CHiAPRT
Centre for Health in All Policies Research Translation

HEALTHY ENVIRONMENTS AND LIVES HEAL

Research to Policy Best Practice

A Case Study Compendium

This compendium has been prepared by the Centre for Health in All Policies Research Translation (CHiAPRT) on behalf of the Healthy Environment and Lives (HEAL) Network.

CHiAPRT and HEAL would like to thank all the researchers and authors for their contributions to the development of this compendium, including all who submitted case studies.

February 2025

Table of Contents

Introduction

In partnership with the Healthy Environment and Lives (HEAL) Network, the Centre for Health in All Policies Research Translation (CHiAPRT) has crafted this compendium to showcase the innovative work being undertaken across the HEAL Network to translate knowledge and research into successful policy and practice outcomes. The Compendium brings together research-to-policy case studies capturing the research translation strategies, methods and outcomes applied by the research teams and provides best practice examples of research to policy translation currently underway across the HEAL Network.

The HEAL Network is an Australian initiative dedicated to advancing community relevant research and effectively translating it into policy and practice. A dynamic coalition of over 100 researchers and more than 30 organizations across Australia, HEAL's core mission of bridging the gap between knowledge and action spurs from the recognition that collaborative, evidence-based approaches to policy can address the environmental and societal inequities we currently face and build a healthier, more resilient society.

HEAL's vision is

> *"To catalyse research, knowledge exchange and translation into policy and practice that will bring measurable improvements to our health, the Australian health system, and the environment."*

This vision is the underlying driver behind the initiative, which brings together a diverse range of expertise, integrating Aboriginal and Torres Strait Islander wisdom, sustainable development principles, epidemiology, data science, and effective communication strategies. The multisectoral, multiorganizational approach authorizes the generation of solutions to complex issues by actively engaging policymakers in research findings and ensuring scientific findings are accessible and relevant to decision-making processes. This is referred to as *research to policy translation* or simply *research translation* of which HEAL is a pioneering advocate.

What is research translation?

It is well understood that good public policy, i.e. relevant and effective policies are informed by evidence, however, the use of evidence in the policy making process is not consistent. There are many other factors that have a significant influence on policy making, such as vested and competing interests, multiple demands on limited financial resources of governments, and the ideology and politics. Each of these factors impact on the way evidence is used within the policy making process.

There exists a significant and poignant divide between the research and knowledge that we have at our disposal and its implementation within the policy making and decision-making processes. That is, there is a *gap* between what we collectively *know* and what we collectively *do*. The goal of research to policy translation is to bridge the gap between our actions and our knowledge to ensure that decision-making processes, which inevitably determine our collective well-being, are informed by current and applicable evidence.

The need for evidence to inform policy is of course both obvious and critical yet bridging the gap between research and policymaking remains challenging. Researchers and policymakers operate in siloed environments, with differing priorities, timelines, and incentives—often described as "two separate worlds." While research relies on rigorous, time-intensive processes, policymakers must navigate fast-moving, competing agendas. The power of research translation therefore lies in its ability to align scientific findings with the priorities and practical constraints of policymakers. Beyond simply presenting research, it requires sustained, trusting relationships between both sectors—built over time

through pragmatism and collaboration. These relationships are not one-way; just as research can inform policy, policy needs can also shape research directions. Ideally, the partnerships built over time leads to co-designed studies that directly address policy-relevant questions.

The importance of research translation in areas like public health, environmental sustainability, and social equity, cannot be overstated. Policies grounded in evidence are more likely to be effective, equitable, and sustainable —ultimately saving lives, improving quality of life, and fostering long-term well-being.

Implementing Research Translation is a priority of the HEAL Network. It seeks to grow a culture of collaboration and exchange to better improve our capacities to respond appropriately and effectively to issues facing our wider communities. The implementation and practice of research translation is a significantly more complex process than would first appear. Reflecting on the realities of policy making and research, it quickly comes to light that research translation cannot simply be achieved by quick and few system or process changes. Rather, the most vital components of research translation lie within individuals and collective capacities to build trusting and collaborative interpersonal relationships which span multiple sectors, organisations and agendas. It is the challenge of standard practices that underpin organisational processes which champion research translation.

Recognising the practical challenges that arise from trying to grow collaboration and communication throughout a wide network of organisations and across multiple stakeholders, HEAL has formulated different principles and practices to support and inform the processes that enable effective research translation. These principles are hugely important to successful research translation and offer those within the network as well as those outside it, a set of guiding concepts to uphold and grow the research translation processes.

Research Translation Principles	**Description**
Research is rigorous, ethical, and underpinned by a shared purpose to achieve the aim and objectives of the HEAL Network.	Members of the HEAL Network are committed to policy- and practice-relevant research and to supporting research impact.
Integration of Aboriginal and Torres Strait Islander concepts, culture, and ways of knowing.	Aboriginal and Torres Strait Islander knowledge is respectfully considered and integrated into all aspects of the HEAL Network's activities.
Empowerment and inclusion of diverse stakeholders.	All stakeholders are valued and empowered to contribute, including at-risk groups, people with lived experience, community organisations, researchers, policymakers, practitioners, and the wider community; power imbalances are identified, acknowledged, and addressed.
Development of Research Impact Plans.	Each part of the HEAL Network (e.g., each Community of Practice) has a Research Impact Plan to ensure that all activities consider policy and practice needs and opportunities.

Action-oriented research to facilitate involvement and knowledge sharing.	Research is largely action-oriented to promote collaboration and knowledge exchange among all stakeholders.
Funding distribution prioritizes research translation and impact.	Opportunities for, and commitment to, research translation, implementation, and impact are considered in the allocation of funds across the HEAL Network.
Collective responsibility for generating policy-relevant knowledge.	Responsibility lies with all members of the HEAL Network to generate knowledge that is policy-relevant, a community priority, and supports meaningful, sustainable outcomes.
Building reciprocal relationships to foster trust and respect.	Reciprocal relationships build trust and respect across research, policy, and practice communities, including the HEAL Network's Communities of Practice, as well as with the broader community; communication facilitates the productive intersection of needs and interests.
Collaboration to create inclusive and dynamic partnerships.	Collaboration creates dynamic, inclusive, and porous communities of researchers, community members and organisations, policymakers, and practitioners; strong partnerships support sustainable outcomes.
Prioritizing capacity development across the network.	Capacity development is emphasized to support skill and knowledge enhancement, encouraging agile and innovative approaches to research translation and implementation.

Best Practice Case Study Call Out

To support HEAL in the delivery of policy relevant and impactful research, a 'call-out' across its network was issued seeking to identify best practice case studies from its pool of researchers. These case studies were sought to provide examples of best practice within research translation. The case studies would demonstrate key aspects of effective research translation that are being utilized and embedded in current research practices throughout the network. The motivations behind the case study call out were two-fold. Firstly, identify and showcase research that embeds research translation practices and ideology into the research itself i.e. best practice research translation. By showcasing and celebrating those who have successfully adapted traditional research methods to the principles of research translation, the continued re-invention of these practices can be shared between researchers themselves and allows for new formulations of research translation approaches. Secondly, invite reflections upon research translation and implementation examples to foster capacity building processes. In which, members can learn and improve.

A case study working group was established to guide the call for case studies, oversee the development of a case study template and the selection criteria. Members of the HEAL Research Translation and Impact Standing Committee were invited to join the working group and contribute to the construction of the call out process. After the creation of the working subgroup, the team was then tasked with developing a template for the case studies to be presented under, selection criteria and a rubric (see Appendix A) to ensure consistency in the reviewing process. These processes ensured a standardised and transparent approach was being taken in selecting the case studies and provided assurance that

the chosen case studies were examples of best practice. The template (see Appendix B) developed for this call out was adapted from existing case study templates used by the Centre for Health in All Policies Research Translation (CHiAPRT) which were designed to gather evidence of good practice. The call was sent out and shared with the members of the HEAL Network in March of 2024, which included the template, and the submission details required. The original submission deadline was made flexible due to competing priorities and schedules. It was an important adaption in the call out process to offer flexibility and consideration to the different capacities and time availability to those wishing to contribute. Thus, it was in September 2024, having received a total of 12 case studies overall, that the review process began.

Selection Process

CHiAPRT put together a team to lead the review process and assess each case study. The case studies were selected using the rubric developed by the working subgroup and the core research translation principles and strategies that had been outlined by the HEAL Network[1]. Of the 12 submissions, 5 were selected as best practice examples of research translation and invited to be included in this compendium. The review process involved in-depth discussion and consensus among the team, prioritizing case studies that effectively embedded research translation principles. It is important to note that as each case study is at a different stage of research i.e. early stages; established or on-going, we weren't seeking the most established research examples. The examples within this compendium demonstrate how research translation can be considered from any stage of development.

Authors of the selected case studies received feedback and the opportunity to refine their submissions, emphasizing research translation aspects of their projects.

All the case studies that were submitted illustrated admirable consideration of research translation strategies, principles and practices throughout all of their research and it is here that we would like to offer our congratulations and thanks to all of those who submitted case studies over the course of this year. We wish to recognise the efforts that have been made by all those who submitted, striving to prioritise research translation principles throughout their research and their continued commitment to bettering research practices in the name of improved health and environmental outcomes.

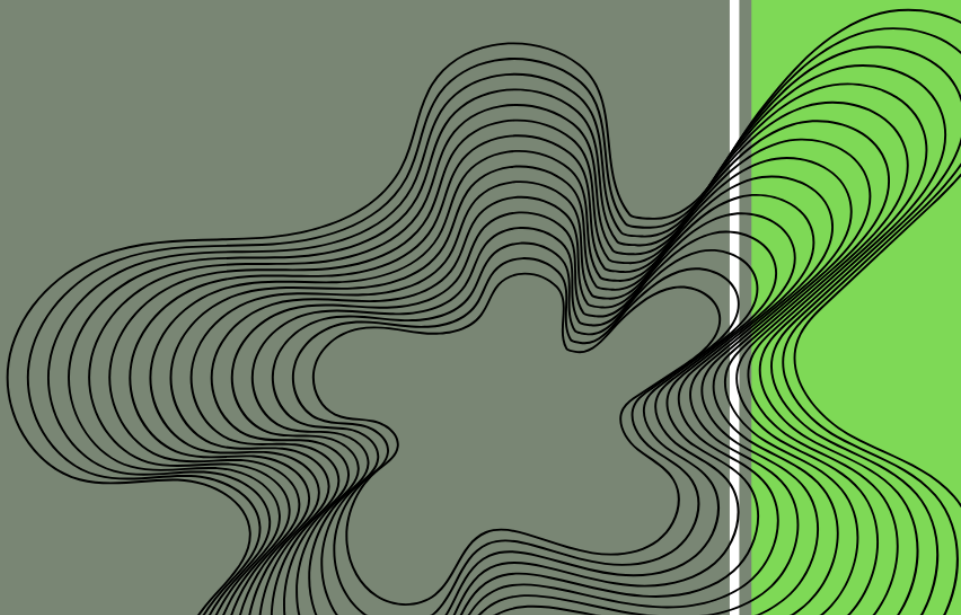
Conclusion

This compendium serves as a testament to the HEAL Network's commitment to advancing research translation as a cornerstone of effective policymaking. By showcasing best practice case studies, the compendium not only celebrates the achievements of researchers who have successfully integrated HEAL's principles into their work but also fosters a culture of reflection, learning, and innovation across the field of research translation. We acknowledge that this task isn't a simple nor swift one and ultimately requires fundamental system change throughout our governments, organisations and economy. But it is the hope that this compendium will contribute to our collective efforts and expose/expand ideas to others in the field. We hope that this compendium will become an influential resource to those who are new to research translation as well as those who are continuing their efforts in the field. Having a collection of current and outstanding research translation practices can help inform others who are attempting the same and guide their practices towards effective translation. As

[1] HEAL Network: Research translation, implementation and impact, 2022.

the HEAL Network continues to champion collaboration, inclusivity, and capacity development, this initiative paves the way for a future where research translation is a central and enduring practice in addressing the complex challenges of our time.

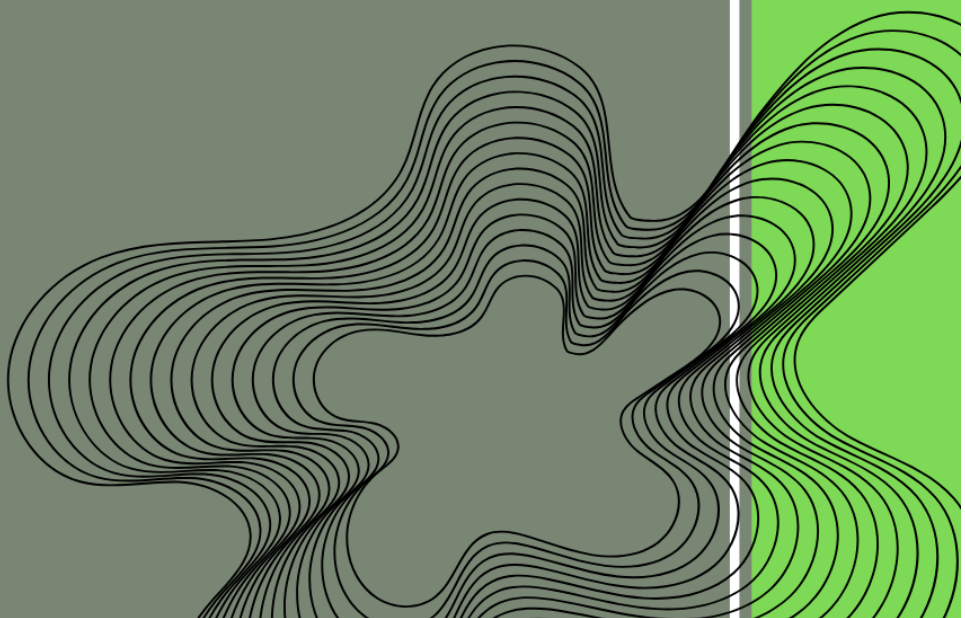
Case Studies



Case Study One

HEAL Communities of Practice – supporting policy change by researching the health Impacts of wood heater smoke

Sotiris Vardoulakis, Fay Johnston, Nigel Goodman, Geoffrey Morgan, Ro McFarlane, and Dorothy Robinson



OVERVIEW: HEAL Communities of Practice – supporting policy change by researching the health Impacts of wood heater smoke

Name of Author/s: Sotiris Vardoulakis, Fay Johnston, Nigel Goodman, Geoffrey Morgan, Ro McFarlane, and Dorothy Robinson

Highlights:

- Wood heater smoke is a major modifiable source of air pollution in Australian cities and towns that reduces community health and wellbeing.
- The HEAL Network conducted a study on the effects of wood heater smoke pollution on mortality in the Australian Capital Territory (ACT). A rapid health impact assessment over 2016–2018, 2021, and 2022 found that wood heaters in the ACT contributed an estimated 13–25% of fine particulate matter ($PM_{2.5}$) air pollution.
- This research demonstrates the health and economic benefits for local government policy changes, such as banning new wood heaters, phasing out existing units in urban and suburban areas, and supports the switch to cleaner, environmentally friendly domestic energy solutions.

Summary:

The HEAL Network conducted research on the health impacts of wood heater smoke in the Australian Capital Territory (ACT), finding it to be a major modifiable source of air pollution that affects community health and wellbeing. A health impact assessment over 2016-2018, 2021, and 2022 estimated that wood heaters contributed 13-25% of fine particulate matter (PM2.5) pollution, resulting in 11-63 premature deaths annually, with economic costs ranging from $57 to $333 million per year. The findings support policy changes, such as banning new wood heaters and phasing out existing ones in urban areas, while promoting cleaner energy alternatives.

The ACT has implemented financial incentives to remove wood heaters since 2004, offering rebates for switching to electric heating systems. To date, over 1,275 heaters have been removed, resulting in projected health benefits exceeding six million dollars. The government plans to phase out wood heaters across the ACT by 2045, excluding rural properties.

The HEAL Network's research was co-designed with stakeholders, including government agencies, advocacy groups, and community members. Engagement with peak bodies such as Asthma Australia and the Victorian EPA emphasized the need for policies addressing air pollution's health impacts. The study has been widely disseminated through media coverage and online engagement, underscoring its public health relevance.

Research findings have informed local government strategies in areas such as Armidale, where initiatives include financial assistance programs for heater replacement, awareness campaigns, and

regulatory changes to limit new installations. The NSW government has also funded studies on air filtration effectiveness in reducing indoor pollution.

The HEAL Network continues to support community engagement and education, incorporating findings into university public health programs and working with Indigenous communities on culturally appropriate solutions. These efforts aim to inform policy and promote healthier, smoke-free environments across Australia.

Key Research Translation Principles

- Research is rigorous, ethical, and underpinned by a shared purpose to achieve the aim and objectives of the HEAL Network
- Empowerment and inclusion of diverse stakeholders.
- Integration of Aboriginal and Torres Strait Islander concepts, culture, and ways of knowing
- Collaboration to create inclusive and dynamic partnerships

FULL CASE STUDY: HEAL Communities of Practice – supporting policy change by researching the health Impacts of wood heater smoke

Introduction

The aim of this research was to estimate the number of deaths and the cost of deaths attributable to wood heater smoke in the ACT. This research builds on previous work led by Dr Robinson and presented at the Centre for Air pollution, energy and health Research (CAR) symposium in 2022. The project was further motivated by engagement with local and national peak bodies (e.g., Asthma Australia), government agencies (e.g., Office for the Commissioner for Sustainability (OCSE); Victorian Environment Protection Authority (EPA); New South Wales Department of Climate Change Energy, the Environment and Water (DCCEEW)), advocacy groups (e.g., Clean Air Communities), and community members.

The ACT currently leads the country on efforts to reduce smoke from wood heaters. Since 2004 the ACT has offered financial incentives to remove wood heaters and install less polluting alternatives. These currently include $250 for the removal of a wood heater, $750 for the removal of a wood heater and installation of an electric reverse cycle system (minimum 3 stars), and $1,250 for the removal of a wood heater and installation of an electric ducted reverse cycle system.

Over 1,275 wood heaters have been removed since the program commenced in 2004 with a projected health benefit of over six million dollars. For the 2022/23 YTD, 50 applications have been received and 31 rebates paid.

By 2045, the ACT government is moving to phase out wood heaters in Canberra. The government said its plan to phase out household woodfired heaters would extend to all parts of the ACT but will exclude properties in rural areas.

This work translates a clear association between health impacts and wood heater smoke into policies and practice. It provides support for local government policy changes and that a clean domestic energy transition can achieve major health and environmental benefits in the ACT and other regions in Australia.

Applying Research Translation in Practice

Stakeholder engagement

- We fostered and extended strong relationships with stakeholders before conducting this research, as follows:
    - Wood heater smoke was identified as a significant issue by participants in several of the HEAL community of practice (CoP) meetings, including those based in the Australian Capital Territory (ACT), Victoria, Tasmania, and New South Wales.
    - In addition to engagement with several national CoPs, the research team worked closely with peak bodies (e.g., Asthma Australia), government agencies (e.g., OCSE ACT, Vic EPA, DCCEEW NSW), advocacy groups (e.g., Clean Air Communities), and members of the public.

- In the Victorian CoP, Clean Air Communities (CAC) stated that the environmental and health interaction of air pollution was a significant concern. The CoP identified a need to connect with grassroots communities to help them to understand the environmental issues directly impacting their health. Additional funding for public health education campaigns that relays research findings on the impacts of air pollution from wood combustion on health.
- Further motivation for our work came from research done by Asthma Australia. The survey found that 77% of the general population agreed that wood heaters should not be allowed in urban or built-up areas.[7] In May 2023, the ACT Community of Practice included input from the Office of Commissioner of Sustainability and Environment (OCSE). There is strong policy evidence from the OCSE for wood heater smoke reduction. Also in early 2023, the Key thinkers Forum on Air Quality, Asthma, and Indigenous Health identified the need for air pollution risk reduction strategies and communication.

- These points helped focus our attention on the issue of wood heater smoke exposure in residential areas. Our work approach thus demonstrates collaboration and co design.

Clear communication and information tailored to the specific setting

- According to Altmetric (which helps us understand who is engaging with research online), this article is in the top 5% of all research outputs scored by Altmetric, and it is among the highest-scoring outputs from this source (#35 of 5,929).
- The article has been mentioned by 59 news outlets, 128 X users and 230 X posts, and on 2 Facebook pages.
- An informative video was developed in partnership with the MJA. Several screen shots are presented below (Figures 1-5) [12].

