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Preparing Health Services for Climate Change in Australia

Blashki G, Armstrong G, Berry H, Weaver HJ, Bi P, Harley D, Spickett J, Hanna L

Abstract

Objective: Whilst the implications of climate change for public health continue to be elucidated, we still require much work to guide the development of a comprehensive strategy to underpin the adaptation of the health system. Our aim is to focus on the health system responses to health risks from climate change, and in particular how best to prepare Australian health services for health risks from; heatwaves, bushfires, infectious diseases, diminished air quality and the mental health impacts of climate change.

Approach: We present some guiding principles for preparing health systems, and also overview some specific preparatory activities in relation to personnel, infrastructure and coordination.

Conclusion: Increases in extreme weather related events superimposed upon health effects arising from a gradually changing climate will place additional burdens upon the health system and challenge existing capacity. Preparing the health system for climate change requires investment in personnel, infrastructure and service coordination. Key characteristics of a climate change prepared health system are that it should be flexible, strategically allocated and robust. Long term planning will also require close collaboration with the non-health sectors as part of a nationwide adaptive response.

Conclusion: climate change, population health, health policy, health services

Introduction

Climate change projections and the implications for health risks have been previously described in leading international journals¹ and also in this supplement. Indications to date suggest that climate change will both increase the background demand for a range of health services, and will also generate a shift in the intensity and frequency of service responses to prepare for, respond to, and recover from, extreme events. Whilst the detailed implications of climate change for public health continue to be elucidated, we still require much work to guide the development of a comprehensive strategy to underpin the adaptation of the health system. Our aim is to focus on the health system responses to health risks from climate change, and in particular how best to prepare Australian health services for those health risks outlined in this supplement; heatwaves, fire risk, infectious diseases, poor air quality and the mental health impacts of climate change. We present some guiding principles for preparing health systems, and also overview specific preparatory activities in relation to personnel, infrastructure and coordination. In this short paper we recognise that we are unable to be comprehensive, for example, we have not dealt with health system responses to climate change related migration, conflict or the flow on effects of socio-economic impacts.

Principles of health system adaptation

We propose three key principles to guide policy makers and planners in preparing the health system for climate change; 1) flexibility, 2) strategic allocation of resources and 3) robustness of health services (see Figure 1).

Figure 1 Principles of health system responses to climate change

Flexibility

- **Location of services**
- **Scale of response**
- **Type of services and by whom they are delivered**

Strategic Allocation of Resources

- **Builds on existing services**
- **Targets vulnerable regions and populations**
- **Equitable and just access**

Robustness

- **Resilient infrastructure**
- **Consistent services**
- **Sustainable workforce**

Flexibility

Flexibility is important because of the inherent uncertainty in climate change predictions² and health impact models³, and the limited predictive capacity of current climate models for small scale geographical regions. It is predicted that Australia will experience more extreme weather events, hotter weather and more heat waves, and further drying across southern parts of the continent. More severe bushfires and infectious disease outbreaks are also likely. We cannot predict with any certainty

exactly when these may occur, how frequently, where, nor how intense they may be. The fires, floods and heatwaves in the summer of 2009 provided a preview of what the future may hold. Yet whether such a salvo of extreme disasters was a random occurrence or an indication of what is to become the new norm, or indeed the first step in an escalating trajectory of intensity is not certain at this stage.

Health service responsiveness to climate requires flexibility in order to meet varying demands in type and scale of service. Large bushfires provide a clear example of the need for flexibility. Up scaling emergency and high acuity health services are needed to deal with the direct consequences in affected regions (e.g. trauma, burns, and other injuries). Fires also increase demands for management of the longer term flow on effects from poor air quality due to increased density of smoke and particulates (e.g. respiratory disease). The complex needs of displaced populations as well as post-trauma follow-up such as psychological support for victims, their families and communities, and also the attending personnel.

Mobility of health services is another desirable quality in responding to climate-related disasters, and the possibility for multiple events to occur simultaneously must be considered in planning. In the case of extreme weather events, such as flooding or fires creating a Mass Casualty Incident, health service response teams may need to be deployed quickly to affected regions to apply emergency management, triage and to coordinate transfer to the appropriate facility. Similarly, flexibility in the type of services required and by whom they are delivered will be valuable. For example, in the case of infectious disease outbreaks, primary health care providers may need to take on more active acute diagnostic and management roles, which is beyond their current capacity.

Strategic allocation of resources

Strategic allocation of resources is necessary to prepare the health system for climate change. The imperative is to identify likely future scenarios and health sector demands and orientate health systems accordingly. It will be most efficient to build on existing services, to identify and target vulnerable regions and populations, and promote and deliver equitable access to health services as an overriding objective.

Climate-related illnesses overlay the substantial burden of high prevalence disorders in the community⁴. Therefore, a guiding principle will be to strengthen existing health services for the additional burden of disease. For example, heatwaves are expected to increase in frequency and intensity, and heat-related illnesses will exacerbate high prevalence disorders such as cardiovascular and respiratory diseases⁵, especially amongst vulnerable groups such as those with limited mobility and those aged over 65⁶.

