

Climate change and primary health care: towards better regional health impact and risk assessments

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Aims

Over 1000 papers have been written about the health effects of climate change which is acknowledged to be one of the greatest health threats of the 21st Century.¹ Australia is one of the world's most climate-vulnerable developed countries. Tasmania has led the nation in loss of farm income due partly to drying conditions² with anecdotal evidence from primary health care practitioners of health impacts. While recent years have seen the emergence of promising new models for conducting climate change health impact and risk assessments at regional-level,³⁻⁷ to date these have not well captured health practitioner assessments of risks, impacts and appropriate adaptations, including in affected rural communities.

This research aims to explore internationally relevant methods for developing regional-level responses to the health effects of climate change, and what general practitioners (GPs) might contribute to such impact and risk assessment exercises.

Structure of this presentation

This presentation

- Offers a *discussion of methods for conducting regional-level evaluations of climate change impacts and risks* in Australia and overseas (Health Impact Assessments or HIAs)
- Develops a *working set of best practices* for examining the different aspects of regional-level climate change impacts, risks, and adaptations, drawing on an illustrative Canadian HIA model
- Describes possible *ways in which GPs could contribute to regional-level impact and risk assessments*, particularly those led by local governments
- *Applies and explores aspects of those practices, especially as they relate to the role of rural GPs in 'climate witnessing'* to the development of qualitative survey questions in a pilot interview study of rural and regional Tasmanian primary health care services to better understand: 1. What health impacts and risks of climate change do general practitioners see in Tasmania, for which groups?; 2. How has this affected the way they practice, clinically and non clinically?
- Concludes by identifying the *critical challenges* in assessing the regional-level health impacts and risks brought by climate change, and the role of rural GPs in meeting those challenges

Health impact assessment methods: a key method for evaluating climate change impacts, risk and possible adaptations

This presentation—aiming to contribute to integrated development of regional health services for climate change adaptation (and ideally mitigation)—emphasises the value of regional and internationally recognised work using established methods in the Health Impact Assessment (HIA), Environment Impact Assessment (EIA), as well as the Social Impact Assessment (SIA) fields as a basis for building the necessary additional multidisciplinary methods.^{3,8,9}

Like other action research tools, HIAs have been described, initially by the 1999 Gothenburg Consensus Paper by the WHO Regional Office for Europe, as a combination of procedures, methods and tools for (usually early predictive) assessment of both the positive and negative effects of a policy or intervention on the health of a population, particularly vulnerable populations.^{10,11} They range from tightly controlled epidemiological studies to holistic, sociological approaches.¹² A recent review of HIAs suggests that most now use elements of both approaches.¹³ They have been used for developing adaptive responses to environmental effects on health more generally—not to do with climate change as such—ideally prior to a planned intervention. A diverse range of sectors and disciplinary knowledge is involved in the HIA (or Environmental Health Impact Assessment 'EHIA') process, from environmental scientists to economic analysts to health advocacy groups.¹² Primary agencies involved in articulating HIA methodology are WHO, which has called for their redevelopment for climate change, the Asian Development Bank, and the National Health and Medical Research Council (NHMRC).¹⁴

The strength of HIAs is as a mechanism for discovering health risks and developing policy from wide-ranging regional-level data, in a way that involves community stakeholders.¹⁵ Yet the applied HIA field lacks high quality, rigorous evaluation of its tools and approaches.^{15,16} Nonetheless, there is evidence of growing international demand over the last decade for HIAs to be developed to meet complex regional-level health challenges (such as service development for disadvantaged groups). These require multiservice and intersectoral collaboration.¹⁷ In Australia, the Department of Health and Ageing (DOHA) has published guidelines for the conduct of HIAs, relevant to the assessment of environmental determinants of health.¹² The DOHA guidelines focus on the impact of human development on the environment (environmental health assessment: often of a specific planned development such as altered motor vehicle traffic) rather than the impact of climate change on human health. There are also other available guidelines for HIAs such as the HIA Screening Tool and guidelines developed by the UK Department of Health.¹²

Health Impact Assessments have been recognised by leading climate change researchers to have special value for studying the impacts of climate change. Recent research suggests how HIAs can be further developed for regional-level climate change discovery research, by way of incorporating and developing standardised WHO comparative risk assessment approaches, which have traditionally involved analysis of the burden linked to individual risks (rather than whole-of-region issues).⁵ There has been substantial work for the Victorian government using HIA methods to scope regional-level climate change impacts on population health and vulnerabilities. This uses Victorian climate change projections to 2030 and 2070 based on key climatic variables. It identifies a wide range of direct and indirect climate-related health impacts on vulnerable populations relevant to Victoria, integrating health care services analyses with social and economic environmental considerations.³ There has also been a major statewide 2008 health impact assessment produced for the West Australian government which concluded that

the lack of detailed knowledge of future climatic conditions in Western Australia, the future distribution and densities of populations and the development of associated infrastructure did not allow for a comprehensive and quantitative assessment of health impacts. What emerged from this project, however, was a good understanding of current activities, their adequacy with respect to health and a range of adaptations and required supporting research.(p.6)⁷

However, a validated climate change and health impact assessment tool has not yet been developed. Ideally, such a tool would extend and question the climate change research, and provide a regional evidence-base for adaptation involving health practitioners. Understanding how different kinds of regional experts and community stakeholders such as GPs can act as 'climate change witnesses' is an important step in our development of this tool.