Figure 1. Overview of study showing impact of wood heater smoke on air quality, health, and the economy

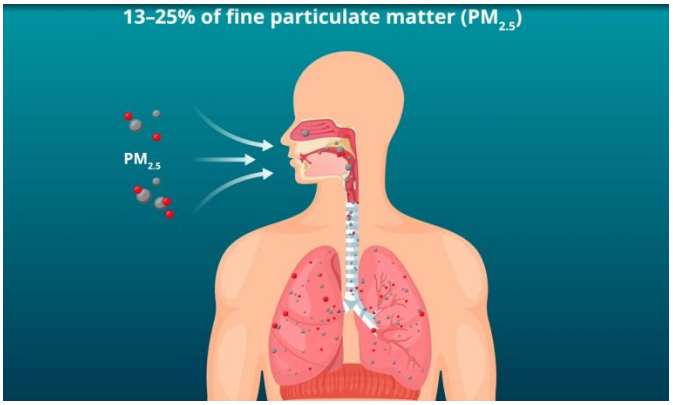


Figure 2. Impact on respiratory system

Figure 3. Key findings from study, demonstrating impact of wood heaters smoke on ACT population

Figure 4. Study recommends the phasing out wood heaters in built up (urban) environments

Build networks and communities to foster long-term relationships

- This project has strengthened existing relationships and built new ones. The HEAL Network built on our existing collaborations with peak bodies including Asthma Australia, government agencies, including OCSE (ACT), EPA (VIC), and DEECCW (NSW) and strengthened relationships with advocacy groups, such as Clean Air Communities (VIC), independent

researchers including Dr Dorothy Robinson, and members of the public. Dr Robinson advocates for reducing wood smoke emissions in Armidale and other towns impacted by wood smoke, and has conducted research to demonstrate the elevated levels of (wood smoke) $PM_{2.5}$ during winter time. [11,13]

Pilot and evaluate interventions

- In this project, the HEAL Network conducted a rapid health impact assessment to study the effects of wood heater pollution on mortality in the ACT. Researchers used air quality data from three representative outdoor pollution monitors and assessed population exposure to fine particulate matter ($PM_{2.5}$) for the calendar years 2016 to 2022 (excluding 2019 and 2020 because of the influence of the Black Summer bushfires). Then, researchers applied published exposure-response functions and population health statistics to estimate the number of deaths and the associated cost of death attributable to wood heater smoke.
- Although the CoP engagement informed the need for this work, this engagement did not specify the method. For this, researchers relied on the published literature, our experience, and other sources.

Research impact strategies

- Our previous (and current) research aims to reduce exposure to smoke from various sources, including wood heaters. For instance, [14] developed a detailed action plan to help "protect yourself and others from bushfire smoke". The fact sheets and knowledge from this work has been widely cited and helps protect individuals and communities in Australia and internationally.
- In addition Asthma Australia has funded several research projects that aim to reduce exposure to smoke (i.e., The Healthy Air Project), which focuses on best practice interventions for reducing exposure to landscape fires. The HEAL Network is currently in the translation phase of the Healthy Air project and developing a range of infographics and messages for Asthma week, 2024.
- Asthma Australia funded another large project led by The University of Tasmania that will assess the effectiveness of a wood heater replacement program. Title Making the Switch – effectiveness of a wood heater replacement program, the project will survey over 700 wood heater owners to understand what types of wood heater incentives would motivate various communities to switch to healthier heating technology, as well as pilot a best practice wood heater replacement trial.
- In addition, the NSW government has funded our group to conduct a study to investigate the effectiveness of air filtration in reducing indoor air pollution and asthma deterioration in Australian homes impacted by wood heater smoke.

Community engagement

- From an educational perspective, the HEAL Network are also helping the next generation to understand and address the issue. At the University of Canberra, we aim to embed our research in within our Public Health education programs, both at undergraduate and postgraduate levels. High uptake of University of Canberra graduates in the ACT Public Service provides another loop of community engagement and awareness, and research translation into policy. For example, members of the team will teach students in the Healthy and Sustainable Places

about air pollution from various sources, including wood heaters, and utilise personal monitors to explore winter air quality and sources of pollution in ACT.

Aboriginal and Torres Strait Islander community engagement

- The HEAL Network work closely with indigenous researchers from the University of Sydney who have expertise on Indigenous knowledge systems (e.g. Healing Country), air pollution (e.g. Healthy Air), and fire ecology focusing on Aboriginal communities.
- On 28 March 2023, to the Sustainable Communities and Waste Hub jointly hosted a Key Thinkers Forum on Air Quality, Asthma and Indigenous Health, with Macquarie University, CSIRO, the HEAL Network, and Asthma Australia.
- In the ACT, Mr Tyson Powell, an indigenous staff member of the Ginninderry Conservation Trust, discussed cultural burning and cultural wellbeing associated with fires, with the CoP

Research Translation Outcomes

This work has demonstrated that there are health and economic benefits of not using wood heaters. The HEAL Network anticipate that our research will helpful those impacted wood heater smoke to advocate for changes in their local government area. It provides much needed local evidence that can support policy. However, the Research-Policy-Practice Translation has not been evaluated as we are still in the early stages of the process.

As mentioned earlier, Asthma Australia has funded a large research project focused on evaluating a wood heater replacement program, that will help motivate communities to switch to healthier heating technology. In addition, the NSW government has funded a study that will investigate the effectiveness of air filtration for reducing indoor air pollution and asthma deterioration in Australian homes impacted by wood heater smoke.

These initiatives suggest peak bodies and government agencies are supportive of our work as well as future efforts to reduce exposure to smoke from wood heaters. Although, state or national policy has not yet changed in response to the research, some progress has been made in regional areas in response to previous work by members of this team.

For instance, Armidale Regional Council has a developed a range of strategies and policies intended to mitigate the impacts of wood heaters during the winter months, including:

- Seeking funding for and undertaking community awareness programs on the impacts of wood heaters on air quality
- Undertaking community awareness programs on the biodiversity and environmental impacts of wood collection within the LGA
- Amending Council's Planning Policies to prohibit any new dwellings from installing wood heaters on lots of 4,000m^2 or less
- Undertaking a trial program to install filtration devices to existing approved wood heaters to understand their effectiveness in reducing woodsmoke pollution generated by existing fireplaces.
- Advocating for the inclusion of a reduced $PM_{2.5}$ limit in the Australian Standard for fuel combustion heaters (AS/NZS 4013:2014)
- Advocating with State Government to establish a financial assistance program to support an incentive package to replace existing wood heaters with alternative cleaner heating options within Armidale
- Undertaking investigations into potential options to phase-out wood heaters within Armidale.

Reflections

Among the factors that motivated us to conduct this research were our interactions with participants from the regional Hubs/CoP and stakeholders such as Asthma Australia. Engagement through the CAR Symposiums, HEAL Conferences (2022, 2023), the “Healthy Air” and “Making the Switch” projects were also critical factors. The HEAL Network aimed to: Identify a health issue; Work closely with stakeholders e.g., Asthma Australia to develop collaborations and grants; and listen to COP participants, who were not always from government or academia.

Although it is still a little early to say what the policy changes will be, nationally, the ACT has committed to phase out wood heaters by 2045. In addition, the Armidale Regional Council has developed a range of strategies to reduce the environmental and health impact of wood heater smoke. These examples can provide guidance to other jurisdictions who are exploring similar programs.

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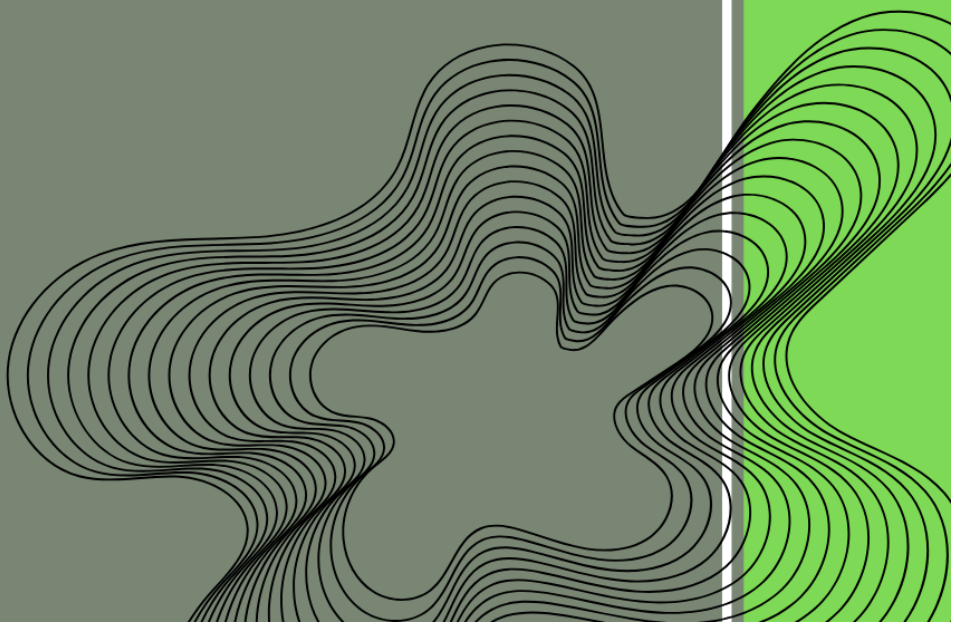
Case Study Two

Understanding bushfire risk perception, preparedness, and the health drivers of intention to leave in Tasmania, Australia

Dr Sharon L. Campbell, Dr Grant J. Williamson, Prof Fay H. Johnston, Prof David MJS Bowman



OVERVIEW: Understanding bushfire risk perception, preparedness, and the health drivers of intention to leave in Tasmania, Australia

Name of Author/s: Dr Sharon L. Campbell, Dr Grant J. Williamson, Prof Fay H. Johnston, Prof David MJS Bowman

Highlights:

- Elevated bushfire risk in human communities around the globe is driven by the interaction of a warming climate and increasing development in bushfire-prone regions.
- Communities in fire-prone regions of Australia need an informed understanding of their local risks and options, in order to facilitate safer decision-making and reduced risk in the threat of a bushfire event.
- The project aimed to increase understanding of bushfire risks and perceptions among Tasmanian residents, and how this may have changed over time.

Summary:

This research examines how Tasmanian residents perceive bushfire risk, their preparedness, and the factors influencing their intention to leave during bushfire threats. Data from the 2016 Tasmanian Population Health Survey and a 2023 survey were analyzed to identify trends and associations over time. The findings indicate an increasing intention to leave properties during bushfire threats, with women and urban residents more likely to leave than men and rural residents. Key health and sociodemographic factors influencing leave intentions include being female, having higher education levels, and having conditions such as asthma or depression/anxiety.

Four distinct groups were identified: 'immediate leavers,' 'prepared stayers,' 'unprepared leavers,' and 'informed leavers,' each characterized by specific sociodemographic traits. These insights hold significant implications for public health and emergency management, aiding in the development of targeted communication and intervention strategies. Ongoing collaboration with stakeholders across public health and emergency management sectors will support the application of these findings to enhance bushfire preparedness and response efforts. Discussions with stakeholders have highlighted a strong interest in continued partnership and co-design of future initiatives to protect high-risk populations and improve policy interventions.

The study highlights the importance of ongoing collaboration between researchers and policymakers to address evolving bushfire risks. The findings support the need for continued investment in public awareness campaigns and targeted interventions to enhance community resilience and safety in the face of increasing bushfire threats.

Key Research Translation Principles

- Empowerment and inclusion of diverse stakeholders.
- Collective responsibility for generating policy-relevant knowledge.
- Building reciprocal relationships to foster trust and respect.
- Collaboration to create inclusive and dynamic partnerships.

FULL CASE STUDY: Understanding bushfire risk perception, preparedness, and the health drivers of intention to leave in Tasmania, Australia

Introduction

The elevated bushfire risk in human communities around the globe is driven by numerous interacting factors. These include an increasing number of days of extreme heat, extended drought, and longer fire seasons due to a warming climate (1, 2), and the increasing expansion of human development into bushfire-prone regions (3, 4). In this context, communities in fire-prone regions of Australia need to have an informed understanding of their local risks and options, in order to facilitate safer decision-making and reduced risk in the threat of a bushfire event.

Our research was undertaken in the island state of Tasmania, Australia. In 2022, Tasmania had an estimated population of 571 500 (5), covering 29 local councils. While the majority of the population reside in the three main centres of Hobart in the south, Launceston in the north and Burnie-Devonport in the northwest, most of the land area is classified as rural and remote (see Figure 1).

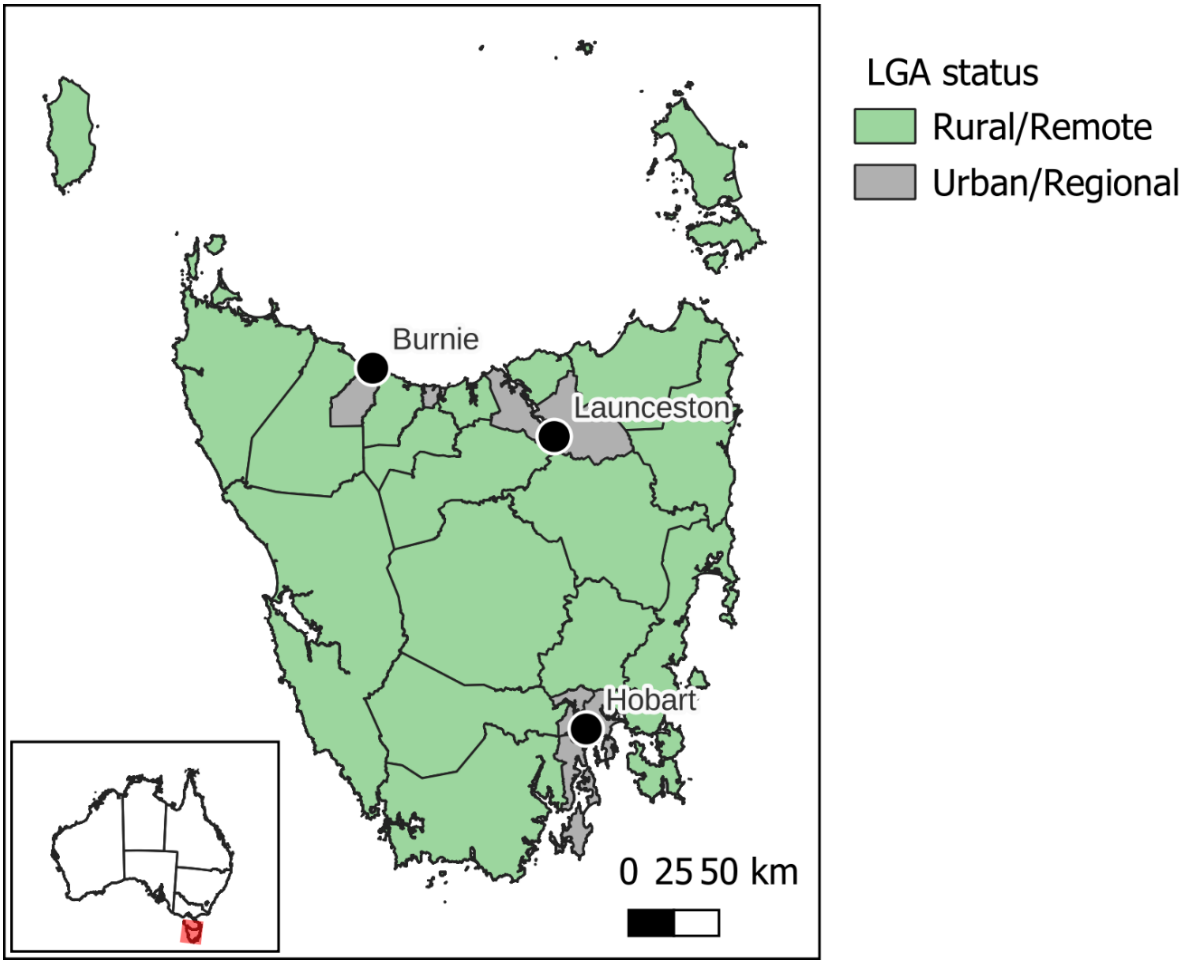


Figure 1: Map of Tasmania, Australia, showing urban/regional and rural/remote local government areas and major population centres.

With substantial areas of bushland extending across the state, approximately 98% of Tasmania's land area is classed as fire-prone (6), and fire risk is distributed across both urban and regional/remote areas (7). Bushfire is considered to have the highest risk profile of all natural hazards in Tasmania (8), with recent major uncontrolled fires occurring in 2013 (the Dunalley-Forcett, Lake Repulse and Bicheno fires), 2016 (North West fires) and 2019 (Gell River, Riveaux Road and Miena fires) (9). Furthermore, and in line with other increasing fire risks globally, Tasmania's bushfire risk is projected to increase in a warming climate (10-12).

In this high-risk context, there is an urgent need for fire and emergency services managers and public health policymakers to understand how the Tasmanian population perceives and understands bushfire risk, residents' intentions when experiencing a bushfire threat, and drivers of self-evacuation.

Our research project therefore aimed to increase the specific understanding of Tasmanian residents' comprehension and awareness of bushfire risk perceptions, leave intentions, and behaviours related to bushfire threats. To achieve this, we used survey data from 1500 Tasmanian residents aged over 18 years, collected in September- November 2023. Survey questions were co-designed with key stakeholders in the public health, disaster preparedness and emergency management sector in Tasmania, ensuring questions aligned with stakeholder areas of interest (see Appendix 1 for survey questions). Comparison data from the 2016 Tasmanian Population Health Survey (TPHS) were obtained from Public Health Services, Department of Health Tasmania. Both datasets were analysed to determine trends and associations, and provide a greater understanding of Tasmanian residents' bushfire risks and intentions.

In line with the HEAL Research Translation Strategy, our research is embedded in the principles of shared responsibility, reciprocal relationships and capacity development. For example, our results have significant implications for the development of targeted messaging and communications strategies in bushfire preparation season and during bushfire events. Once results are published, we intend to re-engage with our co-design stakeholders to help develop policy and interventions designed to further protect Tasmanians from adverse health risks during bushfire disasters.

The project was funded through a grant from the 2023 Natural Disaster Risk Reduction Grant Program Fund, and led by members of the Bushfires, Air Pollution and Extreme Events theme of the HEAL Network.

Applying Research Translation in Practice

Our project grew from identifying a gap in the understanding of trends and shifts in bushfire risk, risk perceptions and evacuation intentions in Tasmanian households over time. Prior to this project, data from the 2016 TPHS supplied a point-in-time analysis of bushfire risk and evacuation intentions. Since 2016, a significant national marketing and communications campaign has been underway, emphasising 'leave early' as the safest option when faced with a bushfire threat (13). Further research was needed to understand if bushfire risk, risk perceptions and evacuation intentions had changed in Tasmania over time.

Stakeholders were engaged in two ways. Firstly, the Department of Health supplied 2016 TPHS data for analysis of bushfire risk, leave intention and various sociodemographic and health indicators. This enabled analysis and identification of health and sociodemographic drivers of leave intention. Secondly, stakeholders were invited to co-design workshops held in March and April 2023, which aimed to understand the needs and areas of interest relevant to partners, and therefore determine suitable survey questions. Stakeholders included the Department of Health, Tasmania Fire Service (TFS), the

Tasmanian State Fire Management Council, Local Government Association of Tasmania and various local councils, Australian Red Cross (ARC) and Natural Hazards Research Australia. During the co-design process, stakeholders were able to provide highly valuable input into survey questions, survey design and survey priorities, ensuring the results would enable a clear research-to-policy translation pathway.

As part of the co-design process, stakeholders were invited to review draft surveys, alongside a diverse mix of community members (for example, ARC volunteers). This process ensured the survey used plain language and was understandable and accessible to survey participants. The decision to use a computer-assisted telephone interview (CATI) methodology was also endorsed by stakeholders.

The project was built on robust and existing networks and collaborations (particularly the Department of Health, TFS and local councils), and has generated new relationships with the ARC. We anticipate the relationship with ARC will continue to be developed once the results of our research are published, and we will actively engage with the organisation at this time to determine further resource development.