In a budget constrained environment priority must be given to target health interventions to those populations that are most vulnerable to climate change⁷, such as the elderly, Indigenous communities, those who are unable to cool their living environment, and those living in regions that are heavily exposed to climate change impacts⁸ (e.g. alpine regions, Murray Darling basin, south east Queensland, Kakadu, south west Australia).

The National Health and Hospitals Reform Commission lists equity as the first of three reform goals to achieve “A Healthier Future For All Australians⁹. Equity is an overriding concern for responding to climate change¹⁰, from an Australian and a

global perspective, with poverty and inequality leading to greater exposure to climate change and a reduced adaptive capacity¹.

Climate change has the potential to expose and exacerbate existing inequities within the health system and in health outcomes. One example is the existing inequities in access to specialist health services for rural and remote communities¹¹. These populations tend to have less access to health services than city-dwellers and these disadvantages can amplify underlying socioeconomic disadvantage by exacerbating the condition and prolonging periods of unwellness¹².

Robustness

An important lesson from the 2009 heatwave and bushfires in Victoria¹³ is that the health systems in place must be robust enough to cope with increased capacity for climate change-related presentations/emergencies, and are well-coordinated with government and non-government organisations. Essential infrastructure, hospitals and other services must be designed to withstand threats to energy supply (e.g. during heatwaves) and direct climatic and environmental impacts (e.g. coastal inundation). Consistency of services is important too, even under strained conditions, so coordinated planning and policy procedures need to be established in high risk regions to manage climate-related contingencies and 'surge capacity' demands.

A sustainable health workforce is the foundation of a robust health system. There needs to be a substantial workforce maintained in high risk areas, for example in vulnerable rural and remote areas¹¹, as there is an upper limit on how health services can be redeployed to respond to climate related events. To this end, forward planning includes; identification and prioritisation of the high-risk events for a particular area (e.g., coastal inundation in seaside areas, bushfire threats in rural bushland areas etc), adequate provision of training related to local climate-related health threats¹⁴, support and critical debriefing, and the provision of adequate resources to enable the delivery of quality health services and local community health education.

Practical health system responses

Policy makers require practical options for adapting the health system for climate change, even where evidence is still incomplete.¹⁵ Here, we briefly overview a suite of practical options for preparing the health system with a focus on: 1) personnel, 2) infrastructure and 3) coordination. Health personnel are a critical element of any response to climate change; changing roles and skills will be required, particularly among front-line primary health care workforce¹⁶. Audits of climate disaster-related infrastructure must be undertaken to inform the development of detailed plans for modification or upgrades required to withstand climate change conditions, and to allow the flexibility required of health system responses.

It will also be essential to ensure coordination of services contributing to the early detection and prevention of climate-related health threats, and to link the various arms of the health system with the broader community. NGO and private sectors, relevant industries, such as power suppliers and aged care agencies, will also need to be part of this coordination approach. We overview several practical adaptations to personnel, infrastructure and coordination in relation to health risks identified in the National Adaptation Research Plan as priorities for Australia¹⁷: heatwaves / fire risk, infectious diseases, poor air quality and the mental health impacts of climate change (Figure 2).

Figure 2 Practical responses to preparing the health system for climate change

	Heatwave / Fire Risk	Infectious Diseases	Poor Air Quality	Mental Health
Personnel	<p>Frontline of health workforce to be alert to the symptoms of heat stress</p> <p>Prepared, equipped and available mobile personnel ready to respond to critical bushfire events</p>	<p>Delivery of education to cover measures for personal, family and community protection against infectious diseases</p> <p>Evaluating the capacity of health personnel to diagnose and manage, and limit infectious disease outbreaks</p>	<p>Health workforce to be alert to the health effects of air pollutants, and preventive measures that can be undertaken by the community</p> <p>Educating and managing those who are most vulnerable (e.g. those with pre-existing cardio-respiratory disease)</p>	<p>Increase awareness of the mental health effects of climate change amongst all health workers, including psychiatric and para-psychiatric services</p> <p>Utilisation of the mental health workforce to educate and prepare those communities most vulnerable to climate change</p>
Infrastructure	<p>Strategies for essential back-up power supplies</p> <p>Deployment of temporary infrastructure to ensure delivery of the range of health services required to respond to fire affected regions</p>	<p>Equipment for rapid testing and diagnosis in regions vulnerable to arboviruses</p> <p>Health and community facilities, including facilities such as aged-care centres, to ensure adequate food practices and storage facilities</p>	<p>Effective air quality surveillance systems</p> <p>Strategies to limit emissions on poor air quality days</p>	<p>Investment in areas where mental health services are under-resourced, and where the mental health effects of climate change will be substantial</p>
Coordination	<p>Development of fully integrated regional bushfire / heatwave health response plans</p> <p>Heatwave warning systems, and the use of pre-recorded health messages</p> <p>Collaborate with urban planning and housing regulators to advocate for more appropriate housing design</p>	<p>Monitoring of outbreaks / sentinel populations, aggressive case-finding measures</p> <p>Interaction between health care professionals, community agencies and government personnel to control the spread of diseases</p>	<p>Coordinating regular communication to the public regarding air quality, and personal health protection strategies</p> <p>Researching the health impact of diminished air quality, and also the interrelationship with other climate change impacts (e.g. heatwaves)</p>	<p>Early introduction of debriefing and counselling, with follow up as required</p> <p>Development of regional mental health response plans to enable emergency response and the building of social capital</p> <p>Working across the broader community, private and government sectors to raise awareness of the mental health effects of climate change</p>