Best practice in studying the different aspects of regional-level climate change risks, impacts and adaptations: An illustrative Canadian model

*Human Health in a Changing Climate: A Canadian Assessment of Vulnerabilities and Adaptive Capacity*⁶ is a major Canadian report offering international leadership in assessing the regional-level impacts and risks of climate change. When it was published in 2008 it offered an innovative new model for integrating different kinds of research methods to evaluate what health responses to climate change were needed in Canada. A critical feature of this study is that it took a policy-making focus at the micro (local council) meso (regional) and macro (national) levels. Another key feature of the report is that it focused on ‘whole-of-health system’ responses needed to coordinate adaptation to climate change at the primary, secondary and tertiary health care levels, from prevention to emergency services. In so doing, the report focuses on how to ensure that the Canadian health care system is able to build on existing health care priorities and planning.

The Canadian study suggests that such a complex national impact and risk assessment exercise will involve different kinds of evidence and research techniques for engaging with regional-level issues. The report can be extrapolated into the following set of best practices for studying the different aspects of regional-level climate change impacts, risk and adaptations. That is, such studies should:

- Involve initial scoping of the literature, both applied and scholarly, to develop the methods
- Involve a community consultation process to develop the research methods for the study
- Ensure that the experiences and knowledge of those who are close to the land, such as Aboriginal communities, farmers and others, are appropriately included
- Develop qualitative and quantitative investigative techniques for analysing direct and indirect health impacts of climate change that engage with socio economic and demographic factors
- Map the health services capacities, including health workforce readiness, in a particular local region
- Draw on quantitative methods for modelling climate change and use futures-oriented scenario-building based on diverse data to maximise the accuracy of predictive risk assessments
- Integrate population health data in epidemiological approaches that are informed by ecological data
- Include a wide range of stakeholders and experts as well as methods for involving these, from the business, not for profit and government sectors, and at all levels of the health system from practitioners to policy-makers; at the least this will involve use of reference groups, briefing sessions and methods such as ‘climate witnessing’.

The Tasmanian pilot study reported in this presentation focuses on the last critical aspect of such HIAs— climate witnessing by community stakeholders and experts. Before reporting our results from that study into what role GPs might have as climate witnesses, it is necessary to describe the framework in which we believe this role should sit: the work of local government as leaders of regional climate change adaptation.

The role of primary health care practitioners as ‘climate witnesses’ in council-led impact and risk assessments

Clearly, effective health impact and risk assessment cannot rely on information from any one kind of expert or stakeholder. Yet primary health care practitioners could play a much greater role in their regions improving the work of local councils in regional-level health service provision for climate change i.e. a role in system-wide development. In designing our pilot Tasmanian interview study we hypothesised that GPs could act as climate change witnesses, helping their local councils better function to develop ‘whole-of-community’ adaptation responses.

The possible partnership between primary health care and local governments has not featured in the climate change scholarship to date. Yet local councils are seen as critical by the Australian government in helping communities mitigate and adapt to climate change through planning decisions, natural resource management, and infrastructure development.¹⁸ The Australian Government’s *Climate Change Adaptation Actions for Local*

*Government*¹⁹ identifies the development of health services as one of six key functions of local councils in helping their communities adapt to climate change. Referring to an evidence-base of literature reviews and stakeholder consultations, it asserts that adaptation of health services and the other five function areas at local council level will provide 'a net economic, social or environmental benefit no matter what level of climate change occurs'(p.1). It identifies a wide range of health impacts of interest to councils, from injuries arising from bushfires and flooding, to vector-borne, food- and water-borne, diseases. It describes how councils already provide a number of public health programs and have regional public health plans.¹⁹

Australian councils are already actively researching the health risks of climate change and developing a range of programs to respond to those regional risks. For example, the South East Councils Climate Change Alliance, a network of eight councils in Victoria, has been conducting research into climate change effects and developing heatwave adaptation strategies for vulnerable populations. Under the Local Adaptation Pathways Program (LAPP), the Australian Government is providing funding for councils to undertake climate change risk assessments and develop action plans to prepare for the regional-level impacts of climate change. Under Round 1 of the LAPP, over 60 local governments from mostly coastal and urban areas received funding for a total of 33 projects. Round 2 of the LAPP focused on improving participation from non urban areas.¹⁹

There are other initiatives such as the work of ICLEI Oceania– Local Governments for Sustainability (an international, not-for-profit association of local governments and local government organisations with a commitment to sustainable development). The Department of Climate Change in Australia has also supported ICLEI Oceania to develop guidance materials for climate change adaptation which are available to all councils: the *Local Government Climate Change Adaptation Toolkit*.²⁰ The work of ICLEI Oceania builds in turn on the work undertaken in *Climate Change Impacts and Risk Management: A Guide for Business and Government* produced by the former Australian Greenhouse Office.²¹ The ICLEI Oceania toolkit is a paper-based workshop-oriented toolkit offering councils general guidance, as well as questionnaires, worksheets and conceptual models to use for broad risk assessments. However, the toolkit does not include a health risk assessment or health service adaptation focus.