We plan to inform all stakeholders of publications relevant to this project, and engage directly with stakeholders and collaborators to determine how these findings can be further disseminated. For example, we presented to the Tasmanian Department of Health in August 2024 to discuss the outcomes of the 2016 TPHS analysis and the analysis of the 2023 survey results. We have also initiated discussions with the TFS to establish how research findings may directly contribute to pilot interventions related to targeted messaging and communication strategies. These conversations will also connect stakeholders in relevant local councils and the ARC, who have a direct role in disaster management and recovery, especially for priority populations such as the elderly, socially isolated, people living with disabilities, and people living in social disadvantage and poverty.

Research Translation Outcomes

Our analysis found that:

- while a greater proportion of people reported living in an area of bushfire risk in 2023 compared to 2016 (27.8% in 2016; 41.5% in 2023), a greater proportion stated their intention was to leave their house at the threat of a bushfire in 2023, compared to 2016 (17.7% in 2016; 31% in 2023). This finding goes part way to evaluating the national messaging and communication change to a recommendation of ‘leave early’ in the threat of a bushfire.
- in Tasmania, women were more likely to leave than men, both in 2016 and in 2023, as were those in urban environments compared to those living in rural environments. Similar disparities in intention to leave based on gender and location have been demonstrated in other regions of Australia and internationally.
- in 2016, selected health and sociodemographic factors in Tasmania were associated with choosing to leave, including being female, having higher educational attainment and having doctor-diagnosed asthma or depression/anxiety. This is a novel finding.
- in 2023, four distinct groups in Tasmania were identified: the ‘immediate leavers’, the ‘prepared stayers’, the ‘unprepared leavers’ and the ‘informed leavers’, each with their own distinct sociodemographic markers. This is also a novel finding for Tasmania.

We have initially shared these preliminary findings with a sub-group of our co-design partners, instigating an open discussion to identify opportunities to collaborate and drive policy change, and develop intervention projects to test evidence on the ground. Funding opportunities will be identified to further these projects as needed. We anticipate these discussions will lead to greater collaboration in the research-policy-practice translation space across multiple disciplines, with new stakeholders and opportunities identified.

The multi-disciplinary nature of our research has also meant our collaborators and stakeholders have had opportunities to interact and network beyond the scope of this specific project. We have also used this opportunity to invite stakeholders to join the Tasmanian HEAL Community of Practice, providing even greater networking opportunities across the state for all collaborators.

Reflections

Our project has been built on the foundations of a long-term collaborative partnership between researchers and policymakers in Tasmania across the areas of public health, fire ecology and emergency management. This is evidenced by two members of the research team having previously worked in joint appointments with academic institutions and government in a public health role. Relationships such as these are pivotal to the success of projects, and are a cornerstone to effective research-to-policy translation.

Furthermore, shared working histories also develop trust and respect, especially in the potentially high pressure environment of emergency management. With an increase in prolonged public health emergencies in the form of the COVID-19 pandemic, bushfires and floods, partnerships between researchers, emergency management and public health authorities in Tasmania, and indeed across Australia, have been newly created and will continue to grow.

Our challenges lie in the next phase of research, to adequately fund, implement and evaluate evidence-based interventions to protect the health of Tasmanian residents during extreme bushfire events. Co-designed projects with the Department of Health, Tasmania Fire Service, local councils and ARC will be developed and submitted for funding grants once research has been published and suitable grants have been identified.

To date, key learnings from the project are centred on the maintenance of collaborations and relationships between researchers and policymakers. This has been achieved through simple acts, such as informal face-to-face catch ups and check-ins, invitations to presentations or seminars of interest to the other party, and an assumption that each party is mutually open to discussion and generation of ideas and collaboration. This environment is easily fostered in a small jurisdiction like Tasmania, where relationships are often forged away from a formal work environment, for example, through social activities or mutual acquaintances. These structures, both formal and informal, can also facilitate respect and trust, potentially translating to a willingness to contribute to ideas and project development, and timely responses to funding opportunities. Involvement of key stakeholders in translational policy research from the outset is critical to future engagement and policy change.

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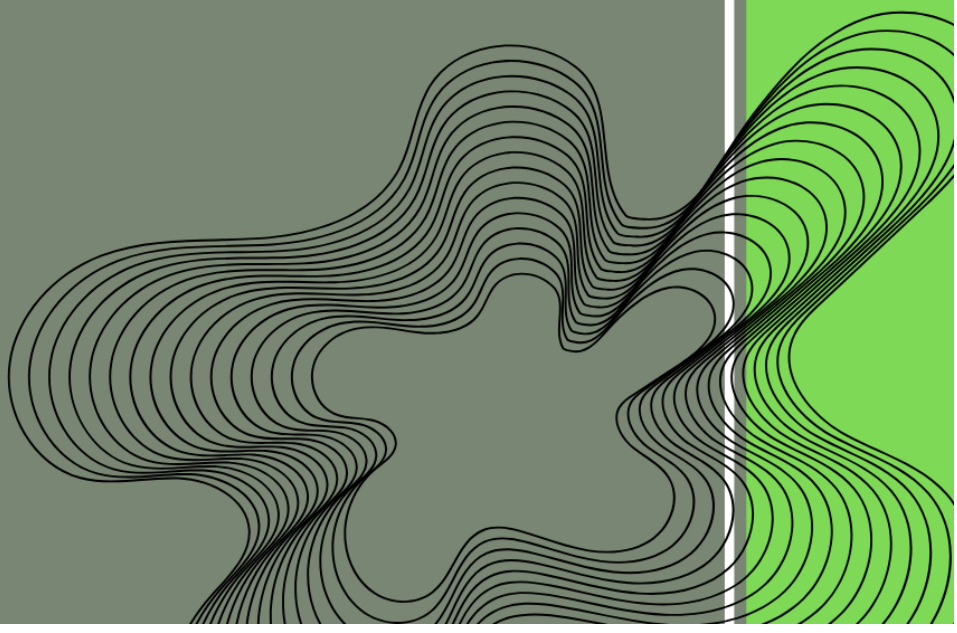
Investigating movement networks of wildlife reservoirs of infection to improve Australia Biosecurity risk assessment and preparedness to emerging infectious diseases.

Dr Tatiana Proboste, Abigail Turnlund, Andrew Bengsen, Matthew Gentle, Cameron Wilson, Lana Harriott, Richard Fuller, Darren Marshall and Ricardo J. Soares Magalhães.



OVERVIEW: Investigating movement networks of wildlife reservoirs of infection to improve Australia Biosecurity risk assessment and preparedness to emerging infectious diseases.

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Highlights

- Australia's wildlife, particularly feral pigs, serves as reservoirs for zoonotic diseases such as Japanese Encephalitis, Brucella, Foot and Mouth Disease, and African Swine Fever, posing significant biosecurity risks.
- The Australian Disease Spread Model (AADIS) aids in formulating policies for emergency animal diseases, simulating incursion, detection, surveillance, and control to protect animal and human health.
- Researchers quantified interactions within and between feral pig sounders in eastern Australia using GPS tracking and network analysis, focusing on factors such as sex, season, and location.
- This research fulfills an urgent need for enhanced biosecurity strategies and readiness for zoonotic and non-zoonotic diseases in Australia. The results aim to improve the AADIS model for better disease preparedness, fostering collaboration among researchers and government partners to address biosecurity challenges.

Summary

Australia's unique ecosystem is home to wildlife species that serve as reservoirs for emerging infectious diseases, posing significant zoonotic and biosecurity risks. Among them, feral pigs are particularly concerning as potential carriers of diseases such as Japanese Encephalitis and Brucella, and vectors for exotic threats like Foot and Mouth Disease (FMD) and African Swine Fever (ASF). Effective management of these risks requires accurate, localized data to inform models like the Australian Animal Disease Spread Model (AADIS), which supports decision-making for biosecurity and disease control.

This study addresses a critical gap in understanding how feral pig populations in Australia interact within and between their groups, or sounders. Collaborating with government agencies and academic institutions, the research team employed GPS tracking and network analysis to quantify direct and indirect contact rates across years, seasons, and populations in eastern Australia. Key findings revealed that the majority of contacts occur within the same sounder, with seasonal and demographic variations significantly influencing contact rates. Adult males, for example, were identified as pivotal in disease transmission, suggesting targeted strategies for outbreak control.

Central to this project was a co-designed research approach that engaged end-user stakeholders—government agencies and biosecurity experts—throughout the process. This partnership ensured that the study was guided by practical needs and real-world applications, emphasizing the translation of research into actionable policies. By integrating localized data into AADIS, this research enhances Australia's preparedness against disease incursions, enabling evidence-based policy adjustments, resource allocation, and targeted interventions.

The findings not only optimize disease modelling but also inform pest control strategies, contributing to both animal and human health and the broader Australian ecosystem. This case exemplifies the importance of collaborative research translation in addressing complex biosecurity challenges.

Key Research Translation Principles

- Empowerment and inclusion of diverse stakeholders
- Collaboration to create inclusive and dynamic partnerships
- Action-oriented research to facilitate involvement and knowledge sharing

FULL CASE STUDY: Investigating movement networks of wildlife reservoirs of infection to improve Australia Biosecurity risk assessment and preparedness to emerging infectious diseases.

Introduction

This project was developed in collaboration with government partners who are actively engaged in feral pig research and management. The primary aim was to generate crucial missing information that could enhance and optimize the AADIS, which is essential for improving animal and human health. Recognizing the need to understand how feral pigs, reservoirs of significant exotic zoonotic and non-zoonotic infections, interact within and between their groups, we embarked on this study.

The need for Research-Policy-Practice Translation within this context is vital. Feral pigs pose a significant threat to Australia's ecosystem, as well as animal and human health. However, a gap exists between research and practice due to the complex nature of these animals' behaviour and the challenges in tracking and studying them in their natural habitats. This gap underscores the importance of our research using a One Health approach and the need for effective Research Translation.

Our research aims to bridge this gap by quantifying interactions within and between feral pig groups in eastern Australia, thereby informing and improving disease modelling and prevention strategies. The research team, which includes UQ researchers and end-user expert teams from the NSW Department of Primary Industries and Regional Development and Biosecurity Queensland, employed network analysis to estimate direct and indirect contact rates across years, seasons, and pig populations. We examined the impact of direct or indirect contact and explored factors that may influence contact rates, such as sex, season, and location.

Our comprehensive analysis, spanning from 2017 to 2023, included 146 tracked animals. The findings revealed that the majority of direct (96%) and indirect (69%) contacts occurred within the same sounder. Indirect contacts within and between sounders were most prevalent during winter and less so in summer. The sex of the dyad significantly influenced the contact rate.

These results are critical parameters that could improve and support AADIS. More importantly, they highlight the importance of considering demographic and seasonal variation when estimating contact rates, as these factors significantly affect contact rates and, likely, the dynamics of disease transmission. The results of this research will be translated into policy change by discussing and disseminating the findings, followed by meetings with stakeholders and researchers working directly with AADIS. The aim is for AADIS researchers to update the feral pig contact rates from previous overseas studies with the new Australian data obtained in our study. Updating AADIS will enhance our capacity for early detection and response mechanisms in case of an incursion of pathogens transmitted by feral pigs, which Australia is currently free of. Policymakers can make informed choices based on accurate, locally optimized, and up-to-date data from AADIS, enabling evidence-based policy adjustments, resource allocation, and targeted interventions. Moreover, understanding feral pig behaviours would also improve pest control strategies. For example, we found that adult males may

play a critical role in connecting populations and thus in disease transmission. Therefore, targeting adult males could be more effective in controlling disease spread.

Applying Research Translation in Practice

While epidemiological models have shown potential in informing policy decisions, such as during the Covid-19 pandemic, governmental entities are often hesitant to rely on model outputs for policymaking. Our team established a relationship of trust with government partners through a co-design process, involving them in data collection, analysis, model development, validation, and reporting. Additionally, partnering with a government entity that included a former PhD student from our team, who is a skilled epidemiological modeller, helped leverage the research collaboration and translate the co-design process to other stakeholders.

The project began as a research idea presented to our partners, which initially did not receive funding. However, our partners later revisited the idea and approached us (researchers at UQ) to fund and collaborate on the project, recognizing its importance for biosecurity. The research collaboration was underpinned by a co-design process for project research questions and to determine the best analytical approach. Our interdisciplinary team included government and academic experts in feral animal management, ecology, epidemiology, veterinary science, and sustainable environmental management.

The co-design process has strengthened collaboration with end-user stakeholders and the research findings are currently under review in a peer-reviewed international journal. All end-user stakeholders have contributed significantly to the research and have been included as co-authors on conference presentations and the manuscript, providing invaluable feedback.

We have communicated our research widely and will continue to do so. Preliminary results were presented at an international conference in 2023, and further results will be shared at the International Symposium on Veterinary Epidemiology and Economics in November 2024 and the International Wildlife Disease Conference (WDA) in December 2024 in Canberra. The WDA presentation aims to make the research accessible to a broader audience through plain language and storytelling formats.

One of the main outputs of this research is the estimation of contact rates between wild animals, specifically how often two individuals interact. This parameter is critical for optimizing the AADIS model, which aims to predict disease spread and improve Australian preparedness. The more frequently two animals interact, the faster a disease can spread. Our research also provides insights into how seasonal variations affect interactions, indicating that controlling an outbreak in summer may be more challenging than in winter due to higher contact rates in summer.

We have forged strong relationships and collaborative partnerships with our partner organizations, all working towards enhancing disease preparedness in Australia. This collaboration has garnered support for two MRFF grant applications, one application for the Queensland Feral Pest Initiative Round 8(b) Feral Pig Management Innovation and Diversification, and plans for an ARC Linkage grant.

The project was divided into milestones, with advanced and preliminary results discussed and presented to stakeholders. We also presented the research to the scientific community to obtain feedback on methodology and approach during the preliminary analysis stage. This feedback led to the incorporation of new techniques, such as estimating animal movements when data is missing, and recommendations for adjusting GPS collar settings to improve future research results.

Throughout our research process, we prioritized partnership and collaboration with end-users. Regular meetings allowed us to discuss results and future plans, ensuring our work was guided by real-world needs and feedback from those impacted. For instance, we investigated the seasonality of contact

rates, recognizing the importance of understanding behavioural changes across seasons and their implications for targeted control strategies during outbreaks.

For the research to influence policy change, there must be a demonstrable benefit of using model outputs to drive operational tasks on the ground. This requires champions within the government partner organization to advocate for the model's adoption. We are currently focusing on implementation, which will involve co-developing a theory of change with our government partners. This will update the existing model with feral pig network data and utilize the new model in place of the old one. We have maintained open dialogue with researchers working on the AADIS model, meeting at the Biosecurity Symposium 2024 with the main developer from CEBRA (University of Melbourne) to discuss our results and their incorporation into AADIS. The co-design of the theory of change with model end-users will involve a written description of the strategies, actions, conditions, and resources needed to facilitate the adoption of the new model.

Research Translation Outcomes

The results of this research can aid in the prevention and mitigation of diseases such as Foot and Mouth Disease and Japanese Encephalitis, where feral pigs play a crucial role in the transmission cycle. Not only has this research offered valuable insights into the behaviour of feral pigs, but it has also provided data to optimise AADIS for effective disease control strategies. Consequently, it contributes to the health and wellbeing of the Australian ecosystem. The results of this research will be translated into policy change by discussing and disseminating the results in the first step. For this, we have lined up a meeting with researchers who developed and maintained the AADIS model to provide them with our research results to incorporate into the model and to discuss any potential change or extra information that may be required. This collaborative partnership is pivotal for my research. As the lead investigator, I am working closely with other researchers studying feral pigs, resulting in co-authorship for two papers. Our research aims to provide accurate data on disease transmission rates among feral pigs. Additionally, understanding their behaviour will enhance pest control strategies. Notably, we've found that male adults play a significant role in disease spread, emphasizing the need to target them for effective control.

Reflections

The essential success factors for implementing Research-Policy-Practice Translation, as demonstrated by our example, encompass regular meetings with partners and their consistent feedback at each stage of the process. This continuous dialogue and collaboration have been pivotal in the project's success. Regarding challenges, we encountered some difficulties in the project's initial stages due to the research's complex nature and the requirement for diverse expertise. These challenges were surmounted by forming an interdisciplinary team and cultivating a collaborative environment where everyone's contribution was valued and taken into account. In retrospect, one aspect we would alter for future projects is to dedicate more time to the planning phase to ensure a smoother project implementation. The key elements that we would advise the HEAL Network to adhere to for best practice in Research-Policy-Practice Translation include nurturing robust partnerships, maintaining open and regular communication with all stakeholders, and ensuring that the research is steered by real-world needs and feedback from those directly affected by the outcomes. Furthermore, we would suggest having additional support in terms of designing a successful Research-Policy-Practice Translation process. This could encompass resources, training, or expert guidance in the field.

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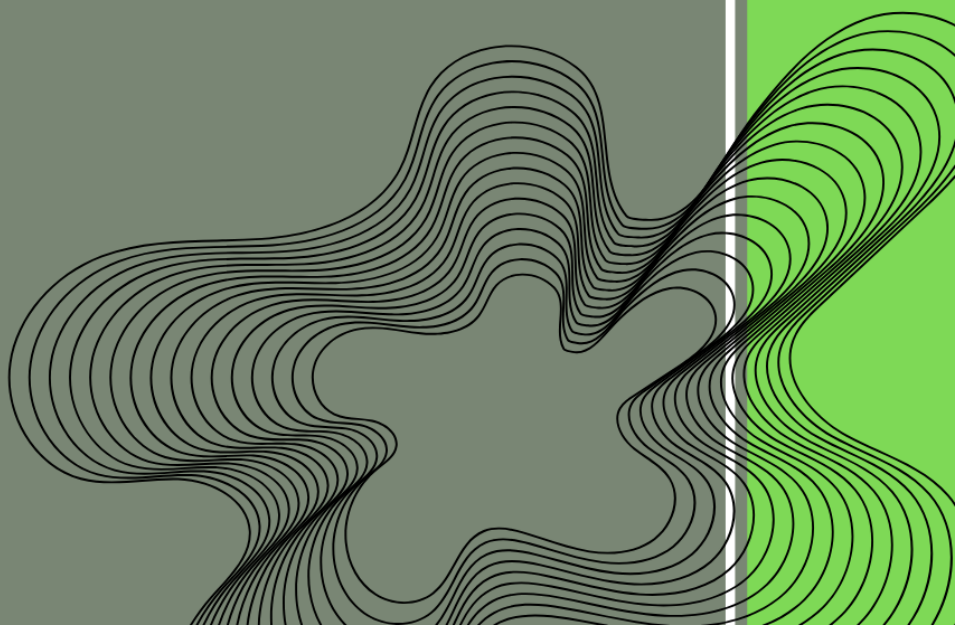
Healing Country on Whadjuk Noongar Boodja: Weaving knowledge systems to meet climate challenges.

Lyn Dimer, Kris Vine, Tia Whyman, Veronica Matthews and Brad Farrant.



OVERVIEW: Healing Country on Whadjuk Noongar Boodja: Weaving knowledge systems to meet climate challenges.

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Highlights

- Aboriginal and Torres Strait Islander communities are currently experiencing severe environmental challenges related to climate change. So far, much of Australia's research and policy development for climate change hasn't had strong Aboriginal or Torres Strait Islander involvement, despite Australia's First Nation peoples being the longest continuous culture in the world and having adapted to and survived climate change events in the past. There is growing recognition of the importance and value of bringing together Western and First Nations' knowledges to inform climate change mitigation and adaptation.
- Using Participatory Action Research and Indigenous methodologies, the project *Healing Country* aims to weave traditional knowledge systems and storytelling with Western climate, environmental and health data to explore what changes to Country Aboriginal community members are noticing and the impacts on health and wellbeing being experienced.
- The project is being led by Aboriginal communities and working across three diverse landscapes: Warumungu (Tennant Creek, NT), Whadjuk Noongar (Perth, WA) and Bundjalung Country (Northern Rivers, NSW). Each site's approach and activities are guided by a Cultural Expert Group of local Elders and knowledge holders.
- This case-study will focus on the project's early processes on Whadjuk Noongar Boodja in the Perth region of Western Australia, where the team are collecting qualitative data through community consultations, social and collaborative yarning and reflective practices, led by community-based Aboriginal researchers based at The Kids Research Institute Australia. Yarning enables a culturally safe approach to collecting stories. It emphasises establishment of connections and relationship building between the researcher and the participants, while allowing participants to have greater control over the sharing of knowledge on a topic.
- Data will be used to create **online story-data maps** as a community-owned decision-making and advocacy tool. Alongside this, a **community-led climate adaptation plan** will be developed in consultation with relevant service providers, government representatives and other stakeholders to outline clear implementable local mitigation and adaptation strategies. This will empower local communities to prioritise their own healing Country strategies and advocate for changes in policy and practice to reduce environmental risks and strengthen the health and wellbeing of community and Country.