Responding to Heatwaves / Fire Risk

The Australian health system needs to prepare for an increase in the frequency and intensity of heatwaves and heat-related mortality⁶ and morbidity (hospitalisations, emergency department visits and ambulance call-outs)¹³, and for the accompanying hot dry conditions that provide fuel for bushfires and place great stress on the infrastructure of the health system.

Health personnel will need to be alert to symptoms of heat stress and associated health complications, particularly GPs, district nurses, ambulance and emergency staff on the health care frontline. Health professionals are ideally positioned to play a critical role in delivering the health promotion messages on how to avoid heat stress, and the health impacts of bushfires. Critical events may exceed past experiences. Bushfire prone nations such as Australia need a prepared and mobile skilled workforce to respond immediately to critical bushfire events.

A National Heatwave Framework must include strategies to reduce power demand, prioritisation of essential power needs and extended duration back-up power supply options in case of a power grid failure¹⁸, plus the deployment of rescue teams for quick repair.

Effective heatwave warning systems will play a critical role, with pre-recorded health messages to be distributed via the mass media. Social support networks, known to act as a protective factor against heat related illness, will need to be supported and developed, such as community care options like buddy systems for the elderly and other vulnerable population groups.

There is a need for coordination between the health sector and the broader community to develop regional bushfire health response plans, and to support community care options and social networks that have a protective effective¹⁹ such as buddy systems for the elderly and other vulnerable populations. The health sector can collaborate with urban planners and housing regulators to ensure housing and urban design provide a protective element during heatwaves in keeping with human behaviours and health needs, and reduce the “heat island” effect¹.

Responding to Infectious Diseases

Within a health system that has developed an increasing focus on non-communicable disease, climate-related infectious diseases will create adaptation challenges under conditions of increasing temperatures and humidity. The Australian health system will need to plan for an increase in infectious diseases such as gastrointestinal infections (e.g. Salmonella), and vector-borne diseases such as dengue fever which threatens to spread further south²⁰. Many of the diseases will not be new to Australia, but rather new to the area, and to the local health service. In addition, outbreaks of infectious diseases can stem from climate-related disasters such as flooding²¹, and infrastructure failures.

Health personnel will need the necessary skills to diagnose and manage a new realm of infectious disease outbreaks, and to fulfil a critical role of delivering disease prevention education to the community. Community education will need to cover measures for personal, family and community protection against infectious diseases, such as peri-domestic sanitation to prevent the spread of dengue, and food hygiene to prevent salmonella poisoning.

In the case of infrastructure, health facilities such as hospitals and aged-care residential centres will need adequate food storage, handling and cooking facilities to prevent gastrointestinal illness amongst patients⁷. Health services will need equipment for rapid testing and detection of infectious diseases, particularly in regions vulnerable to arboviruses.

Surveillance and monitoring systems will be critical to enable early detection and containment of infectious disease outbreaks⁷, as will communication channels between health care professionals, public health and government staff to manage outbreaks of infectious diseases. In the case of arboviruses; coordination with entomologists and epidemiologists to confirm diagnoses and liaise with the affected communities to deploy aggressive case-finding measures to prevent an epidemic⁷. Healthcare staff experienced in infectious diseases, and local government, will be required to work with local communities to undertake vector control (e.g. screening windows, etc) and water control to identify agricultural, drainage and other sites of potential breeding areas for mosquitoes²².

Responding to Diminished Air Quality

Overall, air quality in Australia is relatively good. The Ambient Air Quality National Environment Protection Measure established ambient air quality standards and monitoring and reporting protocols for listed air pollutants, namely CO₂, SO₂, lead, NO₂, photochemical oxidants (measured as ozone), and particulates (PM₁₀)²³. Exceedences are few, and usually occur on hot days and during dust storms and bushfires, events which are likely to increase with climate change. The likely effects of climate change on increased community exposure to levels of ozone and particulates will have adverse consequences for public health^{24 25} including increased mortality and a range of respiratory and cardiovascular health effects²⁶. Vulnerability to air pollutants is highest in urban areas where exposure to vehicle and industrial emissions is greatest²⁷, or in rural areas affected by bushfires and dust-storms. Those most susceptible include young children, the elderly and those with pre-existing cardio-respiratory disease^{28 29}. Strategic planning is required to reduce the impacts of potential increases in air pollutants due to climate change.

Health agencies need to be prepared for surges in service needs related to asthma and other cardio-respiratory illnesses. At the primary care level, health practitioners need to be alert to the health effects of air pollutants, and be able to educate vulnerable patients to take precautionary measures to prevent excessive exposure, and to take prophylactic medications where appropriate.

