenges and create more sustainable and liveable environments for both humans and wildlife.</p> <p><u>Effectiveness:</u> Inconclusive: no explicit mention of evaluation of effectiveness of Green Infrastructure. While the study emphasizes the benefits of Green Infrastructure, it primarily focuses on highlighting the advantages of Green Infrastructure rather than presenting a specific evaluation of its effectiveness.</p>
(Vien et al. 2024)	<p><u>Study type:</u> Scoping review</p> <p><u>Climate impact:</u> Wildfire / bushfire</p>	<p><u>Australian studies included:</u> 6</p> <p><u>Setting:</u> Not specified</p>	To identify: (1) relevant peer-reviewed studies about wildfire smoke risk communications, including communication resources for vulnerable, at-risk populations; (2) characteristics of effective communications, dissemination strategies, and gaps in the peer-reviewed literature; and (3) recommendations to improve wildfire smoke	Wildfire/bushfire smoke risk communications (communications materials, dissemination strategies, behaviour change, and communications for vulnerable audience)	<p><u>Key findings:</u> Limited studies describing behaviour change to reduce wildfire smoke exposure, characteristics of effective communication materials and messaging, and communication delivery strategies. Literature on risk communications, dissemination, and behaviour change for vulnerable populations was even more limited.</p> <p><u>Effectiveness:</u> Inconclusive: many articles included some assessment of effectiveness of risk communications, but more work is needed.</p>

Reference	Review type & Climate impact	Australian studies included & Setting	Aim(s)	Intervention(s)	Key findings & Effectiveness
			research and communication practices.		
(Zhao et al. 2022)	<p><u>Study type:</u> Narrative review</p> <p><u>Climate impact:</u> Suboptimal temperatures, wildfires, smoke, floods, droughts, water scarcity.</p>	<p><u>Australian studies included:</u> 5</p> <p><u>Setting:</u> Not specified</p>	To review the effects of climate change on a broad range of health outcomes; to discuss mitigation and adaptation strategies against climate change and how these strategies may benefit human health in other ways.	Mitigation and adaptation solutions, including health adaptation plans and early warning systems.	<p><u>Key findings:</u> Pathways between climate change and human health, and possible solutions, including directions for future research.</p> <p><u>Effectiveness:</u> Not assessed</p>