Summary

The case study explores the integration of Aboriginal and Western knowledge systems to address climate change impacts on Aboriginal communities in Australia. Aboriginal and Torres Strait Islander

communities are experiencing significant environmental challenges due to climate change, yet their involvement in policy and research has been limited despite their long-standing knowledge of environmental adaptation.

The Healing Country project, led by Aboriginal communities, aims to combine Indigenous knowledge with Western environmental and health data to document observed changes to Country and their effects on community wellbeing. The initiative is implemented across three diverse landscapes: Warumungu (NT), Whadjuk Noongar (WA), and Bundjalung Country (NSW), with a specific focus on the Whadjuk Noongar Boodja region in Perth, Western Australia.

A participatory action research (PAR) approach, alongside Indigenous methodologies such as yarning, is being used to facilitate culturally safe data collection and relationship building. The project is community-led, with guidance from a Cultural Experts Group (CEG) comprising respected Elders who provide cultural governance and local leadership.

Key project activities include qualitative data collection through yarning, development of online story-data maps, and co-design of community-led climate adaptation plans. These outputs will serve as advocacy tools and support decision-making on mitigation and adaptation strategies. The project prioritizes Indigenous Data Sovereignty principles, ensuring community ownership and control over shared knowledge.

Early findings reveal significant climate-related challenges such as rising temperatures, drying waterways, and declining bush food and medicine availability. Urbanization and air pollution further exacerbate these challenges, impacting both human and environmental health.

Success factors include employing community-based researchers, fostering trust through kinship networks, and adapting communication methods to local cultural contexts. Challenges include recruitment difficulties, logistical barriers, and the complex social determinants affecting community health and wellbeing.

Ultimately, the project emphasizes the importance of Aboriginal leadership and collaborative approaches in designing meaningful and actionable climate adaptation strategies that prioritize the health and wellbeing of both community and Country.

Key Research Translation Principles

- Research is rigorous, ethical, and underpinned by a shared purpose to achieve the aim and objectives of the HEAL Network
- Integration of Aboriginal and Torres Strait Islander concepts, culture, and ways of knowing
- Action-oriented research to facilitate involvement and knowledge sharing
- Building reciprocal relationships to foster trust and respect

FULL CASE STUDY: Healing Country on Whadjuk Noongar Boodja: Weaving knowledge systems to meet climate challenges.

Introduction

For tens of thousands of years Aboriginal people have been leaders in caring for their Country and are acutely aware of the changing climate and environmental factors as they walked, lived, and worked the lands for survival.

This case study, based on Noongar Boodja (Noongar Country) in Perth, aims to weave together local Aboriginal community knowledge and experiences in how Country is changing with an aim to co-design tools and actions for change. This involves documenting their climate concerns, developing online story-data maps to demonstrate the changes that have been occurring to Country and using these as the basis of community-led climate action plans that outline strategies to address priority climate change issues. This project will also co-design evaluation tools and processes to help guide community selection of evaluation and monitoring indicators that represent value concepts important to community to evaluate the implementation of local climate adaptations.

This community-led partnership is between Noongar Elders and Aboriginal community members, researchers, local service providers and relevant stakeholders. Aboriginal traditional knowledges about extreme climate and environmental factors are told through narratives and relate to the six Noongar seasons (Figure 1). Environmental changes within the seasons are relational to flora, fauna, and community. Shared narratives are revealing that climate change is severely impacting Aboriginal people and everything around them. This includes their relationships with Country, their families, distribution of bush foods and medicines, health and wellbeing, and planning for the future. People are observing that the days are hotter, waterways are drying up and reduced access to shade is prevalent. Bush foods and medicines are getting harder to access and urbanisation projects competing for land and water is displacing wildlife. A continuous increase in health issues due to air pollution is becoming evident to the community, affecting humans, flora and fauna.

Figure 1: Noongar six seasonal calendar (Developed by Dannjoo Koorliny Walking Together https://danjookoorliny.com.au/pages/six-seasons)

These many changes present challenges in maintaining healthy connections to communities, culture, Country, bush food, medicines, totems and waterways. In addition, Perth is one of the fastest drying regions on the planet. Hence, the importance and value of bringing together Aboriginal and Western ways and knowledges to inform climate change mitigation and adaptation strategies using a bottom-up community-led approach.

The project overall seeks to answer the following questions:

1. Is participatory community-based mapping an acceptable methodology for Aboriginal communities to document current climate concerns, convey understandings of changes to Country and what may occur into the future with climate change modelling and predictions?
2. What are the practical Indigenous Cultural and Intellectual Property safeguards required to ensure strong Data Sovereignty principles are maintained when drawing on Aboriginal Knowledges?
3. What is an appropriate systems methodology to bring together diverse policy and service provider stakeholders to implement Aboriginal-led climate mitigation and adaptation strategies?

Upholding principles of Indigenous Data Sovereignty, the project brings together community and relevant stakeholders to co-design and implement climate change adaptation strategies embedded within a monitoring and evaluation framework.

A Locally-based Approach

To ensure the project prioritises and reflects the unique community protocols, Country and climate concerns, the Healing Country WA Cultural Experts Group (CEG) has been established. The CEG provides place-based leadership and cultural guidance and local governance to ensure the project is delivered *right way*. The group is made up of five respected local Aboriginal Elders with lived experience and knowledge on changing climate conditions in relation to the six Noongar seasons. Made up of male and female Elders to ensure diversity of knowledge and experiences, this group brings a wealth of experiential knowledge including local community initiatives for healing Country in collaboration with partnering organisations. Together with the Healthy Environment and Lives (HEAL) WA Aboriginal Steering Group (ASG), these groups provide cultural governance and leadership overall for the project.

The research is being conducted using culturally safe research methods such as a Participatory Action Research (PAR) approach and Yarning. PAR enables Aboriginal people to hold decision-making power at all stages of the research and enables the co-design of all research activities including knowledge translation. Yarning is a culturally appropriate method for collecting the stories of Aboriginal people (Bessarab & Ng'andu, 2010). For this project, yarns were facilitated using a yarning tool for data collection. The appropriate Aboriginal community members for yarning with were identified using a snowball method, initiated by Elders in the CEG. Yarns included sharing knowledge and understanding of how Country has been changing through the lens of the Noongar seasons.

Aboriginal community members were informed about the project and their right to participate and withdraw from the project at any time. In line with Indigenous Data Sovereignty principles, transcripts were shared with participants for validation. This provides participants the opportunity to confirm if the data is allowed to be kept and shared with community and stakeholders, to remove or amend anything that is not captured correctly, or identify if any knowledge is not appropriate for public sharing.

Applying Research Translation in Practice

This project aims to demonstrate best practice in engaging and involving Aboriginal communities in research. The team is working to achieve this, as the project is co-designed and led by Aboriginal people. Aboriginal people are included at all levels of the research including governance, data collection, and designing research outputs. The project follows a Participatory Action Research methodology, as described below.

Community and stakeholder engagement

The engagement with community and stakeholders commenced with social yarns well before the formal research began. As part of another project, yarns with members of the Aboriginal community highlighted concerns about the changes to Country and climate and how they were impacting on Aboriginal people's health and wellbeing and their ability to access their Country. These social yarns showed that, for the Aboriginal community in Perth, the term 'climate change' predominantly referred to weather patterns and extreme events. Therefore, to support shared understanding, 'changes to Country' and 'health of Country' replaced the phrase 'climate change'.

These initial yarns signalled to the researchers that the community was interested in climate change research and highlighted the importance of communication. Using the right language is essential when yarning with community and to connect, engage and later recruit Elders to the project. It also supports understanding and knowledge, to assist and guide yarning and to be prepared for questions asked from local community.

Collaborative yarning with Aboriginal community members and relevant stakeholders were opportunistic in nature, and were used to brainstorm, share, collaborate and come up with many ideas to guide next steps and ensure stakeholders were engaged early on. Community engagement and connections were strengthened by attending community events on Noongar Boodja such as NAIDOC events and workshops delivered for and with the community on relevant topics. It was essential at that stage to establish new connections or build on existing relationships with Elders in the community to engage and discuss what changes to Country means to them. These yarns directly shaped the development of this project.

These initial yarns informed the development of the yarning tool to guide collecting community stories. This will lead to the co-design of community climate action plans alongside service delivery agencies, local organisations and policy representatives.

We also yarned with the Aboriginal community about the name of the project. Themes from the initial yarns centred on: how our bush tucker and bush medicine is no longer readily available for us; these things are not easily found when going on Country. It was agreed that the term used needed to be changed and community came back saying we were talking about 'healing Country'. This led to removing the language barriers for ongoing yarns on Noongar Boodja. It was also found that local terms used were hard for some in the yarning process, such as 'climate change'. There was always a need for reflection and restructuring the way questions were being posed. This was found as we introduced topics of access to bush food, flora for bush medicines and access to clean water supply especially when it was reported people were no longer able to fish from the river.

To participate, members of the community and local organisations are made aware of the research nature of the project and sign consent forms. Based on previous yarns, a yarning tool was developed. This was used to guide yarns with Aboriginal community members. Yarns start with the six seasons on

Noongar Boodja (Figure 1) and follow an open-ended semi-structured interview format led by the participant. They provide a local Aboriginal community perspective on changes to Country and include knowledge on environmental changes that have impacted communities' health and wellbeing over time. Yarns are recorded and transcribed. This knowledge is being woven together with quantitative health and environmental data to develop community story-data maps to visually represent changes as an education and advocacy tool. The data will also be used to co-design a community action plan with input from all stakeholders to detail effective and appropriate climate adaptation strategies aimed at strengthening community adaptability and improving the health and wellbeing of community and Country.

Through the HEAL network, connections and partnerships have been endorsed in WA. There have been meetings with policy makers, non-government and other stakeholders attending as invitees through the HEAL WA regional conference and Communities of Practice meetings. At these meetings new partnerships have been established based on relational work required for the project.

Aboriginal community workshops have also been attended through collaboration with stakeholder members. The workshops conducted were with Aboriginal Elders, government and non-government representation and younger people caring and supporting their Elders. The meetings attended were based on climate change and disaster resilience, seeking the understanding, knowledge and impact on the local community's needs including the resources available to them and any consultations at a local government level. Visual imagery was used to help support the delivery throughout the yarning sessions, helping Aboriginal community members to understand the discussion on topics relative to their community location.

Development of cultural governance

The project has a strong focus on governance to ensure the outcomes of this research are used by the project team and Aboriginal community members as tools for informing relevant policy and multisectoral changes to practice.

Governance was provided to the project in the first instance, by the HEAL WA Aboriginal Steering Group (ASG). The ASG is made up of a range of Aboriginal people of different ages, genders, experience in research, and that live in geographically diverse parts of WA. This diverse group brings a wealth of knowledge to the governance of our project. An Elder, Uncle/Dr Noel Nannup, from the ASG was identified as a key person to be involved in the project, due to his leadership, knowledge, expertise, skills and passion for working in the area.

As a result of the ASG governance meetings, it was suggested that a Cultural Experts Group (CEG), be formed and for Uncle Noel to be part of the group. Uncle Noel identified other knowledgeable Aboriginal Elders to be included in the group. The process of continued consultation ensured group members were knowledgeable in the topic and were able to connect, engage and support each other without conflicting issues. A total of four other Elders were recruited for the CEG. Representation of male and female Elders was determined as important for best practice, especially as men's and women's business is important to culture, history, and Aboriginal Lore.

The CEG meets every second month. The first meeting focused on bringing together the members to introduce each other, establish rapport and build strong relationships whilst ensuring everyone was willing to work within the project and with each other. It was necessary to ensure those nominated were able to attend the majority of CEG meetings and participate in doing special tasks if required. This group identified other appropriate Aboriginal community members to be part of the research as participants,

such as those who have worked in land management, water corporations, as well as the Whadjuk Aboriginal Corporation and other Aboriginal groups.

Ongoing governance, guidance and support is sought from the ASG and CEG to ensure the project accurately reflects the needs and knowledge of the Aboriginal community. Communication with the ASG and CEG, the broader Aboriginal community and other partners will be maintained through open dialogue that is authentic, transparent and honest, with truth telling if required. Knowledge shared from the participants will be collated and used to create story-data maps. The governance groups will also advise on how to best share this information with the community and stakeholder groups.

Research Translation Outcomes

Although the project is still underway, multiple research translation outcomes are expected, including a digital story-data map, a climate change action plan, and community-led research translation activities.

The digital story-data maps that will be developed by Noongar Elders and knowledge holders, will showcase their ancient and contemporary wisdom, as well as relevant environmental and health data, to be used as a communication tool for communities to advocate for change. These story-data maps will help communities lead development of local climate action plans in conjunction with relevant policymakers and service providers. These story-data maps and plans will support local decision-making on what climate change adaptation and mitigation strategies to implement and evaluate – which, in the long-run, will improve health and wellbeing outcomes of both community and Country.

Further knowledge synthesis and translation activities will be co-designed in formats that community indicate are of value to them. Based on previous research project, these may include arts-based research outputs, plain language summaries of publications, short videos, infographics and community reports in accessible language and formats. These products will be co-developed with local community and other First Nations designers to ensure cultural translatability and appropriateness.

Reflections

Success factors:

- Employment of community-based researchers.
- Having a connectedness to community through family, Elders, kinship and Aboriginal services.
- Developed relationships based on trust, honesty, authenticity and foundational rapport with kinships.
- Overcoming language barriers, simplifying messages and use of imagery e.g., climate change Vs healing Country.
- Consulting with community on local issues and inviting members onto governance groups and workshops supports local ownership.
- Provision of reciprocated information sharing.
- Having a developed set of questions to guide yarning for better understanding, knowledge exchange and better decision making.

Challenges:

- Recruitment of older members for governance groups as they are busy with family commitments and often already members of other groups.
- Social determinants impacting on community health and wellbeing, including sorry business, grieving without opportunity to heal leading to further sickness and stress.
- Difficult to contact Elders, often use shared phones with other family members, and won't answer if number is unknown to them.
- Unreliable transport for travel to meetings.
- Remuneration for participants, eg. gift cards.

Key factors for best practice Research-Policy-Practice Translation

- Essential to have Aboriginal leadership so that the project reflects their needs and ensures that the end result will be something useful, beneficial and of meaningful value to the community.
- Working at the pace of community.

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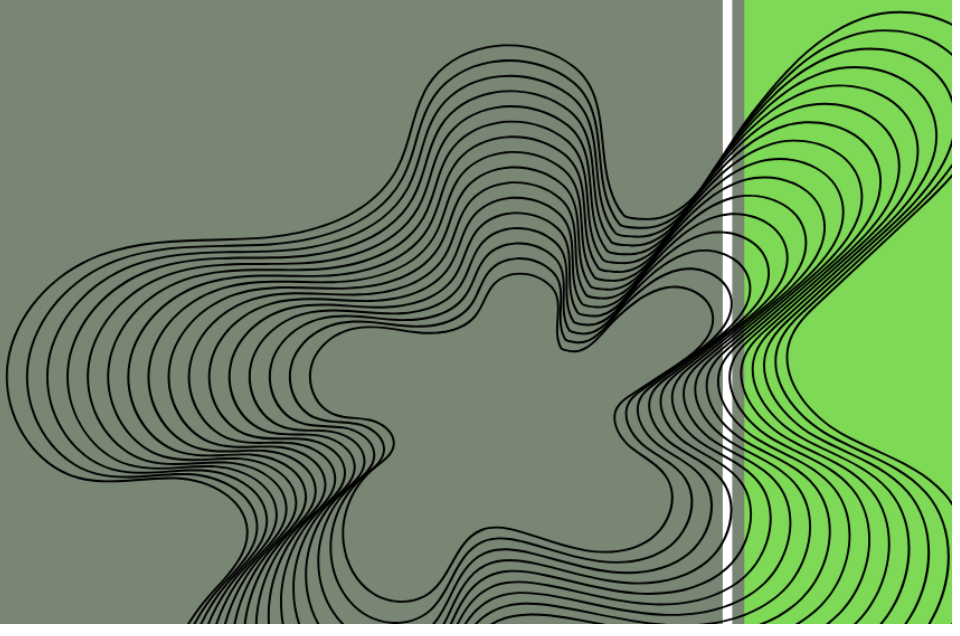
Working with industry to prevent and mitigate antimicrobial resistance (AMR)

Sopheak Hem, Mary Carr, Rachael Nightingale, Alex Lloyd, Aaron Jex, Ricardo Soares-Magalhaes, Andrew Barnes, Nicholas J. Ashbolt, Erica Donner



OVERVIEW: Working with industry to prevent and mitigate antimicrobial resistance (AMR)

Title: Working with industry to prevent and mitigate antimicrobial resistance (AMR)

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Highlights

- Implementing an effective One Health AMR policy faces significant challenges due to low awareness among industry stakeholders.
- Illustrating SAAFE CRC's co-design approach that fosters collaboration across diverse sectors, promoting understanding and prioritizing AMR as a shared responsibility.
- Demonstrating active engagement with private enterprises and governments, SAAFE seeks to transform AMR from an abstract threat into a manageable, investment challenge, driving behavioural and technological changes that lead to tangible real-world impacts, as developing with SAAFE-SA.EPA risk modelling and management project.

Summary

Antimicrobial resistance (AMR) poses a critical global threat to human, animal, and environmental health, demanding a multi-sectoral response. The Cooperative Research Centre for Solving Antimicrobial Resistance in Agribusiness, Food, and Environments (SAAFE CRC) addresses these challenges through a One Health approach. By integrating human, animal, plant, and environmental health perspectives, SAAFE fosters collaboration among researchers, industry, and government to mitigate AMR risks effectively.

AMR arises from decades of antimicrobial use, leading to resistant microorganisms that threaten treatment efficacy across sectors. Recognizing the complexity of AMR drivers, SAAFE employs a co-design approach, involving stakeholders in research design to ensure practical implementation. Key programs include monitoring AMR genes and organisms, analysing data for informed decision-making, and developing innovative solutions such as vaccines and water treatment technologies. Foundational projects focus on high-priority areas like agriculture, water management, and waste treatment.

SAAFE's governance structure, featuring advisory committees like the Research Advisory Committee and the Policy and Regulatory Advisory Committee, ensures research is aligned with industry needs and

regulatory frameworks. The establishment of the First Nations and Youth Advisory Committees highlights a commitment to inclusivity. In its first year, SAAFE launched nine research projects, leveraging over $21 million in support, and hosted its inaugural AMR Solutions Summit, uniting over 200 stakeholders.

SAAFE's efforts are transforming AMR into a manageable challenge by driving behavioural and technological changes. Through partnerships and outreach, including webinars, newsletters, and an annual summit, SAAFE facilitates knowledge exchange and strengthens stakeholder engagement. Its integrated approach positions it as a leader in addressing AMR, ensuring the sustainability of human, animal, and environmental health, as well as food security and economic prosperity, in Australia and beyond.

Key Research Translation Principles

- Empowerment and inclusion of diverse stakeholders
- Action-oriented research to facilitate involvement and knowledge sharing
- Collaboration to create inclusive and dynamic partnerships
- Building reciprocal relationships to foster trust and respect
- Collective responsibility for generating policy-relevant knowledge

FULL CASE STUDY: Working with industry to prevent and mitigate antimicrobial resistance (AMR)

Introduction

Antimicrobial resistance (AMR) represents a critical global threat with profound implications for human health, water quality, food safety, security, and agricultural productivity. Left unchecked, AMR poses the risk of widespread treatment failures across multiple species, production disruptions, and significant impacts on trade, ultimately endangering food safety and security (1). The far-reaching consequences of AMR affect not just healthcare systems but industries and communities at large, demanding a coordinated, multi-sectoral response.