Air quality alerts disseminated by public health units can increase health protective behaviours³⁰. Continuous efforts to improve the modelling and forecasting of air quality will be necessary to provide more advanced and accurate warning, and the effective use of these will provide critical information to prepare health services and warn the broader community to avoid excessive exposure.

Work with the broader community is required to produce and disseminate air pollution health impact assessments that provide adaptation strategies and identification of vulnerable groups and regions, such as an assessment that was conducted in Western Australia³¹.

Responding to Mental Health Impacts

Berry et al.³² have reported that climate change has important implications for mental health through increasing the likelihood of extreme weather events that directly (for example, loss and trauma arising from direct exposure, or anxiety about the future in a world of potentially catastrophic climate change), and indirectly harm mental health. The latter includes disruption to the social determinants of mental health and wellbeing in vulnerable communities (such as economic security, social exclusion and displacement). To respond, the Australian health system needs to understand the links between climate change and psychosocial wellbeing, to promote this understanding and to increase preparedness for future events or situations that may harm mental health.

Efforts are required to raise the awareness of the mental health impacts of climate change in psychiatric and para-psychiatric services, and in the primary health care and related workforce. We can utilise the mental health and related workforce to educate and prepare those groups, communities and places most vulnerable to the effects of climate change.

Investment in community mental health infrastructure is required, especially in communities that may need greater support such as those in rural and remote areas and Indigenous communities, where mental health services are under-resourced and where the effects of climate change on mental health will be substantial.

Mental health referral pathways need to be developed and integrated with the broader community sector, promoting equitable access to primary mental health care, and coordinating a patient-centred focus. Coordination is required to engage and develop links with communities and organisations to build programs that; provide mental health awareness-raising and support, and develop regional mental health response strategies. Supporting activities in vulnerable communities that work toward 'climate-change proofing' could result in increased social connections that add a layer of protection against mental health problems.

Conclusion

Preparing the health system for climate change requires investment in personnel, infrastructure and coordination. This needs to be done even in the context of uncertainty about the extent and nature of specific climate change effects on health. Key characteristics of a climate change prepared health system are flexibility, robustness and strategically allocated resources. Long term planning will require close collaboration with the non health sectors as part of a nationwide adaptive response.

References

1. Costello A, Abbas M, Allen A, Ball S, Bell S, Bellamy R, et al. Managing the health effects of climate change: Lancet and University College London Institute for Global Health Commission. *Lancet* 2009;373(9676):1693-733.
2. CSIRO. Climate change projections for Australia. Aspendale: CSIRO Atmospheric Research, 2001.
3. Patz JA, Campbell-Lendrum D, Holloway T, Foley JA. Impact of regional climate change on human health. *Nature* 2005;438(7066):310-7.
4. Woodruff R, McMichael, T., Butler, C., Hales, S. Action on climate change: the health risks of procrastinating. *Australian and New Zealand Journal of Public Health* 2008;306(6):567-571.

5. Hoffman B HS, Boes T, Weiland D, Jockel K. Increased Cause-Specific Mortality Associated with 2003 Heat Wave in Essen, Germany. *Journal of Toxicology and Environmental Health Part A* 2008;71:759-765.
6. Woodruff R, Hales S, Butler C, McMichael AJ. Climate change health impacts in Australia: effects of dramatic CO2 emission reductions. Report for the Australian Conservation Foundation and the Australian Medical Association. 2005.
7. Horton G, McMichael A. CLIMATE CHANGE HEALTH CHECK 2020: The Climate Institute and Doctors for the Environment Australia, 2008.
8. Hennessy K FB, Bates B.C, Harvey N, Howden S.M, Hughes L, Salinger J, R Warrick. Climate Change 2007: Impacts, Adaptation an Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernment Panel on Climate Change, Chapter 11: Australia and New Zealand. Cambridge, UK: Cambridge University Press, 2007:507-540.
9. National Health and Hospitals Reform Commission. A Healthier Future For All Australians – Final Report. *Canberra: Department of Health and Ageing*, <http://www.health.gov.au/internet/main/publishing.nsf/Content/nhhrc-report> 2009.
10. Blashki G, Berry, H., Kidd, M. Primary health care responses to climate change. In J. Moss (Ed.), *Climate Change and Social Justice*. Melbourne: Melbourne University Press 2009.
11. Blashki G. Climate change and the rural health workforce. *Aust J Rural Health* 2008;16(1):1.
12. Hanna L. Continued neglect of rural and remote nursing in Australia: the link with poor health outcomes. *The Australian Journal of Advanced Nursing* 2001;19(1):36-45.
13. Department of Human Services. January 2009 Heatwave in Victoria: an Assessment of Health Impacts: Victorian Government, 2009.
14. Hamel Green I, Blashki G, Berry H, Harley D, Hall G, Horton G. Preparing Medical Students for Climate Change. *Australian Family Physician* 2009(in press).
15. APHA Technical Report. Public health policy-making in the presence of incomplete evidence. *American Journal of Public Health* 1990;80(6):746-750.
16. Blashki G, McMichael T, Karoly DJ. Climate change and primary health care. *Aust Fam Physician* 2007;36(12):986-9.
17. McMichael AJ WH, Berry H, Beggs PJ, Currie B, Higgins J, et al., . Human Health and Climate Change: National Adaptation Research Plan. *Brisbane: National Climate Change Adaptation Research Facility*, http://www.nccarf.edu.au/sites/default/files/NationalAdaptationResearchPlan-HumanHealth_0.pdf 2008.
18. Essential Services Commission of South Australia. Performance of ETSA Utilities during the heatwave of January 2009. *Information paper* 2003.
19. O'Neill MS ZA, Schwartz J,. Modifiers of the Temperature and Mortality Association in Seven US Cities. *Am J Epidemiol* 2003;157(12):1074-1082.
20. Bambrick H, Dear, K., Woodruff, R., Hanigan, I., McMichael, A. The impacts of climate change on three health outcomes: temperature-related mortality and hospitalisations, salmonellosis and other bacterial gastroenteritis, and population at risk from dengue. *Garnaut Climate Change Review*, 2008.

21. Kjellstrom T, . Weaver, H. Climate change and health: impacts, vulnerability, adaptation and mitigation. *New South Wales Public Health Bulletin* 2009;20:5-9.
22. Vanlerberghe V, Toledo, M., Rodriguez, M., Gomez, D., Baly, A., Benitez, J. Community involvement in dengue vector control: cluster randomised trial. *British Medical Journal* 2009;338:b1959.
23. National Environment Protection Council. Air Toxics NEPM. *Canberra: Commonwealth Department of Water, Heritage and the Arts; [13th February 2009; cited 29th August 2009]; Available from: <http://www.environment.gov.au/about/councils/nepc/index.html>. 2009.*
24. Kinney P. Climate Change, Air Quality, and Human Health. *American Journal of Preventive Medicine* 2008;35(5):459-467.
25. Jacob D WD. Effect of climate change on air quality. *Atmospheric Environment* 2009;43:51-63.
26. Bell M, Goldberg, R., Hogrefe, C., Kinney, P., Knowlton, K., Lynn, B., Rosenthal, J., Rosenzweig, C., Patz, JA. Climate change, ambient ozone and health in 50 US Cities. *Climatic Change* 2007;82:61-76.
27. WHO. Health Aspects of Air Pollution. Results from the WHO project 'Systematic Review of Health Aspects of Air Pollution in Europe. 2004.
28. Confalonieri U, Akhtar, R., Ebi, KL., Hauengue, M., Kovats, RS., Revich, B., Woodward, A. . Human health. *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. . 2007:391-431.*
29. Beggs P. Impacts of climate change on aeroallergens: past and future. *Clinical and Experimental Allergy* 2004;34(10):1507-1513.
30. Kolbe A GK. An extreme bushfire smoke pollution event: health impacts and public health challenges. *NSW Public Health Bulletin* 2009;Jan-Feb;20(1-2):19-23.
31. Spickett J, Brown, H., Katscherian, D. . Health impacts of climate change: Adaptation strategies for Western Australia, Department of Health, Western Australia. 2008.
32. Berry HL, Kelly BJ, Hanigan IC, Coates JH, McMichael AJ, Welsh JA, et al. Rural Mental Health Impacts of Climate Change. *Canberra: The Australian National University. 2008.*

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A sustainable health workforce is the foundation of a robust health system. There needs to be a substantial workforce maintained in high risk areas, for example in vulnerable rural and remote areas¹¹, as there is an upper limit on how health services can be redeployed to respond to climate related events. To this end, forward planning includes; identification and prioritisation of the high-risk events for a particular area (e.g., coastal inundation in seaside areas, bushfire threats in rural bushland areas etc), adequate provision of training related to local climate-related health threats¹⁴, support and critical debriefing, and the provision of adequate resources to enable the delivery of quality health services and local community health education.

Practical health system responses

Policy makers require practical options for adapting the health system for climate change, even where evidence is still incomplete.¹⁵ Here, we briefly overview a suite of practical options for preparing the health system with a focus on: 1) personnel, 2) infrastructure and 3) coordination. Health personnel are a critical element of any response to climate change; changing roles and skills will be required, particularly among front-line primary health care workforce¹⁶. Audits of climate disaster-related infrastructure must be undertaken to inform the development of detailed plans for modification or upgrades required to withstand climate change conditions, and to allow the flexibility required of health system responses.

It will also be essential to ensure coordination of services contributing to the early detection and prevention of climate-related health threats, and to link the various arms of the health system with the broader community. NGO and private sectors, relevant industries, such as power suppliers and aged care agencies, will also need to be part of this coordination approach. We overview several practical adaptations to personnel, infrastructure and coordination in relation to health risks identified in the National Adaptation Research Plan as priorities for Australia¹⁷: heatwaves / fire risk, infectious diseases, poor air quality and the mental health impacts of climate change (Figure 2).