Recognizing the interconnected nature of human, animal, plant, and environmental health, Australia's Cooperative Research Centre for Solving Antimicrobial Resistance in Agribusiness, Food, and Environments (SAAFE CRC) adopts a One Health approach to address this challenge (2). SAAFE CRC facilitates collaboration among researchers, industry, and government partners, working together to co-design research projects and implement systems aimed at mitigating AMR (Figure 1). As the Centre transitions from its establishment phase to full operation, initial projects focus on high-priority sectors, including water management, agriculture, and viticulture (3). These efforts are supported by a range of educational initiatives and aim to drive substantial progress in safeguarding the health of Australia's industries and communities (4)

Figure 1: A 'One Health' approach to managing AMR recognizes that populations, species, facilities, and industries co-exist within environments, and are connected by the movement of people, animals, goods and materials. The drivers of AMR (e.g. antibiotics, antifungals etc), as well as the resistant organisms and their genes (all represented here by white dots), are also connected across populations, species, and environments.

In alignment with global appeals from the Food and Agriculture Organization (FAO), the World Organisation for Animal Health (WOAH/OIE), the World Health Organization (WHO), and the United Nations Environment Programme (UNEP), SAAFE aims to act urgently to address the growing AMR crisis

(5). Through the annual AMR Solutions Summit and leadership initiatives, SAAFE fosters collaboration across sectors, bringing together future leaders from industry and government to address AMR with a One Health mindset.

The global challenge of AMR arises from decades of antimicrobial use in human, animal, and plant health to prevent and treat infections. As microorganisms evolve resistance to these antimicrobials, once-treatable infections become increasingly difficult—and sometimes impossible—to manage. Antimicrobial stewardship, which focuses on the judicious use of these drugs, is essential to slow the development of resistance and ensure continued efficacy, but it also required interventions from other sectors to contain AMR development, such as in the management of manures and sewage and where their residuals end up.

Despite the pressing nature of the problem, implementing One Health AMR policy is challenging. The multi-sectoral nature of AMR, compounded by pervasive uncertainties and complex risk factors, requires widespread industry engagement and regulatory support. Low awareness among stakeholders presents an additional barrier, making it essential to communicate AMR risks effectively and tailor strategies to specific industry needs. Collaborative research programs, like those at SAAFECRC, target these challenges through ongoing monitoring, analytics, and innovative solutions, ensuring a holistic approach to antimicrobial stewardship and AMR mitigation (6).

This case study will examine how the One Health approach, combined with SAAFE's strategic initiatives, is transforming AMR from an abstract global threat into a manageable, investment challenge for diverse industries (7). Through co-design and collaborative research, SAAFE is facilitating the behavioural and technological changes necessary to address this critical issue, driving tangible impacts across sectors (8) (Figure 2)

Figure 2: SAAFE's research program structure focuses attention on AMR monitoring, analytics, and solutions.

Applying Research Translation in Practice

Managing AMR presents a complex challenge due to its cross-sectoral nature, pervasive uncertainties, and the intricate interconnections among its risks and drivers. AMR impacts multiple domains, including human health, agriculture, animal health, and environmental sustainability. This network of interrelated factors complicates the development of effective management and mitigation strategies (9).

Australia's Cooperative Research Centre for Solving Antimicrobial Resistance (SAAFECRC) is a national consortium that addresses these complexities. Led by Professor Erica Donner (Research Director) and Mr. Alex Lloyd (CEO), SAAFE brings together leading researchers, industries, and government partners from the food, agribusiness, and environmental sectors. Through a collaborative approach, SAAFE is developing solutions to protect industries, communities, and the environment from AMR.

To support this collaborative effort, SAAFE established a series of advisory committees that guide its research and governance (Figure 3). These include the Research Advisory Committee (RAC), which comprises industry leaders to evaluate research needs and opportunities, the International Expert Advisory Committee (IEAC), which brings global expertise in AMR and One Health, and the Policy and Regulatory Advisory Committee (PRAC), which evaluates the research needs and outcomes for science-based decisions and policy development. Other advisory Committees still to be formed include the First Nations Advisory Committee (FNAC), and the Youth Advisory Committee (YAC) (2).

Figure 2: SAAFE's research program structure focuses attention on AMR monitoring, analytics, and solutions.

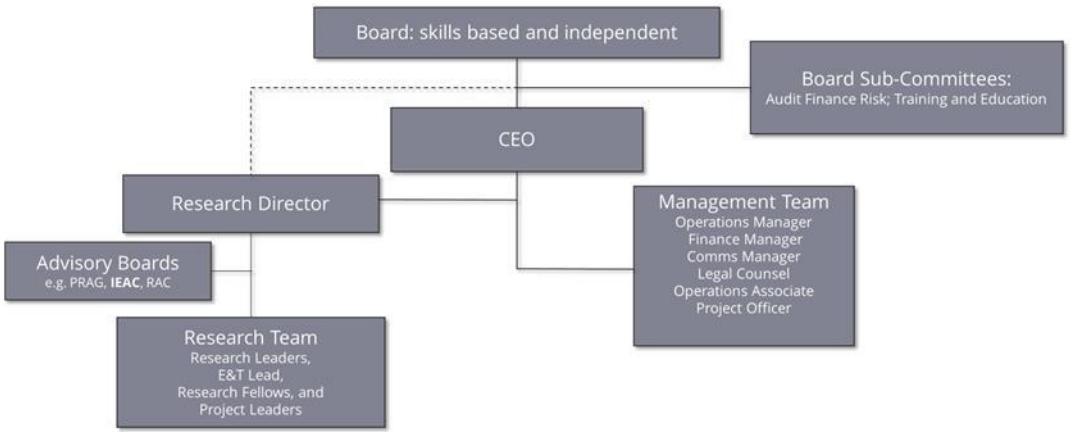

Figure 3: SAAFE Governance and management Overview

With a commitment to invest $150 million in relevant research, SAAFECRC began operations in 2023, and commenced a series of co-design foundation projects aimed in developing core skills and standardised approaches to manage AMR risks. These collaborative efforts prioritize the environmental dimensions of AMR and focus on coordinated actions across all sectors that use antimicrobials (Figure 4).

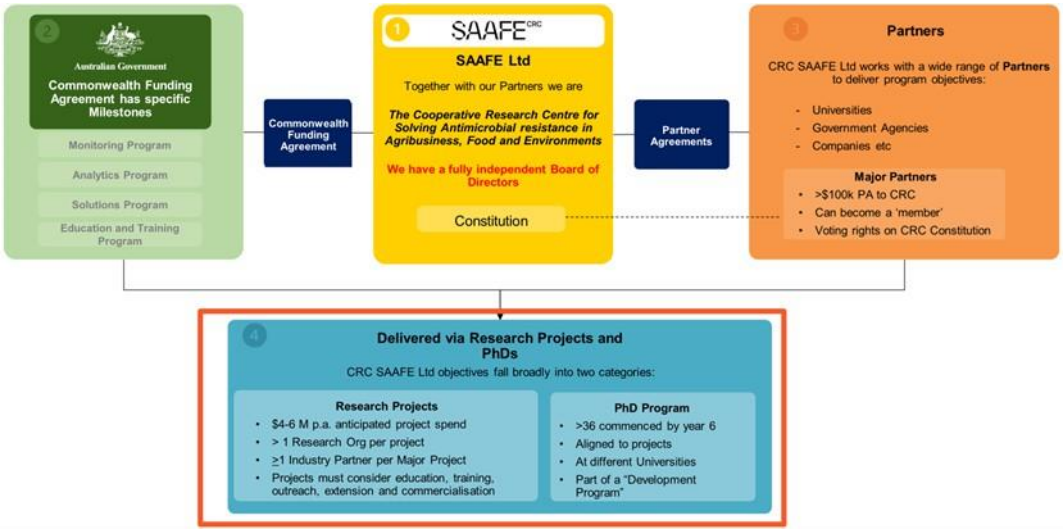

Figure 4: SAAFE's Objective Setting Framework

A key component of SAAFE's work is its co-design strategy, which transforms AMR from an overwhelming threat into a challenge that industries can tackle (10). By actively involving stakeholders in research design, SAAFE ensures that projects have clear pathways to practical implementation and impact. This approach is central to fostering behaviour change and driving technological innovations that help mitigate AMR (11) (Figure 5).

Figure 5: SAAFE is forming partnerships across multiple sectors to help mitigate the threat of AMR.

SAAFE's research activities are organized into three integrated programs: the Monitoring Program, the Analytics Program, and the Solutions Program.

The Monitoring Program, led by Associate Professor Aaron Jex, develops the platforms and protocols needed to track AMR genes and organisms across industry-specific environments such as water, organic waste, and food. Foundational projects include monitoring AMR in Australia's water systems and developing diagnostics for managing fungicide resistance in agriculture. This program also supports risk assessments and interventions to manage the transmission of AMR organisms through environmental pathways (2).

The Analytics Program, led by Professor Ricardo J. Soares Magalhães, focuses on data integration across food and water value chains to provide industry-specific AMR intelligence. By collaborating with industry and government, the program enhances decision-making processes in food production and waste management through improved data governance and management systems (2).

The Solutions Program, led by Professor Andy Barnes, identifies, creates, and tests interventions that reduce AMR risks in agribusiness, food, water, and waste systems. This includes developing vaccines, alternative treatments, and engineered solutions to improve water quality and waste treatment, ultimately reducing AMR in the environment (2).

SAAFE's Living Labs program, led by Professor Nicholas Ashbolt, further bridges research and real-world application by facilitating AMR management and technology demonstrations. This program helps assess cost-effective strategies for managing AMR, with a focus on setting critical control points and shaping future policies for antimicrobial stewardship (2).

In addition to its research initiatives, SAAFE actively engages with its stakeholders through the annual AMR Solutions Summit. This event provides a platform for sharing insights and advancing strategies to combat AMR. It also serves as a cornerstone for outreach efforts, influencing decision-makers, building credibility, and fostering engagement across sectors.

SAAFE's work ultimately aims to mitigate the risks of AMR across diverse industries while supporting the long-term sustainability of human and animal health, biosecurity, and environmental protection. Through its integrated research programs and strategic collaborations, SAAFE is helping to ensure that critical antimicrobial treatments remain effective in the face of growing AMR challenges.

Research Translation Outcomes

SAAFE is successfully uniting a broad network of partners, including industry stakeholders, researchers, government agencies, and communities, to AMR. This collaboration navigates a dynamic landscape where AMR risks are continually evolving due to technological advances, shifting consumer behaviours, and emerging antimicrobial use patterns.

To effectively engage stakeholders and support decision-makers, SAAFE employs strategies tailored to the unique needs and contexts of various sectors, including healthcare, agriculture, and environmental management. This ensures that the right messages and actions are promoted.

With a dedicated team and a network of highly skilled professionals, SAAFE is poised to develop and implement innovative solutions to address AMR. Following a productive initial year, SAAFE is set to embark on a ten-year journey to find solutions to AMR, a problem that could potentially cost the Australian economy up to $283 billion by 2050. The first cohort of foundation research projects has been established, with nine projects approved by the SAAFE board. These projects, now either underway or in the final stages of contracting, will collectively contribute more than $21 million in cash and in-kind support to SAAFE's research program over the coming years.

A major highlight of 2023 was SAAFE's official launch and the inaugural AMR Solutions Summit, which brought together over 200 attendees from more than 70 forward-thinking research, industry, and government partners, along with leading AMR experts from around the world. After a year of establishment, recruitment, and planning, 2024 has focused on seeding, facilitating, and fostering collaboration among projects and sector. This includes the continued recruitment of SAAFE Foundation

Research Fellows, the establishment of scientific and industry review panels, and the initiation of initiatives to build connections and share knowledge among projects.

In 2024, SAAFE will expand its research programs, enhance connections between projects, and communicate progress through a new monthly newsletter, an updated website, and a monthly webinar series featuring expert presentations and project updates (12).

Adopting a One Health approach, SAAFECRC recognizes the interconnectedness of human, animal, and environmental health. By facilitating collaboration among its partners, SAAFE aims to lead the global fight against AMR. We look forward to continuing our efforts with our partners to coordinate the AMR response across the Australian agribusiness, food, and environmental sectors, thereby safeguarding human and animal health, food security, and economic prosperity for the future.

Reflections

Over the past two decades, a significant amount of data and literature has been generated regarding the environmental dimensions of AMR. Researchers have explored various aspects, including the impacts of AMR on ecosystems, public health, and agriculture. However, despite this valuable information, we have seen limited progress in achieving the behavioural and technological changes needed to effectively address AMR.

This gap between what we know and what we do highlights the importance of understanding the barriers to change that still exist in the field. Many stakeholders—policymakers, healthcare professionals, and researchers alike—often find it challenging to translate their findings into practical solutions that can create real-world impacts.

In light of these challenges, SAAFE's work aims to share insights into the obstacles hindering progress in AMR management. By identifying these barriers, we aim to help discover strategies for meaningful action. We also aim to enhance collaboration and engagement across various sectors. This shared understanding may lead to more effective implementation of interventions and increase the likelihood that our collective efforts will yield meaningful benefits for public health and the environment. Ultimately, fostering a more integrated and cooperative approach to mitigating AMR is essential for ensuring a sustainable future and protecting both human and ecological health.

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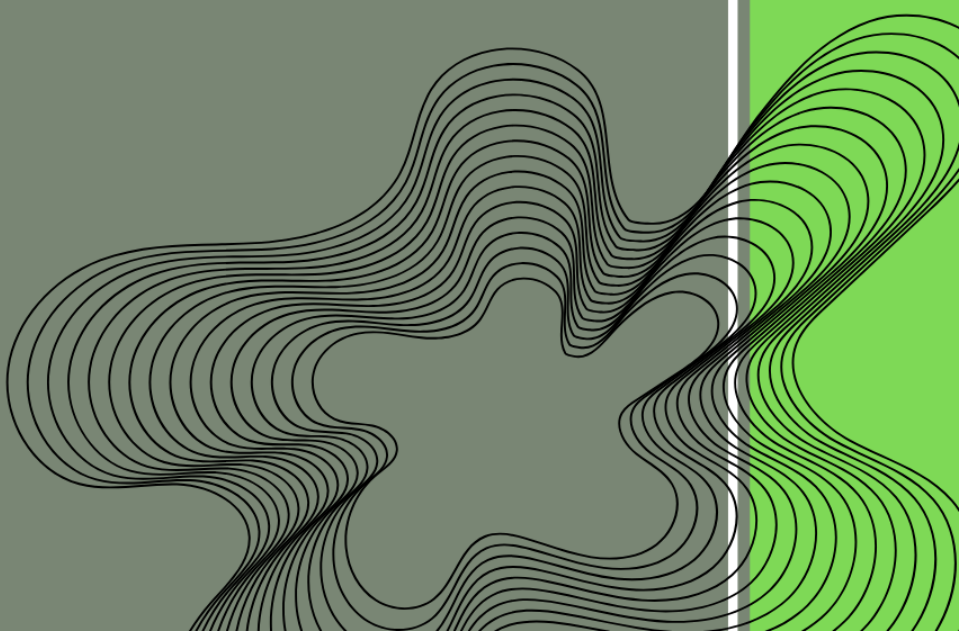
The Australian Environmental Health (AusEnHealth) Project

Aiden Price, Kerrie Mengersen



OVERVIEW: The Australian Environmental Health (AusEnHealth) Project

Name of Authors: Aiden Price, Kerrie Mengersen

Highlights

- The Australian Environmental Health (AusEnHealth) project was initiated to address fragmented environmental health data across Australia, which has hindered effective policy-making and public health interventions.
- By integrating environmental and health datasets, AusEnHealth provides policymakers, health practitioners, and researchers with interactive tools to visualize vulnerability indices and environmental indicators.
- Research undertaken as part of this case study involved a detailed analysis of environmental health data, collected and integrated from various sources across Australia.
- A significant outcome of this work was the development of a digital environmental health decision support platform, which offers policymakers and practitioners easy access to essential data and insights. This platform enables strategic policy planning, as well as urban planning and community resilience, demonstrating its value as a tool for bridging the gap between research and practice.

Summary

This case study exemplifies best practice Research-Policy-Practice Translation (RPPT), adhering to the principles outlined in the HEAL Research Translation Strategy, including communication, collaboration, trust and partnership building, co-design with communities, and capacity building. The project maintained these principles through regular stakeholder meetings, workshops, and collaborative decision-making processes. Involving community voices in the platform's design ensured that the solutions developed were practical, relevant, and widely accepted.

Research translation activities were a key aspect of AusEnHealth's development, ensuring that the resulting decision support platform could be easily understood and utilised by a wide range of stakeholders. As a result of these research translation efforts, AusEnHealth has had a tangible impact in the environmental health space, informing national and state-level policy discussions such as the Western Australia Climate Inquiry and Australia's National Health and Climate Strategy. The platform has been adopted by various government agencies for strategic planning and environmental health risk assessments. Further, ongoing collaborations with institutions like the Australian Institute for Health and Welfare (AIHW), the Western Australian Department of Health (WADOH), and the Environmental Protection Authority Victoria (EPAV) continue to drive enhancements in data integration and visualization. Ultimately, research translation drives the research product into the hands of end users and will support the long-term, widespread use of AusEnHealth by policy makers in future.

The project has also enhanced the capacity for research translation within the HEAL Network, with key shared learnings including the importance of early and continuous stakeholder engagement, the need for flexibility in addressing data-related challenges, and the value of presenting clear, actionable insights

to policymakers and other project stakeholders. This case study demonstrates best practices in Research-Policy-Practice Translation by effectively addressing environmental health issues through a collaborative, evidence-based approach, setting a benchmark for future HEAL Network RPPT initiatives aimed at improving public health and environmental outcomes. The AusEnHealth project has also engaged members of the network in plans for continued development, resulting in the award of $1.94m in research funding from the National Health and Medical Research Council's Medical Research Future Fund (MRFF). Future development will focus on expanding data coverage, refining user experience, and strengthening cross-sector engagement to further embed AusEnHealth into policy and practice frameworks.

Key Research Translation Principles

- Action-oriented research to facilitate involvement and knowledge sharing
- Empowerment and inclusion of diverse stakeholders
- Funding distribution prioritizes research translation and impact
- Building reciprocal relationships to foster trust and respect

FULL CASE STUDY: The Australian Environmental Health (AusEnHealth) Project

Introduction

The AusEnHealth project was developed in response to the fragmented nature of environmental health data across Australia, which has long posed a challenge for policymakers, health practitioners, and researchers seeking to assess and mitigate public health risks. Without a centralized system to integrate, analyse, and visualize environmental health indicators, decision-makers have struggled to respond effectively to hazards such as rising temperatures, extreme weather events, and worsening air quality.

This initiative, led by the Queensland University of Technology (QUT) in collaboration with FrontierSI, NGIS, and multiple government agencies, sought to respond to the above need by developing a comprehensive, digital environmental health decision-support platform. The primary research question guiding this effort was: "How can environmental health data be effectively integrated and utilized to inform policy decisions and public health interventions in Australia?" By bringing together diverse datasets and presenting them in an accessible, interactive format, the project aims to enhance situational awareness, support vulnerability assessments, and inform strategic planning for climate adaptation and public health resilience.

Key challenges in the project included overcoming inconsistencies in data formats, negotiating access to restricted datasets, and ensuring that the platform was both user-friendly and scientifically robust. These challenges were addressed through an iterative co-design process that engaged policymakers, researchers, and community stakeholders at every stage. By incorporating their feedback, the project team was able to refine data processing methodologies, develop clear and actionable insights, and tailor the platform's functionalities to meet diverse user needs.

The implementation of the HEAL Network's Research Translation Strategy played a crucial role in guiding the project. Principles such as collaboration, capacity-building, and co-design with communities were embedded throughout the development process. Extensive stakeholder engagement was conducted to identify key use cases and data requirements, followed by rigorous data audits and integration efforts. The platform was designed to be dynamic, with ongoing updates and refinements driven by emerging research and evolving policy priorities.

Currently in its operational phase, the AusEnHealth platform continues to evolve through user-driven improvements and expanded data coverage. It serves as a vital tool for policymakers, researchers, and community planners, enabling evidence-based interventions to protect public health in the face of environmental challenges.

Applying Research Translation in Practice

From the outset, policymakers, community members, non-government stakeholders, and other relevant parties were actively involved in the AusEnHealth project through regular meetings, workshops, and consultations. These engagements ensured that the project priorities aligned with stakeholder expectations and fostered a sense of ownership among participants.