Figure 2 Practical responses to preparing the health system for climate change

	Heatwave / Fire Risk	Infectious Diseases	Poor Air Quality	Mental Health
Personnel	<p>Frontline of health workforce to be alert to the symptoms of heat stress</p> <p>Prepared, equipped and available mobile personnel ready to respond to critical bushfire events</p>	<p>Delivery of education to cover measures for personal, family and community protection against infectious diseases</p> <p>Evaluating the capacity of health personnel to diagnose and manage, and limit infectious disease outbreaks</p>	<p>Health workforce to be alert to the health effects of air pollutants, and preventive measures that can be undertaken by the community</p> <p>Educating and managing those who are most vulnerable (e.g. those with pre-existing cardio-respiratory disease)</p>	<p>Increase awareness of the mental health effects of climate change amongst all health workers, including psychiatric and para-psychiatric services</p> <p>Utilisation of the mental health workforce to educate and prepare those communities most vulnerable to climate change</p>
Infrastructure	<p>Strategies for essential back-up power supplies</p> <p>Deployment of temporary infrastructure to ensure delivery of the range of health services required to respond to fire affected regions</p>	<p>Equipment for rapid testing and diagnosis in regions vulnerable to arboviruses</p> <p>Health and community facilities, including facilities such as aged-care centres, to ensure adequate food practices and storage facilities</p>	<p>Effective air quality surveillance systems</p> <p>Strategies to limit emissions on poor air quality days</p>	<p>Investment in areas where mental health services are under-resourced, and where the mental health effects of climate change will be substantial</p>
Coordination	<p>Development of fully integrated regional bushfire / heatwave health response plans</p> <p>Heatwave warning systems, and the use of pre-recorded health messages</p> <p>Collaborate with urban planning and housing regulators to advocate for more appropriate housing design</p>	<p>Monitoring of outbreaks / sentinel populations, aggressive case-finding measures</p> <p>Interaction between health care professionals, community agencies and government personnel to control the spread of diseases</p>	<p>Coordinating regular communication to the public regarding air quality, and personal health protection strategies</p> <p>Researching the health impact of diminished air quality, and also the interrelationship with other climate change impacts (e.g. heatwaves)</p>	<p>Early introduction of debriefing and counselling, with follow up as required</p> <p>Development of regional mental health response plans to enable emergency response and the building of social capital</p> <p>Working across the broader community, private and government sectors to raise awareness of the mental health effects of climate change</p>

Responding to Heatwaves / Fire Risk

The Australian health system needs to prepare for an increase in the frequency and intensity of heatwaves and heat-related mortality⁶ and morbidity (hospitalisations, emergency department visits and ambulance call-outs)¹³, and for the accompanying hot dry conditions that provide fuel for bushfires and place great stress on the infrastructure of the health system.

Health personnel will need to be alert to symptoms of heat stress and associated health complications, particularly GPs, district nurses, ambulance and emergency staff on the health care frontline. Health professionals are ideally positioned to play a critical role in delivering the health promotion messages on how to avoid heat stress, and the health impacts of bushfires. Critical events may exceed past experiences. Bushfire prone nations such as Australia need a prepared and mobile skilled workforce to respond immediately to critical bushfire events.

A National Heatwave Framework must include strategies to reduce power demand, prioritisation of essential power needs and extended duration back-up power supply options in case of a power grid failure¹⁸, plus the deployment of rescue teams for quick repair.

Effective heatwave warning systems will play a critical role, with pre-recorded health messages to be distributed via the mass media. Social support networks, known to act as a protective factor against heat related illness, will need to be supported and developed, such as community care options like buddy systems for the elderly and other vulnerable population groups.

There is a need for coordination between the health sector and the broader community to develop regional bushfire health response plans, and to support community care options and social networks that have a protective effective¹⁹ such as buddy systems for the elderly and other vulnerable populations. The health sector can collaborate with urban planners and housing regulators to ensure housing and urban design provide a protective element during heatwaves in keeping with human behaviours and health needs, and reduce the “heat island” effect¹.

Responding to Infectious Diseases

Within a health system that has developed an increasing focus on non-communicable disease, climate-related infectious diseases will create adaptation challenges under conditions of increasing temperatures and humidity. The Australian health system will need to plan for an increase in infectious diseases such as gastrointestinal infections (e.g. Salmonella), and vector-borne diseases such as dengue fever which threatens to spread further south²⁰. Many of the diseases will not be new to Australia, but rather new to the area, and to the local health service. In addition, outbreaks of infectious diseases can stem from climate-related disasters such as flooding²¹, and infrastructure failures.

Health personnel will need the necessary skills to diagnose and manage a new realm of infectious disease outbreaks, and to fulfil a critical role of delivering disease prevention education to the community. Community education will need to cover measures for personal, family and community protection against infectious diseases, such as peri-domestic sanitation to prevent the spread of dengue, and food hygiene to prevent salmonella poisoning.

In the case of infrastructure, health facilities such as hospitals and aged-care residential centres will need adequate food storage, handling and cooking facilities to prevent gastrointestinal illness amongst patients⁷. Health services will need equipment for rapid testing and detection of infectious diseases, particularly in regions vulnerable to arboviruses.

Surveillance and monitoring systems will be critical to enable early detection and containment of infectious disease outbreaks⁷, as will communication channels between health care professionals, public health and government staff to manage outbreaks of infectious diseases. In the case of arboviruses; coordination with entomologists and epidemiologists to confirm diagnoses and liaise with the affected communities to deploy aggressive case-finding measures to prevent an epidemic⁷. Healthcare staff experienced in infectious diseases, and local government, will be required to work with local communities to undertake vector control (e.g. screening windows, etc) and water control to identify agricultural, drainage and other sites of potential breeding areas for mosquitoes²².

Responding to Diminished Air Quality

Overall, air quality in Australia is relatively good. The Ambient Air Quality National Environment Protection Measure established ambient air quality standards and monitoring and reporting protocols for listed air pollutants, namely CO₂, SO₂, lead, NO₂, photochemical oxidants (measured as ozone), and particulates (PM₁₀)²³. Exceedences are few, and usually occur on hot days and during dust storms and bushfires, events which are likely to increase with climate change. The likely effects of climate change on increased community exposure to levels of ozone and particulates will have adverse consequences for public health^{24 25} including increased mortality and a range of respiratory and cardiovascular health effects²⁶. Vulnerability to air pollutants is highest in urban areas where exposure to vehicle and industrial emissions is greatest²⁷, or in rural areas affected by bushfires and dust-storms. Those most susceptible include young children, the elderly and those with pre-existing cardio-respiratory disease^{28 29}. Strategic planning is required to reduce the impacts of potential increases in air pollutants due to climate change.

Health agencies need to be prepared for surges in service needs related to asthma and other cardio-respiratory illnesses. At the primary care level, health practitioners need to be alert to the health effects of air pollutants, and be able to educate vulnerable patients to take precautionary measures to prevent excessive exposure, and to take prophylactic medications where appropriate.

Air quality alerts disseminated by public health units can increase health protective behaviours³⁰. Continuous efforts to improve the modelling and forecasting of air quality will be necessary to provide more advanced and accurate warning, and the effective use of these will provide critical information to prepare health services and warn the broader community to avoid excessive exposure.

Work with the broader community is required to produce and disseminate air pollution health impact assessments that provide adaptation strategies and identification of vulnerable groups and regions, such as an assessment that was conducted in Western Australia³¹.

Responding to Mental Health Impacts

Berry et al.³² have reported that climate change has important implications for mental health through increasing the likelihood of extreme weather events that directly (for example, loss and trauma arising from direct exposure, or anxiety about the future in a world of potentially catastrophic climate change), and indirectly harm mental health. The latter includes disruption to the social determinants of mental health and wellbeing in vulnerable communities (such as economic security, social exclusion and displacement). To respond, the Australian health system needs to understand the links between climate change and psychosocial wellbeing, to promote this understanding and to increase preparedness for future events or situations that may harm mental health.

Efforts are required to raise the awareness of the mental health impacts of climate change in psychiatric and para-psychiatric services, and in the primary health care and related workforce. We can utilise the mental health and related workforce to educate and prepare those groups, communities and places most vulnerable to the effects of climate change.

Investment in community mental health infrastructure is required, especially in communities that may need greater support such as those in rural and remote areas and Indigenous communities, where mental health services are under-resourced and where the effects of climate change on mental health will be substantial.

Mental health referral pathways need to be developed and integrated with the broader community sector, promoting equitable access to primary mental health care, and coordinating a patient-centred focus. Coordination is required to engage and develop links with communities and organisations to build programs that; provide mental health awareness-raising and support, and develop regional mental health response strategies. Supporting activities in vulnerable communities that work toward 'climate-change proofing' could result in increased social connections that add a layer of protection against mental health problems.

Conclusion

Preparing the health system for climate change requires investment in personnel, infrastructure and coordination. This needs to be done even in the context of uncertainty about the extent and nature of specific climate change effects on health. Key characteristics of a climate change prepared health system are flexibility, robustness and strategically allocated resources. Long term planning will require close collaboration with the non health sectors as part of a nationwide adaptive response.

References

1. Costello A, Abbas M, Allen A, Ball S, Bell S, Bellamy R, et al. Managing the health effects of climate change: Lancet and University College London Institute for Global Health Commission. *Lancet* 2009;373(9676):1693-733.
2. CSIRO. Climate change projections for Australia. Aspendale: CSIRO Atmospheric Research, 2001.
3. Patz JA, Campbell-Lendrum D, Holloway T, Foley JA. Impact of regional climate change on human health. *Nature* 2005;438(7066):310-7.
4. Woodruff R, McMichael, T., Butler, C., Hales, S. Action on climate change: the health risks of procrastinating. *Australian and New Zealand Journal of Public Health* 2008;306(6):567-571.