The involvement of diverse stakeholders significantly influenced the research direction, ensuring that it remained responsive to real-world needs and challenges. The project team modified the development of

AusEnHealth based on feedback from stakeholders to ensure usability and immediate impact. Additionally, AusEnHealth project research outputs have been co-authored with relevant stakeholders and partners, reflecting a shared commitment to the project's goals and ensuring that the findings were both relevant and actionable.

To ensure the platform connects with a wide range of project stakeholders, AusEnHealth was developed as a series of five modules which explored different aspects of the project's key use cases: extreme climate and air pollution. Two examples are provided below to better understand the resulting AusEnHealth product.

Heat Risk Assessment Demonstrator

This demonstrator is designed to enhance strategic policy making and health service planning by providing an interactive visualization tool that features historical and current climate data, indicators, and indices to aid state governments in effective decision-making. The demonstrator, seen in

Figure A, utilises linked visualization tools such as choropleth maps, tables, and dynamic charts to aid users in identifying trends across a range of data for both the whole of Australia and for specific regions of interest.

Data displayed in this demonstrator include the extreme climate indicators, vulnerability indices, and built environment and demographics data deemed relevant to heat health risks through background AusEnHealth activities. Data is available to visualise at both statistical area level 2 (SA2) and statistical area level 3 (SA3) geographical resolutions across Australia and from 2000-2020 (depending on the parameter) at either yearly or monthly resolution. Finally, all data presented by AusEnHealth is available for download in each of the demonstrators.

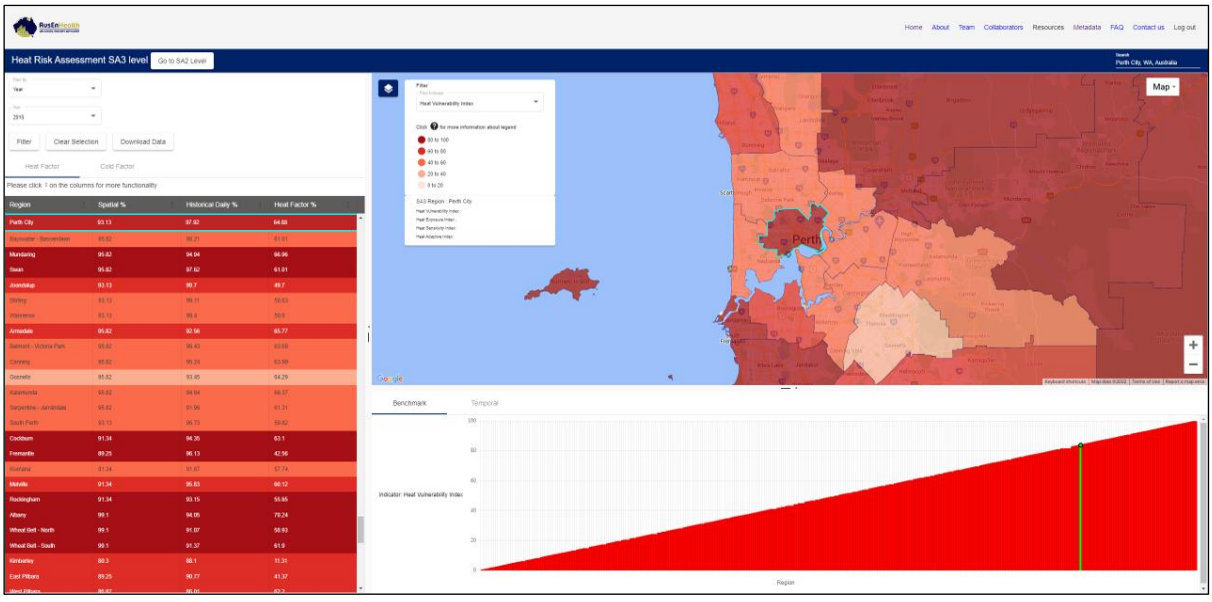


Figure A: The AusEnHealth Heat Risk Assessment demonstrator, displaying the year 2015's heat vulnerability index at the SA3 geographical resolution, centred on Perth, Western Australia.

Heat Climate Change Assessment Demonstrator

This demonstrator aims to provide insight into which regions will be most at risk from heat in the future due to climate change, as well as which regions will transition into heat-risk areas in the future. By leveraging temperature projections from the Intergovernmental Panel on Climate Change (IPCC), this demonstrator specifically addresses the needs of state government users for strategic policy and health service planning purposes. Linked choropleth maps and tables (see

Figure B) are used in this demonstrator to explore "at risk" and "high risk" temperature days for a selected state and its underlying SA3 regions over time, accompanied by a time slider ranging from the year 2000 through to 2100.

The demonstrator allows users to quickly identify the impact of the IPCC climate projections on across Australia, both visually and through supporting data tables. At the state level, a chart also displays temporal trends for temperature forecasts, "at risk" days, and "high risk" days, allowing state governments to anticipate future heat risks and develop proactive strategies to mitigate the health impacts of climate change.

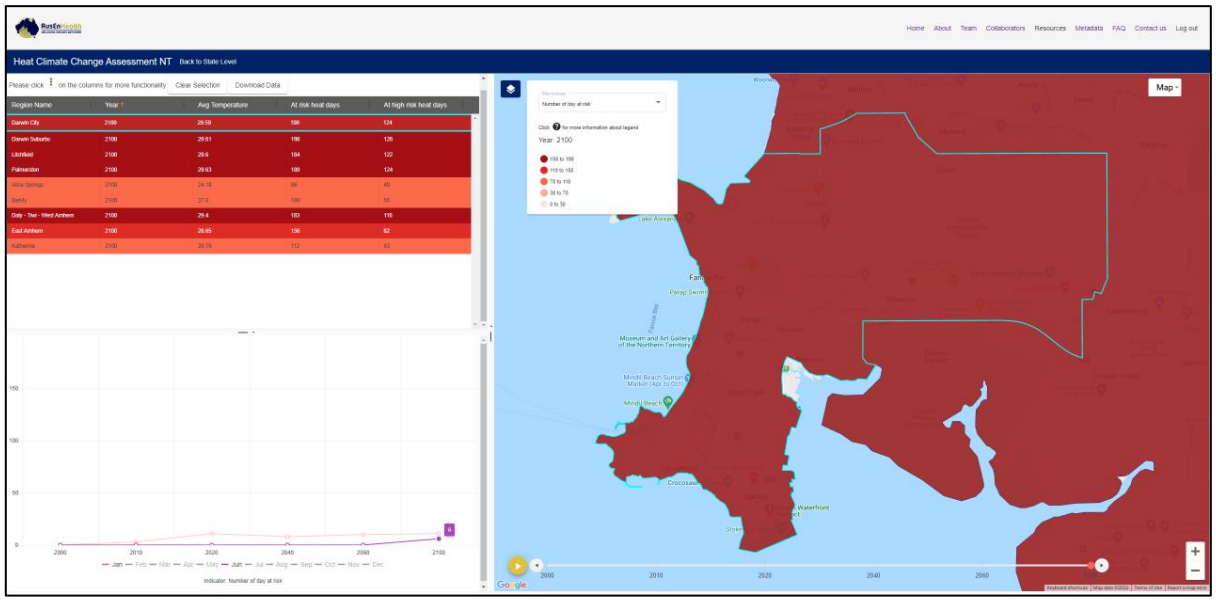


Figure B: The AusEnHealth Heat Climate Change Assessment demonstrator, displaying the year 2100's forecast number of "at risk" heat days as the SA3 geographical resolution, centred on Darwin, Northern Territory.

The communication strategy for AusEnHealth emphasised the use of plain language to ensure accessibility across diverse audiences. Research findings were tailored to the needs of users across different environmental health domains and levels of expertise, highlighting practical implications and real-world applications. This approach made the data and insights more relatable and actionable for policymakers, practitioners, and community members.

Efforts were made to customise the research outputs to address specific local conditions and challenges. For instance, extreme climate data was presented in a way that allowed city planners to easily identify areas needing intervention. The platform's user interface was designed to be intuitive, ensuring that even those with limited technical expertise could navigate and utilise the data effectively, using features such as customizable dashboards and interactive maps. Additionally, the AusEnHealth platform explored live integration with existing external data assets, which allowed experienced users to

parse customised data requests using SQL and inexperienced users to achieve similar results with a simple SQL user interface.

The project successfully established long-term relationships and collaborative partnerships with various stakeholders. Regular interactions with government agencies, NGOs, and community groups helped build a robust network of engaged participants. One particular highlight fostering long-term relationships includes the relationship between AusEnHealth and the Australian Institute of Health and Welfare (AIHW). A member from AIHW, Australia's national data custodian for health outcome data, joined the AusEnHealth steering committee after numerous discussions on both data access and AusEnHealth capabilities and is now a significant contributor to ongoing funding opportunities sought by the AusEnHealth research team based at QUT.

To foster long-term relationships, the project team organised workshops, demonstrations, and held update sessions to keep stakeholders informed about the latest platform developments. These events also served as forums for stakeholders to share their experiences with the platform and insights for future developments, further enriching the collaborative process.

The AusEnHealth project answers decades-long calls for the development of a national environmental health decision support platform and was designed as a pilot product to measure the feasibility and effectiveness of the interventions of such a platform. The AusEnHealth platform has been designed with a modular approach to ensure that a fully developed AusEnHealth resource will effectively resolve challenges in data access and analysis required by researchers and policy makers across Australia.

Feedback from these pilot studies highlighted the need for certain adjustments in data presentation and user interface design and improvements to analysis centred around particular regions to better understand opportunities for intervention and/or mitigation. The insights gained from these pilots helped the project team to plan modifications for future platform developments, ensuring that the platform will be more user-friendly and effective in future development iterations.

Community engagement was a cornerstone of the AusEnHealth project. The team maintained open dialogue with community members throughout the translation and implementation process, ensuring that their perspectives were considered and integrated. Aboriginal communities were also consulted as part of the AusEnHealth project, with specific discussions with the Aboriginal and Torres Strait Islander Community Health Service (ATSICHS) around consideration of indigenous regions and the use of indigenous data in the development of vulnerability indices. Engagement with broad community members ensured that design and implementation phases were carried out with as much input from end-users as possible.

Research Translation Outcomes

The co-benefits achieved through this project include enhanced public awareness of environmental health issues, improved capacity for local governments to plan and respond to health risks and generally has encouraged stronger collaboration across sectors. These outcomes have been optimised by the RPPT process, which ensured continuous stakeholder engagement and adaptation based on feedback.

This engagement has led to a high-quality product which has led to numerous opportunities for the research team behind AusEnHealth's development. This includes the development of health risk indicators with the Western Australian Department of Health (WADOH), consultation to guide the development of ATSICHS data dashboards, the development of indicator tracking tools with the Environmental Protection Authority Victoria (EPAV), ongoing contributions to the development of diverse

data management practices with the Queensland Parks and Wildlife Services (QPWS), assessing intervention impacts in collaboration with the Western Australian Council of Social Services (WACOSS), and informing large-scale landscape restoration programs lead by Greening Australia.

The focus on best practices in RPPT has heightened awareness of the importance of translating evidence-based information into actionable policies and interventions. This has fostered a culture of collaboration and knowledge exchange among researchers, policymakers, and community stakeholders involved in the AusEnHealth project, with follow-on research observed across the AusEnHealth research consortia, as well as through the HEAL Network as noted above.

In summary, AusEnHealth combines existing public and siloed data assets, creates new national indicators and has developed vulnerability indices which capture the intersection of vulnerable populations with vulnerable environments. As such, the AusEnHealth project is well placed to resolve calls in national and state environmental health policy documents for improved decision support capabilities, including the 2019 Western Australia Climate Inquiry and Australia's first National Health and Climate Strategy. The AusEnHealth platform will undergo continued development with paired outreach and co-design to ensure that AusEnHealth is a common tool used for the development of environmental health policy developments.

Reflections

Critical Success Factors

The critical success factors for implementing Research-Policy-Practice Translation (RPPT) in the AusEnHealth project included strong stakeholder engagement, effective communication, and the integration of diverse data sources. The commitment to co-design with community members and policymakers ensured that the platform was both practical and relevant. Continuous collaboration and feedback loops were essential in refining the platform and aligning it with user needs.

Challenges

One significant challenge was the initial difficulty in identifying and integrating disparate data sources with varying standards and consistency. Another challenge is in the communication of results with stakeholders and the public, including the difficulty in separation of inferred associated versus causation. If approached again, and in future developments of AusEnHealth, these communication measures ought to receive more scrutiny to ensure that insights are clear to the diverse target end-users.

Key Factors for Best Practice

Key factors to pass on to the HEAL Network include the importance of early and continuous stakeholder engagement, the need for flexible and adaptive data integration strategies, and the value of clear, actionable communication of research findings. Building strong, collaborative relationships and maintaining open dialogue are crucial to ensure that research is effectively translated into policy and practice.

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Assessing climate change, mortality, urban heat island and greening adaptations using CARDAT (the Clean Air Research Data and Analysis Technology) platform for national climate change and health impact assessments.

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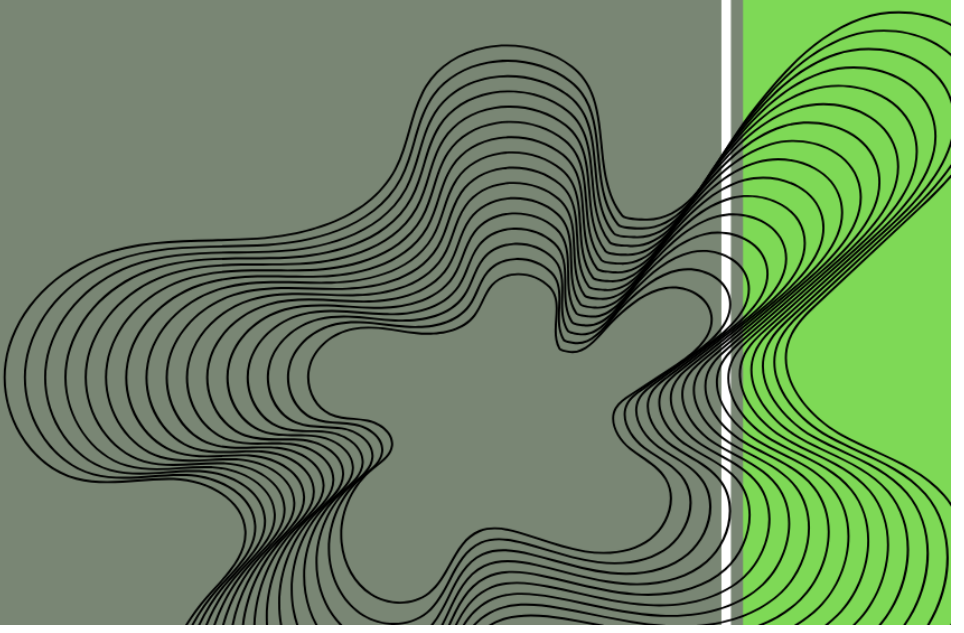

OVERVIEW: Assessing climate change, mortality, urban heat island and greening adaptations using CARDAT (the Clean Air Research Data and Analysis Technology) platform for national climate change and health impact assessments.

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Highlights

- The CARDAT (Clean Air Research Data and Analysis Technology) platform has been instrumental in assessing climate change impacts, mortality, urban heat islands (UHI), and greening adaptations to inform national climate change and health impact assessments.
- A significant application of CARDAT has been in modelling climate-related mortality under different climate change scenarios. The platform integrates air quality, meteorological, and health data to assess the effectiveness of adaptation strategies such as urban greening (increasing tree canopy cover) and reducing black roofs in new developments.
- Findings highlight that these interventions can significantly mitigate heat-related mortality, reducing projected deaths from 540 per year (2080-2099) to approximately 130 under adaptive measures.
- Through research translation efforts, CARDAT has directly influenced urban planning policies in jurisdictions such as South Australia's Playford and the City of Cockburn, where policies to ban black roofs and enhance urban greening have been adopted.
- This case study underscores the importance of robust data platforms in bridging research and policy to enhance urban resilience against climate change and heat-related health risks.

Summary

Increasing heatwave frequency and intensity has become a serious threat for population health. The built environment in cities is further aggravating the impacts of heatwaves known as urban heat island (UHI) effect, with densely populated urban areas being more susceptible to heat-related mortality. Addressing these challenges requires a collaborative approach with multi-disciplinary expertise across academia and policy domains. The integration of the technology required for data analysis and data-sharing of exposure science and health impact assessment (HIA) is needed for such collaboration.

For this case study the Australian Clean Air Research Data and Analysis Technology (CARDAT) platform is used to describe how the collaborative environment enabled researchers and policy workers to investigate relationships between climate change and health (CC&H). CC&H is complex and multifaceted, encompassing many environmental, socio-economic, and demographic attributes. The CARDAT platform was used to develop and co-design a research and policy recommendation process between NSW Ministry of Health, Department of Planning and Environment (DPE), and academics. This enabled the identification of actions to alleviate environmental health impacts by translating data output into policy.

This case study emphasises the importance of sustainable urban development to reduce the impact of heatwaves and UHIs on health. It has demonstrated its effectiveness in generating research and media and policy-informing outputs. It exemplifies successful Research-Policy-Practice Translation, bridging the gap between scientific research and policy development to aid understanding and managing health impacts from climate change.

Key Research Translation Principles

- Development of Research Impact Plans
- Prioritizing capacity development across the network
- Action-oriented research to facilitate involvement and knowledge sharing
- Collaboration to create inclusive and dynamic partnerships

FULL CASE STUDY: Assessing climate change, mortality, urban heat island and greening adaptations using CARDAT (the Clean Air Research Data and Analysis Technology) platform for national climate change and health impact assessments.

Introduction

Heatwaves are a significant public health concern, with increasing frequency and intensity due to climate change. Researchers have quantified mortality rates attributable to heatwaves, revealing alarming patterns using quantitative data analysis. Data analysts often use data platforms that allow for collaborative access to the online computer environments and sharing of advanced modelling tools to facilitate the quantification of the burden of disease. In this case study, the CARDAT platform has been used to model the burden of disease attributed to extreme heat particularly in urban centres, allowing for targeted public health interventions, allowing for a Research-Policy-Practice translation.

Urban areas are particularly susceptible to climate change, with the urban heat island (UHI) effect exacerbating temperature extremes. The NSW Adaptation Research Hub's Human Health and Social Impacts Node funded projects, in collaboration with the NSW Dept. Planning, Industry and Environment, Ministry of Health, the University of Sydney, and the WHO Collaborating Centre for Climate Change & Health Impact Assessment at Curtin University, provided a fertile ground for advancing the analysis of heat and health impacts in Australia. Through a competitive grants process, several projects around 2020 focused on developing Health and Social indicators of Environmental Exposures. By the time HEAL was founded in 2022, these efforts had evolved into creating Environmental and Social Indicators for tracking climate and health impacts. These initiatives, collectively known as the NSW Environmental Health Indicators (EHI) for Monitoring and Evaluation of Climate Change and Health, form the backbone of the current case study.

Projected climate scenarios indicate worsening health outcomes if current trends continue. CARDAT enables incorporating future climate conditions and their potential health impacts, providing critical insights for policymakers. The platform's scenario modelling capabilities help estimate the burden of climate-attributable mortality under various climate change trajectories.

CARDAT has played a critical role in climate change and health (CC&H) projects by providing robust data and analytical capabilities to evaluate these impacts. For example, it has supported State Government-funded HIA projects integrating air quality, meteorological, and health data, enabling researchers to conduct studies on climate-related health outcomes. In one case study, CARDAT was used in a project for the New South Wales (NSW) Adaptation Research Hub on Heatwaves, the Urban Heat Island (UHI) effect, climate change and using urban greening to adapt to the negative health impacts. Subsequently, the HEAL members have built on top of that work and generated multiple subsequent papers and reports, with tangible policy impacts.

CARDAT has been instrumental in analysing the impact of UHIs on mortality rates. Studies using the platform indicate that densely populated cities may experience higher mortality rates unless effective adaptation strategies are implemented. CARDAT's spatial analysis tools are essential for urban planning and the

development of heat mitigation policies. It also facilitates a high level of interdisciplinary collaboration across the project.

CARDAT provides evidence-based recommendations for urban planners and public health officials aiming to enhance urban resilience to climate change, by modelling the potential impact of these interventions. One promising adaptation strategy is greening urban environments with increasing tree canopy cover to reduce the impact of the UHI effect to reduce heat-related mortality. Another intervention is to reduce the amount of black roofs in new developments. CARDAT supports research on the effectiveness of such urban greening interventions.

Contextual factors such as government funding and institutional collaboration played a crucial role in shaping this research. The strong support from state agencies ensured the research outcomes were directly impacting the Research-Policy-Practice translation process. However, barriers such as data integration challenges and varying levels of policy engagement initially hindered effective translation.

Addressing these barriers is critical. The gap between research and practice often exists due to the complexity of integrating multidisciplinary data and the need for continuous stakeholder engagement. The Research-Policy-Practice is vital for this case study as it ensures that evidence-based insights lead to tangible policy actions, ultimately improving public health resilience against climate change. CARDAT's role in facilitating these collaborations underscores the importance of robust data platforms in bridging the gap between research and actionable policy.

Applying Research Translation in Practice

In recent years, CARDAT has emerged as a transformative platform in the study of environment, climate and health. Developed through collaborations involving universities, government departments, and various research institutions, CARDAT facilitates multidisciplinary research by providing a robust data-sharing and analysis environment.

Co-Design and Collaborative *Framework*

The development of the climate change, mortality, urban heat island and greening project on CARDAT was driven by a co-design process involving the NSW Ministry of Health (MoH), Department of Planning and Environment (DPE), and academic experts. Through workshops, they identified priority hazards and set ambitious goals to develop a framework for ongoing monitoring and evaluation of Environmental Health Indicators. This collaborative effort aimed to ultimately establish a set of indicators which could form a "State of the Environment" report for health, providing a comprehensive overview of environmental impacts on public health.

In 2019, the initial collaboration project focused on completing high-priority risk assessments. With additional funding, the scope was expanded in 2020 to include urban heat, greenspace, future climate projections, and the inclusion of First Nations perspectives. This expansion brought in new collaborators, enhancing the platform's capability to address a broader range of environmental health issues. Although the COVID pandemic severely disrupted the rollout of the products of the project, it has become an ongoing collaboration within the HEAL network. It brings together researchers across the HEAL Decision Support System (DDSS) (including the AusEnHealth team) and the Bushfires, Air pollution and Extreme Weather Events theme. The publications of the collaborations highlighted how increases of vegetation cover and creating green spaces could reduce urban heat islands and associated mortality only so far, and that even

more additional urban heat reducing measures, such as banning black roofs, may also be required.[1,2] These findings were pivotal in shaping State and Local Government public health strategies and urban planning policies around urban greening and black roofs, aimed at mitigating heat-related risks.

CARDAT's success story is a testament to the power of collaborative research and effective Research-Policy-Practice translation, guided by the principles of the HEAL Research Translation Strategy. By continuously engaging stakeholders and adapting to new challenges, CARDAT has made substantial contributions to supporting public health in preparing to adapt to climate change.

Effective Collaboration and Policy Translation

One of the notable successes of CARDAT is its ability to bring together diverse teams of scientists, public policy workers, and urban planners. Despite being based in different universities and government departments; these multidisciplinary teams can collaborate effectively using CARDAT's tools. This seamless integration is crucial for translating research into practice, ensuring that policies are informed by the latest scientific evidence.

Through their active engagement in initiatives such as serving as an invited speaker at Government departments, or preparing and sharing data and software codes, the authors have been engaged in driving conversations around urban heat HIA. Notably, Dr Hanigan participated in a workshop of the Department of Planning, Lands, and Heritage in Western Australia in May 2024 themed "Emergency, Health, and the Urban Greening Strategy" with multiple WA government agencies (including the Department of Mines, Industry and Resources; Department of Justice; Cemeteries Board; The National Trust; Department of Health; Sports Centre Trust; Department of Primary Industry and Rural Development; Training and Workforce Development; Racing and Wagering WA; Department of Treasury; Government Architects of Western Australia; Department of Water and Environmental Regulation; and Department of Biodiversity, Conservation, and Attractions). Such workshops are designed for State Government agencies to foster discussions with researchers on enhancing urban cooling initiatives. Dr. Hanigan's role as a guest speaker elucidated aspects of the achievable reductions in urban heat and improvements for health under climate change, emphasising how urban greening and reducing black roofs can effectively reduce adverse health impacts. These policy-relevant discussions with government workers have prompted a re-evaluation of policies exacerbating urban heat islands, leading to changes in jurisdictions like South Australia's Playford and the City of Cockburn. Local and state government-level discussions reflect a growing commitment to sustainable urban planning.[3,4]

Figure 3: Black roofs. Source: https://www.news.com.au/technology/environment/sustainability/a-state-government-has-acted-on-growing-calls-to-ban-popular-darkcoloured-roof-home-design-trend/news-story/cf503f9a605f93d4fe8d86c3f1d4f2d9

City Heat and Death

As an example, the new platform has been used to find ways to reduce heat-related deaths in cities by reducing the so-called urban heat-island effect. Air temperature observations aggregated from a range of agencies, combined with modelled results of the excess heat from cities, can be linked with downscaled health data and seasonal trends in death rates. From this, the number of deaths attributable to the urban heat-island effect can be estimated. This number could be projected forward to show the likely future mortality from heat in cities under continued global warming.

This significant case study involving CARDAT investigated the mortality impacts of heatwaves in Sydney under different climate change scenarios. This research highlights how rising temperatures, exacerbated by urban heat islands, can lead to increased mortality rates; however, this burden can be greatly reduced if effective adaptations are implemented. The CARDAT platform's comprehensive data integration capabilities allow researchers to model these impacts, projecting future health outcomes based on current climate trends.

One key adaptation strategy is using urban greening. CARDAT has enabled land use planners and public policy workers to analyse the effectiveness of greening initiatives in reversing the impact of UHIs by increasing tree canopy cover and reducing the built-up areas with black roofs, reducing ambient temperatures, lowering heat-related mortality rates. This evidence-based approach supports policymakers in making informed decisions to enhance urban resilience against climate change.

In 2022, Dr Chaston, Dr Hanigan and Prof Morgan authored a significant paper projecting the trajectory of heatwave-attributable mortality in Sydney, estimating an annual risk from 117 attributable deaths (in person-years) presently to approximately 540 annually by the late 21st century (2080-2099) under the RCP8.5 scenario. However, by implementing adaptive measures such as urban greening and reducing black roofs to eliminate the UHI, this negative impact could be reduced to aroun 9 deaths currently and approximately 130 in the distant future.

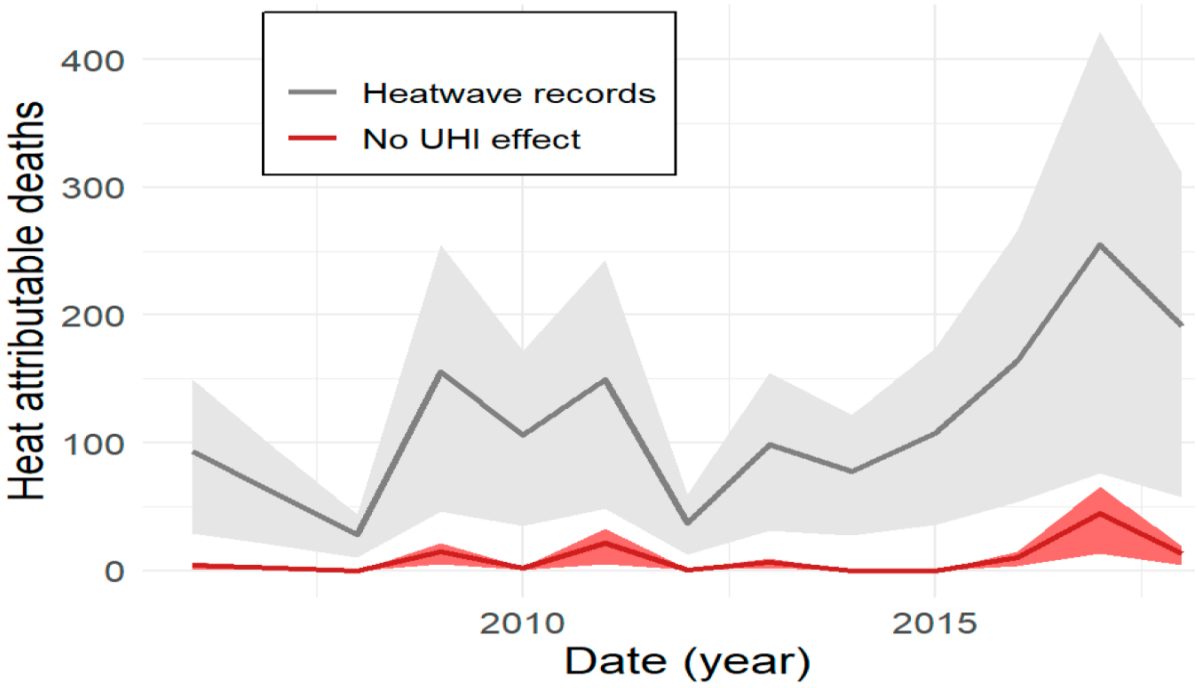

Figure 4: Health burden. Source: Chaston et al. 2022 https://doi.org/10.3390/atmos13050714

Methods for Heatwave-Attributable Deaths and Urban Greening Study

The 2022 study on heatwave-attributable deaths and the impact of greening as an adaptation measure used robust methods to analyse securely held mortality data from 1997 to 2018 and integrate it with environmental exposure data. A brief overview of the methods from Chaston et al. 2022[1] follows:

1. Population and Temperature Data: Data spanned from 1997 to 2018, with mortality data specifically from 2006 to 2018. The Australian Gridded Climate Data (AGCD) and Australian Water Availability Project (AWAP) provided temperature data at a 5 km resolution, including daily maxima and minima.
2. Estimating Extreme Temperature: The study estimated the 95th percentile of daily maximum temperatures (Tmax) using baseline data from 1997 to 2016.
3. Seasonal Mortality Curve: Researchers utilised a seasonal mortality curve derived from 13 years of state-level death data in NSW, along with small area (SA2) death data, to estimate daily death fractions.
4. Calculating Heatwave Deaths: The daily attributable number (AN) of deaths was calculated for each day within each climate zone and then aggregated to determine the total burden of heatwave deaths per year.
5. Exposure Datasets such as future climate change projections, vegetation cover and the urban heat island

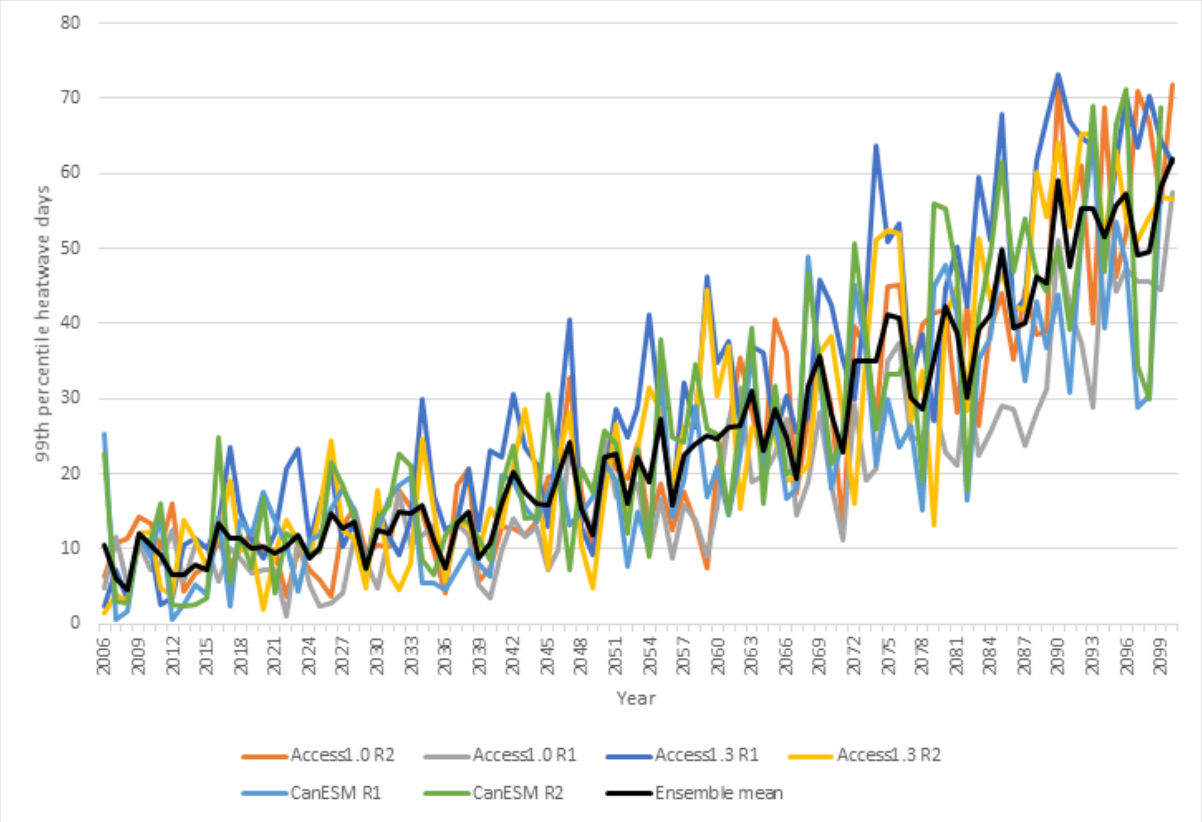

Figure 5: Projection of heat-related mortality under different climate scenarios. Source: Chaston et al. 2022 https://doi.org/10.3390/atmos13050714)

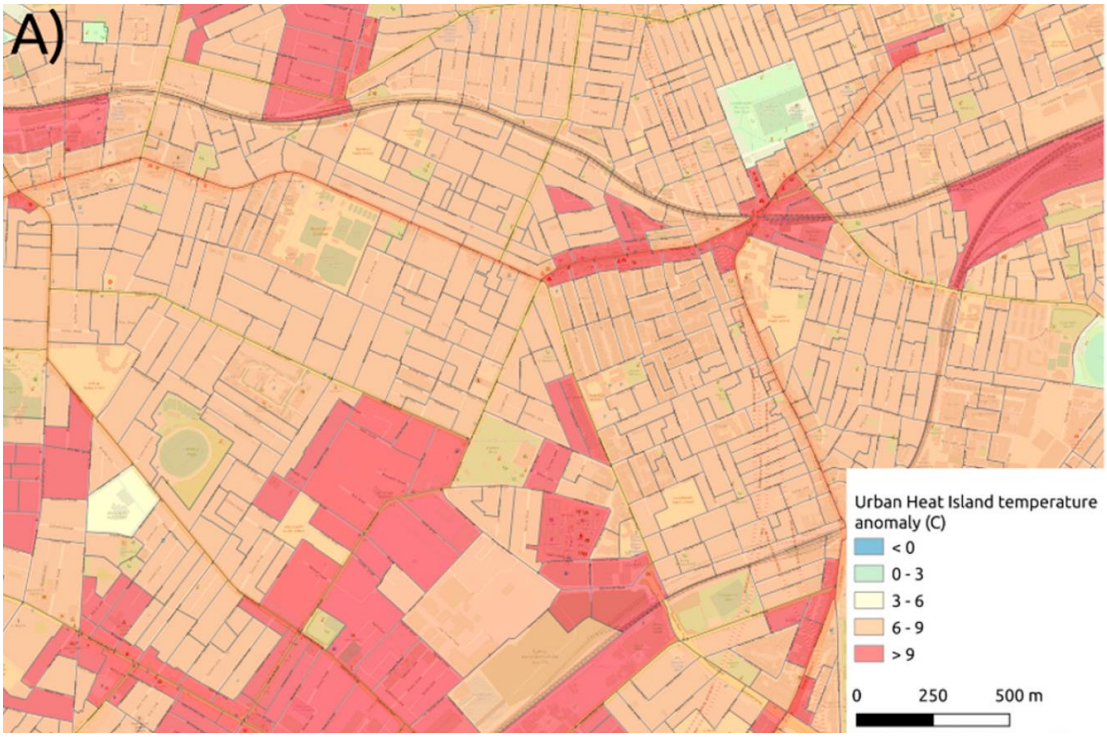

Figure 6 Infrared satellite imaging to identify most affected areas by urban heat. Source: Chaston et al. 2022 https://doi.org/10.3390/atmos13050714)

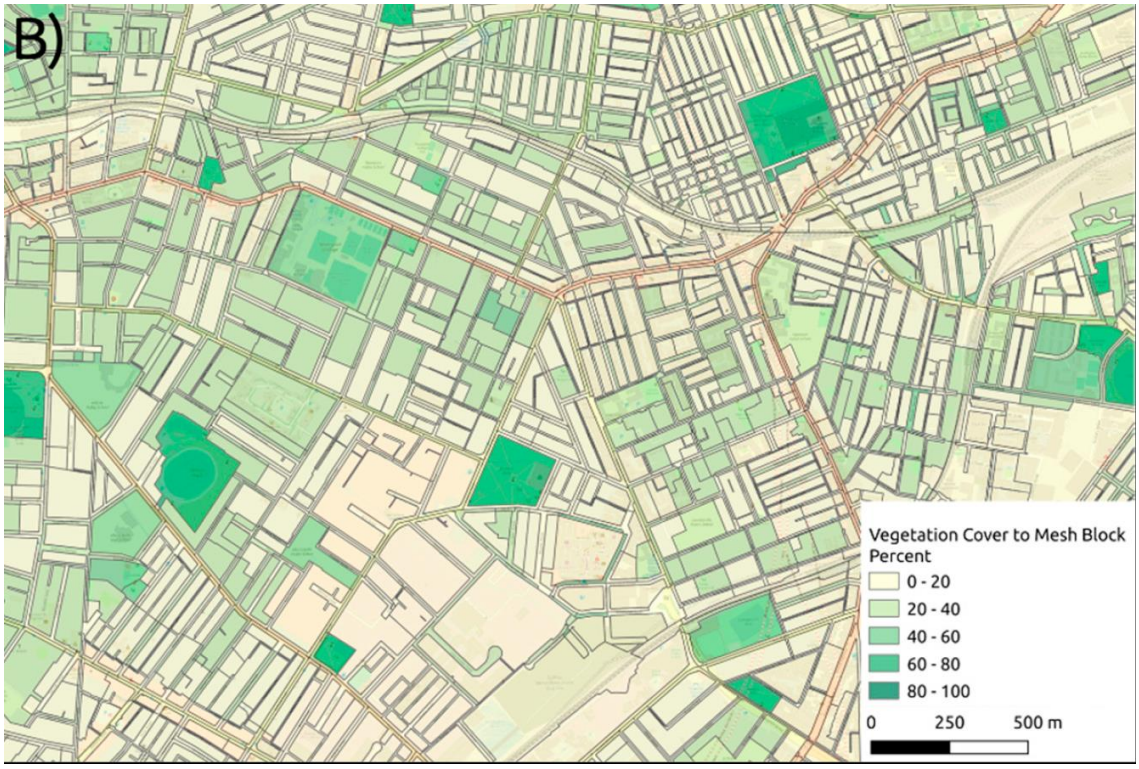

Figure 7 Derived from satellite imaging to assess cooling effects of urban greening. Source: Chaston et al. 2022 https://doi.org/10.3390/atmos13050714)

How CARDAT works

CARDAT is an online research platform, overseen jointly by the Centre for Safe Air (CSA) and Curtin WHO Collaborating Centre for Climate Change and Health Impact Assessment. It consists of a collection of IT infrastructure that enables easy data sharing and reuse and reproducible data analysis. CARDAT collates a wide array of datasets alongside various analysis tools and methodology resources in support of air pollution, climate and health research with a particular focus on the Australian region. Datasets held by CARDAT include but are not limited to air pollution, weather and climate, built environment, population and mortality. This platform promotes and supports collaboration between researchers and policymakers.

CARDAT infrastructure consists of a data inventory, cloud storage, virtual desktops and shared code on the GitHub platform for open-source software. The Data Inventory is an open online database cataloguing CARDAT datasets and associated metadata that are internally used to manage access. The Cloud CARDAT Repository is a cloud-based file storage for CARDAT datasets, enabling data sharing and synchronisation. Cloud-based virtual desktops are managed on the National Research Cloud by the NCRIS Facility “TERN” which produced CoESRA, a secure environment for reproducible, collaborative data analysis.