5. Hoffman B HS, Boes T, Weiland D, Jockel K. Increased Cause-Specific Mortality Associated with 2003 Heat Wave in Essen, Germany. *Journal of Toxicology and Environmental Health Part A* 2008;71:759-765.
6. Woodruff R, Hales S, Butler C, McMichael AJ. Climate change health impacts in Australia: effects of dramatic CO2 emission reductions. Report for the Australian Conservation Foundation and the Australian Medical Association. 2005.
7. Horton G, McMichael A. CLIMATE CHANGE HEALTH CHECK 2020: The Climate Institute and Doctors for the Environment Australia, 2008.
8. Hennessy K FB, Bates B.C, Harvey N, Howden S.M, Hughes L, Salinger J, R Warrick. Climate Change 2007: Impacts, Adaptation an Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernment Panel on Climate Change, Chapter 11: Australia and New Zealand. Cambridge, UK: Cambridge University Press, 2007:507-540.
9. National Health and Hospitals Reform Commission. A Healthier Future For All Australians – Final Report. *Canberra: Department of Health and Ageing*, <http://www.health.gov.au/internet/main/publishing.nsf/Content/nhhrc-report> 2009.
10. Blashki G, Berry, H., Kidd, M. Primary health care responses to climate change. In J. Moss (Ed.), *Climate Change and Social Justice*. Melbourne: Melbourne University Press 2009.
11. Blashki G. Climate change and the rural health workforce. *Aust J Rural Health* 2008;16(1):1.
12. Hanna L. Continued neglect of rural and remote nursing in Australia: the link with poor health outcomes. *The Australian Journal of Advanced Nursing* 2001;19(1):36-45.
13. Department of Human Services. January 2009 Heatwave in Victoria: an Assessment of Health Impacts: Victorian Government, 2009.
14. Hamel Green I, Blashki G, Berry H, Harley D, Hall G, Horton G. Preparing Medical Students for Climate Change. *Australian Family Physician* 2009(in press).
15. APHA Technical Report. Public health policy-making in the presence of incomplete evidence. *American Journal of Public Health* 1990;80(6):746-750.
16. Blashki G, McMichael T, Karoly DJ. Climate change and primary health care. *Aust Fam Physician* 2007;36(12):986-9.
17. McMichael AJ WH, Berry H, Beggs PJ, Currie B, Higgins J, et al., . Human Health and Climate Change: National Adaptation Research Plan. *Brisbane: National Climate Change Adaptation Research Facility*, http://www.nccarf.edu.au/sites/default/files/NationalAdaptationResearchPlan-HumanHealth_0.pdf 2008.
18. Essential Services Commission of South Australia. Performance of ETSA Utilities during the heatwave of January 2009. *Information paper* 2003.
19. O'Neill MS ZA, Schwartz J,. Modifiers of the Temperature and Mortality Association in Seven US Cities. *Am J Epidemiol* 2003;157(12):1074-1082.
20. Bambrick H, Dear, K., Woodruff, R., Hanigan, I., McMichael, A. The impacts of climate change on three health outcomes: temperature-related mortality and hospitalisations, salmonellosis and other bacterial gastroenteritis, and population at risk from dengue. *Garnaut Climate Change Review*, 2008.

21. Kjellstrom T, . Weaver, H. Climate change and health: impacts, vulnerability, adaptation and mitigation. *New South Wales Public Health Bulletin* 2009;20:5-9.
22. Vanlerberghe V, Toledo, M., Rodriguez, M., Gomez, D., Baly, A., Benitez, J. Community involvement in dengue vector control: cluster randomised trial. *British Medical Journal* 2009;338:b1959.
23. National Environment Protection Council. Air Toxics NEPM. *Canberra: Commonwealth Department of Water, Heritage and the Arts; [13th February 2009; cited 29th August 2009]; Available from: <http://www.environment.gov.au/about/councils/nepc/index.html>. 2009.*
24. Kinney P. Climate Change, Air Quality, and Human Health. *American Journal of Preventive Medicine* 2008;35(5):459-467.
25. Jacob D WD. Effect of climate change on air quality. *Atmospheric Environment* 2009;43:51-63.
26. Bell M, Goldberg, R., Hogrefe, C., Kinney, P., Knowlton, K., Lynn, B., Rosenthal, J., Rosenzweig, C., Patz, JA. Climate change, ambient ozone and health in 50 US Cities. *Climatic Change* 2007;82:61-76.
27. WHO. Health Aspects of Air Pollution. Results from the WHO project 'Systematic Review of Health Aspects of Air Pollution in Europe. 2004.
28. Confalonieri U, Akhtar, R., Ebi, KL., Hauengue, M., Kovats, RS., Revich, B., Woodward, A. . Human health. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. . 2007:391-431.
29. Beggs P. Impacts of climate change on aeroallergens: past and future. *Clinical and Experimental Allergy* 2004;34(10):1507-1513.
30. Kolbe A GK. An extreme bushfire smoke pollution event: health impacts and public health challenges. *NSW Public Health Bulletin* 2009;Jan-Feb;20(1-2):19-23.
31. Spickett J, Brown, H., Katscherian, D. . Health impacts of climate change: Adaptation strategies for Western Australia, Department of Health, Western Australia. 2008.
32. Berry HL, Kelly BJ, Hanigan IC, Coates JH, McMichael AJ, Welsh JA, et al. Rural Mental Health Impacts of Climate Change. Canberra: The Australian National University. 2008.