Research Translation Outcomes

Due to the enabling serviced of CARDAT, our researchers have been empowered to produce sophisticated, data-intensive research outputs that directly inform policy. Through disseminating this research and engaging as guest speakers, we've highlighted achievable reductions in urban heat and improvements in health amidst climate change. Emphasising the efficacy of urban greening and reducing black roofs, we've highlighted their potential to reduce negative health impacts. These discussions with government officials have supported the

development of new policies to reduce urban heat islands, resulting in tangible changes in jurisdictions like South Australia's Playford (where black roofs are banned) and the City of Cockburn (who put a motion forward at the Australian LGA committee to have a blanket ban on black roofs). The ongoing dialogues at local and state government levels signify a growing dedication to sustainable urban planning, supported by the research translation enabled by CARDAT and the HEAL network.

Reflections

Facilitating a high level of interdisciplinary collaboration across the project and enabling access to linked datasets is crucial for HEAL network members to conduct meaningful Research-Policy-Practice translation, elucidating intricate relationships between risk factors and human health. These datasets integrate diverse data types, including environmental data, health outcomes and demographic information, enabling analyses that informing public health interventions and policies. However, accessing such data poses challenges due to constraints related to data accessibility, ethical considerations, and associated costs. While platforms like CARDAT provide access to shared data, they come with limitations such as increased costs, permission restrictions, and IT infrastructure service agreements that can be difficult to obtain with University IT departments. To address this, the CARDAT project explored new models of access to integrated datasets within the network of collaborators. We were able to store health data sourced from the AIHW (Australian Institute of Health and Welfare) and ABS (Australian Bureau of Statistics), and share this using the Five Safes methodology[5] (Safe people, safe projects, safe settings, safe data and safe outputs). Furthermore, this approach enabled data sharing in the international best practice: FAIR framework[6] (Findable, Accessible, Interoperable and Reusable), meaning it is easier for collaborations across the broader HEAL network.

Throughout this project, we have gained valuable insights. We recognise that the Australian Research Cloud and ARDC offer an ideal solution for multidisciplinary teams that span academia and government agencies. The CARDAT team provides the methods and technological know-how to create flexible yet secure research data infrastructure needed for collaborative research efforts. Additionally, with a carefully managed mediated access data-sharing model, CARDAT has demonstrated its effectiveness in facilitating data access for researchers. By leveraging these insights and optimising data access methods, we aim to enhance the HEAL network's capacity to conduct impactful research, ultimately facilitating evidence-based health policies and practices.

Conclusions

The CARDAT platform, and its climate change, mortality, urban heat and greening projects, demonstrates a case study that shows a high level of interdisciplinary collaboration across the Research-Policy-Practice bridge. The attributable heat-related health impact is a significant challenge on local, regional and national governments and necessitates a holistic multidisciplinary approach. It includes the participation of various governmental stakeholders and academia, supported by reliable and rigorous data. The development of data analysis and climate simulation platforms further substantiate the decision-making process to identify hazards and address the risks for population health.

This case study showcases the successful implementation of a collaborative workshop and co-designing approach to adjust to the risk of heat-related mortalities, demonstrating the requirement for local adaptation strategies. Informed through CARDAT’s research data, climate modelling and infrared satellite imaging, local governments successfully developed policies on black housing roofs, as well as understanding the urgency of greening urban spaces to reduce the development of urban heat islands. This collaboration enhanced our

understanding of climate change impacts on health and supported the development of proactive, evidence-based Research-Policy-Practice translation to adapt to these impacts. These policies will further support the understanding of sustainable urban design, stressing the importance for future dialogue.

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6. Australian Research Data Commons. Making Data FAIR. Published online n.d. Accessed February 11, 2025. https://ardc.edu.au/resource-hub/making-data-fair/

Annex 1

Australian Government's investment in CARDAT data sharing initiative accelerates collaborations across HEAL and the CSA. The CARDAT team utilised a grant from the ARDC called the "Public Sector Bridges" project AirHealthData (https://doi.org/10.47486/PS022), which led to the publication of data in CARDAT of even higher geography and time-resolved mortality data for environmental health than the data ever published before. We were able to get the smaller spatial units (LGA and GCC) and smaller temporal units (monthly for rare diseases/small areas, daily for GCC). This and a similar updated dataset were published on CARDAT and have led to several papers demonstrating how the integration of health and environment data can lead to research outputs.

A selection of these publications are:

Borchers-Arriagada N, Vander Hoorn S, Cope M, Morgan G, Hanigan I, Williamson G, et al. The mortality burden attributable to wood heater smoke particulate matter (PM2.5) in Australia. Science of The Total Environment 2024;921:171069. https://doi.org/10.1016/j.scitotenv.2024.171069.

Chaston, T. B., Broome, R. A., Cooper, N., Duck, G., Geromboux, C., Guo, Y., Ji, F., Perkins-Kirkpatrick, S., Zhang, Y., Dissanayake, G. S., Morgan, G. G., & Hanigan, I. C. (2022). Mortality burden of heatwaves in Sydney, Australia is exacerbated by the urban heat island and climate change: Can tree cover help mitigate the health impacts? Atmosphere, 13(5). https://doi.org/10.3390/atmos13050714

Chaston TB, Knibbs LD, Morgan G, Jalaludin B, Broome R, Dennekamp M, et al. Air pollution mortality benefits of sustained COVID-19 mobility restrictions in Australian cities. Public Health 2024;226:152–6. https://doi.org/10.1016/j.puhe.2023.10.050.

Guo, Y.L., Ampon, R.D., Hanigan, I.C., Knibbs, L.D., Geromboux, C., Su, T., Negishi, K., Poulos, L., Morgan, G.G., Marks, G.B., Jalaludin, B. (2021). Relationship between life-time exposure to ambient fine particulate matter and carotid artery intima-media thickness in Australian children aged 11–12 years," Environ. Pollut., vol. 291, no. April, p. 118072

Hanigan, I., Dear, K., & Woodward, A. (2021). Increased ratio of summer to winter deaths due to climate warming in Australia, 1968–2018. ANZJPH, 45(5). https://doi.org/10.1111/1753-6405.13107

Hanigan I.C., Broome RA, Chaston TB, Cope M, Dennekamp M, Heyworth JS, Heathcote K, Horsley JA, Jalaludin B, Jegasothy E, Johnston FH, Knibbs LD, Pereira G, Vardoulakis S, Vander Hoorn S, Morgan GG. (2021). Avoidable Mortality Attributable to Anthropogenic Fine Particulate Matter (PM2.5) in Australia. International Journal of Environmental Research and Public Health. 18(1):254. https://doi.org/10.3390/ijerph18010254

Hanigan, Ivan C., and Timothy B. Chaston. 'Climate Change, Drought and Rural Suicide in New South Wales, Australia: Future Impact Scenario Projections to 2099'. International Journal of Environmental Research and Public Health 19, no. 13 (2022): 7855.

Hertzog, L., Morgan, G. G., Yuen, C., Gopi, K., Pereira, G. F., Johnston, F. H., Cope, M., Chaston, T. B., Vyas, A., Vardoulakis, S., & Hanigan, I. C. (2024). Mortality burden attributable to exceptional PM2.5 air pollution events in Australian cities: A health impact assessment. Heliyon, 10(2), e24532. https://doi.org/10.1016/j.heliyon.2024.e24532Jegasothy, E., Hanigan, I. C., Van Buskirk, J., Morgan, G. G., Jalaludin, B., Johnston, F. H., Guo, Y., & Broome, R. A. (2023). Acute health effects of bushfire smoke on mortality in Sydney, Australia. Environment International, 171, 107684. https://doi.org/10.1016/j.envint.2022.107684

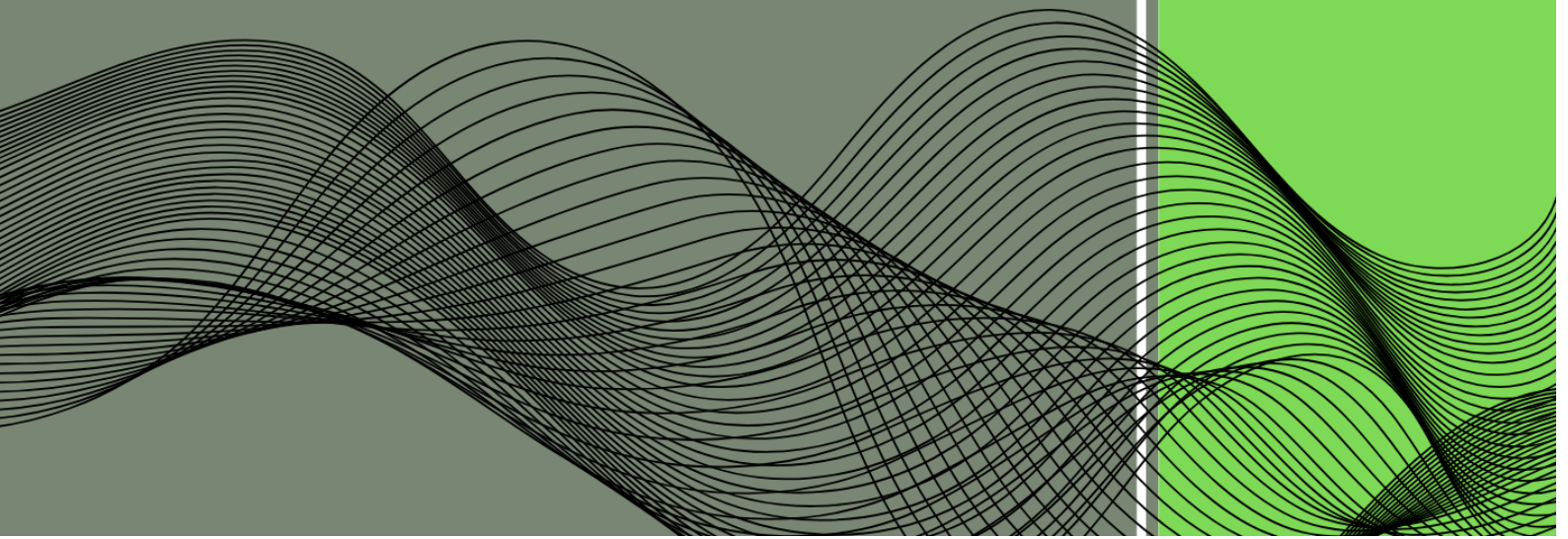
Lee GW, Van Buskirk J, Jegasothy E, Knibbs LD, Cowie C, Morgan GG. Cleaner air for vulnerable people – Finding better locations for essential building premises. City and Environment Interactions 2023;20:100116. https://doi.org/10.1016/j.cacint.2023.100116.

Sadeghi, M., Chaston, T., Hanigan, I., de Dear, R., Santamouris, M., Jalaludin, B., & Morgan, G. (2022). The health benefits of greening strategies to cool urban environments – A heat health impact method. Building and Environment, 207. https://doi.org/10.1016/j.buildenv.2021.108546

Standen, J.C.; Spencer, J.; Lee, G.W.; Van Buskirk, J.; Matthews, V.; Hanigan, I.; Boylan, S.; Jegasothy, E.; Breth-Petersen, M.; Morgan, G.G. Aboriginal Population and Climate Change in Australia: Implications for Health and Adaptation Planning. Int. J. Environ. Res. Public Health 2022, 19, 7502. https://doi.org/10.3390/ijerph19127502

All members of HEAL and the CSA can request access via the CARDAT team (https://cardat.github.io/data_access_request_form.html), and external collaborators can too if the request is approved by the committee. These datasets also demonstrate how we worked with AIHW to release new time periods (e.g., adding 2019 data to expand the study period from 2018), which we hope we can do again now that more years of data have been collected (2020-2022).

Conclusion



Conclusion

This compendium presents a selection of case studies that demonstrate the effective integration of research translation practices across diverse public health and environmental challenges within the HEAL network. The aim of the call for case studies was to identify and showcase research projects that embed key principles and strategies of research translation. These cases offer concrete examples of how research can be translated into real-world impact, serving as models for researchers across the HEAL network and beyond.

The key findings from these case studies reveal several critical themes that underpin successful research-to-policy and practice translation efforts within the HEAL network. These themes include fostering trusting relationships, early stakeholder engagement and co-design, multidisciplinary collaboration, clear and accessible communication, transitioning from knowledge generation to actionable outcomes, community-driven research approaches, piloting and demonstrating effective solutions, adaptability to evolving needs and uncertainties, and establishing structures to ensure long-term collaboration.

A key theme emerging from the case studies is the importance of building trust and reciprocal relationships between HEAL researchers and policymakers or community groups. Trust is developed through long-term relationships, starting well before research design and continuing after project completion. These relationships enable the creation of policy-relevant research questions and facilitate smooth integration of research into decision-making processes, leading to policy change. Regular check-ins, informal meetings, and ongoing collaboration are essential for maintaining alignment with practical needs. Pre-existing relationships with government agencies and community members provide a strong foundation. The role of HEAL Network's Communities of Practice (CoP) in fostering trust and co-designing research was evident in some cases, but these CoPs, need to be further strengthened and more fully utilised. They offer HEAL researchers' opportunities to build relationships with policymakers, communities, and practitioners, helping achieve the HEAL network's vision of translating research into policy and practice.

All case studies emphasise the importance of engaging a diverse range of stakeholders, including government agencies, community groups, advocacy organisations, and Indigenous communities. In many cases, research was co-designed with stakeholders to ensure findings were both relevant and actionable. Studies on wood heater pollution, bushfires and the CARDAT project, for example, demonstrated the benefits of involving stakeholders early in shaping research questions, design, and outcomes. However, some case studies indicated that engagement with policy actors occurred later in the process, such as during survey development, data collection, or dissemination. Beyond early involvement, several studies highlighted the value of aligning research with existing policy frameworks and government priorities. Notably, the wood heater case study influenced policy decisions, as it was aligned to the ACT's plan to phase out wood heaters by 2045. A key takeaway for HEAL researchers is the need to engage stakeholders from the outset, ensuring research is co-designed and directly addresses the needs of communities and policymakers.

A critical theme that emerged from the case studies is community-driven research, particularly the integration and empowerment of Indigenous knowledge, as well as cultural sensitivity. In addition to the CoPs, the HEAL network uniquely embraces Indigenous knowledge systems, recognising structures outside of Western academic paradigms and utilising this wisdom to shape public discourse. Some case studies, such as the Healing Country case, demonstrate strong community-driven methodologies that integrate Indigenous knowledge and respect Indigenous governance structures. This highlights the

need for a mindset reorientation among HEAL researchers to ensure that research has a positive societal impact. Key considerations include framing and language (e.g., Health of the Country vs. climate change), culturally appropriate methods (e.g., yarning vs. surveys), data and knowledge ownership (shared knowledge vs. controlled IP), and most importantly, recognising the decision-making power and sovereignty of Indigenous communities. These practical approaches must be further strengthened through existing and future HEAL capacity-building initiatives, such as the HEAL Future Leaders' School and the HEAL Mentorship Program.

The case studies highlighted the importance of action-oriented, impact-focused research that goes beyond knowledge generation to provide actionable recommendations, interventions, or tools, which increases uptake by policy actors and communities. An equally important theme emphasised across the case studies is the need for clear, accessible communication of research findings. Various formats, including plain-language summaries, infographics, fact sheets, videos, and interactive tools, helped make research findings understandable and actionable for diverse audiences. The use of social media, traditional media, and online platforms further reinforced the need to engage the broader public and policymakers in an accessible manner. HEAL researchers are encouraged to adopt tailored communication methods—and go beyond the traditional academic platforms —to ensure that their research findings are accessible and understandable to a wide range of audiences.

Overall, these case studies underscore the power of integrating research translation practices into the very fabric of the research process, highlighting the reciprocal nature of relationships between researchers, policymakers, practitioners and communities. They provide practical insights for researchers looking to engage more effectively in research translation and contribute to capacity-building efforts within the HEAL network and beyond. The lessons drawn from these examples emphasise that translating research into practice requires not only scientific rigor but also a commitment to inclusive, collaborative, and context-sensitive approaches that prioritise the needs of the actors involved. As such, the work shared in these case studies serves as both inspiration and guidance for future research endeavors aimed at addressing complex health and environmental challenges.

We acknowledge the HEAL (Healthy Environments And Lives) National Research Network, which receives funding from the National Health and Medical Research Council (NHMRC) Special Initiative in Human Health and Environmental Change (Grant No. 2008937).

Appendix

Appendix A: Rubric for HEAL Case Studies Assessment

	Exceptional **4 points**	**Good** **3 points**	**Considered** **2 points**	**Poor** **1 point**
Alignment with HEAL Mission and Goals	Exceptional alignment, explicitly demonstrating contribution to HEAL's mission.	Clearly aligned with HEAL's mission and goals.	Some alignment but lacks clarity on connection to HEAL's objectives.	Limited alignment with HEAL's mission and goals.
Stakeholder Engagement	Demonstrates exceptional involvement of all relevant stakeholders at all stages of research including formulation, design and implementation	Good involvement of all/some relevant stakeholders at all stages of research including formulation, design and implementation	Adequate involvement of some relevant stakeholders throughout some stages of the research process	Limited involvement of relevant stakeholders throughout the research process
Communication of Research	Demonstrates exceptional communication of research to various audiences with high consideration and adaption of language and delivery for relevant audiences.	Good communication of research to various audiences with moderate consideration and adaptation of language and delivery for relevant audiences.	Some communication of research to various audiences with some consideration and adaptation of language and delivery for relevant audiences.	Limited communication of research to various audiences with limited consideration and adaptation of language and delivery for relevant audiences.
Collaborative Efforts	Demonstrates outstanding collaboration with various disciplines at all stages of the research	Good collaboration with various disciplines at all/some stages of the research	Some collaboration throughout the research	Limited collaborative efforts through the research
Aboriginal and Torre Strait Islander Community Engagement	Demonstrates exceptional engagement with Aboriginal and Torres Strait Islander communities, with impactful consultation evident throughout the case study.	Demonstrates good Aboriginal and Torres Strait Islander engagement through impactful consultation.	Some engagement with Aboriginal and Torres Strait Islander communities, with consultation occurring in some aspects of the case study.	Limited engagement with Aboriginal and Torres Strait Islander communities, with little to no consultation occurring.

Evaluation and Pilot Procedures	Demonstrates exceptional evaluation process integrated throughout the research. Shows outstanding ability to adapt research to new inputs or findings.	Good evaluation process integrated throughout the research. Shows good ability to adapt research to new inputs or findings.	Some evaluation process integrated throughout the research. Shows some ability to adapt research.	Limited evaluation process integrated throughout the research. Shows limited ability to adapt research.
Research Impact Strategies	Demonstrates exceptional use of Research Impact Strategies such as Exchange as foundational to research	Shows good use of Research Impact Strategies such as Exchange throughout most stages of the research	Some use of Research Impact Strategies in some areas of research	Limited to no Research Impact Strategies evident in the research
Community Engagement	Demonstrates exceptional efforts in community engagement and empowerment.	Good community engagement and empowerment initiatives.	Some engagement with the community, but empowerment is limited.	Minimal community engagement or empowerment efforts.
TOTAL	***34-44 points Exceptional effectiveness in research translation within the HEAL context.***	***23-33 points Proficient effectiveness in research translation within the HEAL context.***	***12-22 points Moderate effectiveness in research translation within the HEAL context.***	***1-11 points Limited effectiveness in research translation within the HEAL context.***

Appendix B: Compendium Template

Compendium Template

The structure of this template is representative of how the case study will be displayed and published in the compendium. Please cut, paste and rework your original case study to meet these subheadings. Images and tables are welcome to be used and copied into this template. Annexes are also welcome if required.

Title:

Name of Author/s:

Highlights

Similar to the abstract yet with a strong focus on the research translation aspects of your case study.

Introduction

- This can be a combination / reworking of the context and overview section of your original case study
- Simply to set the scene, describe the problem and introduce the reader to the study

Applying Research Translation in Practice (Originally Section 3)

- The content from section 3 of the original case study should be placed under this subheading.
- Please consider our feedback when reviewing this section
- Remove subheadings that were previously included unless considered necessary

Research Translation Outcomes

As in the original case study

Reflections

As in the original case study

References