The contribution of rural primary health care practitioners could be by way of integrating their knowledge into such initiatives by local councils, to improve regional climate change adaptation for health. Tasmania, where our pilot study examining how GPs could act as regional climate change witnesses is based, was the first state to legislate in 1996 for HIA to be a formal requirement of the environmental impact assessment process. Local councils in Tasmania are familiar with the process, however, it is known that HIA is also occurring informally in other jurisdictions, through councils.^{12,15} Rather than add an extra layer of work for councils, health impact and risk assessment for climate change should aim to build upon and develop existing arrangements and infrastructure in local councils for HIAs and EIAs, as well as existing models for adapting to climate change. This will involve a strong focus on capacity-building, particularly through building partnerships between climate change and health researchers, local councils, and health and allied health agencies. The integration of HIAs with EIAs has already occurred in Tasmania. It offers important lessons about how to value and include regional-level observations with empirical quantitative data, and incorporate the perspectives of community stakeholders. It has also been found that HIAs do not add greatly to the cost of EIAs.¹² However, what is not known is whether and how GPs could act as one kind of climate change witness for their region, offering useful clinical and non clinical information about impacts and risks that could be included in such HIAs.

A pilot study of rural and regional Tasmanian primary health care

Methods for the Tasmanian pilot rural GP climate witness study

The study population

There are currently 165 publicly listed general practices across Tasmania. The study aimed to exclude population centres larger than 20,000 or without permanent medical staff. This brought the number of practices contacted and provided with the full research brief down to 33. It should be noted that while our original intention was to conduct a random sample, it quickly became apparent that such a requirement for eligibility for participation in the study, coupled with the expected low response rate of GP practices dealing with the urgent and immediate daily challenges of health care, meant all 33 practices should be contacted. The need to obtain a spread of GPs from the different regions was also a factor in inviting all 33 in the hope of obtaining at least one GP interview from the different major regions of Tasmania.

Thus, 33 eligible practices were provided with the research information sheet and consent form. Our pilot interviews are of 6 GPs in at least 5 different practices in rural and regional Tasmania (excluding Hobart and Launceston). Some of these doctors work in more than one practice. Interviewees were primary care practitioners from the north (1), south (3 with 2 from the same practice), northeast (1) and northwest (1) of Tasmania. Interviewees were working at registrar level to general practitioner level. They had practiced in their region from 6 months to 2 years (for 2) to 12 to 23 years. They practiced from an average of 8 sessions a week (4 GPs) to full-time on call.

Interview procedures

All interviews were administered and conducted by a medical professional qualified to emergency resident level at a regional hospital. Practice managers were initially contacted by telephone, informed of the study and asked if they would provide the research information and consent forms to all practitioners in their practice. Where consent for participation was given, a suitable interview time was arranged. Interviews lasted 15-30 minutes and involved the following questions provided to interviewees prior to the interview:

A. How long have you practiced in this region?

B. How many direct contact hours with patients have you had over that time, on an average week?

The following questions ask you to talk about how climate has shaped your region in the last five years at least (if you have not lived there that long, tell us about what you do know from local knowledge, including patient accounts, without identifying anyone)

1. How has climate specifically affected the health and wellbeing of people in your region through events such as drought, bushfires, flooding, storms?
2. What kinds of mental health issues do you see in your region?
3. Do you see many patients with asthma or allergic conditions linked to pollens and weeds? Please describe any changes in your region in the number and seasonal timing of such conditions.
4. What kinds of health conditions do you see that relate to insect-borne diseases (such as Ross River Virus)?
5. Is water supply (too little or too much) a concern in your region? Has it caused hardship for people?
6. Do you have many presentations related to environmental extremes, such as heat stroke? How about increases in cataracts and skin cancers linked to longer-term sun exposure?
7. Do you feel changes in climate in your region are interacting with economic factors to make people close to the land, such as farmers, more vulnerable, including in terms of their health?
8. Are there any new health threats that people in your region now face?
9. Do you think that climate is changing in ways that affect human health in your region? Other regions in Australia? If so, has this changed the way you practice?

The interviewer took notes from, as well as recorded, the interviews. The notes were provided in de-identified form to a second independent researcher who summarised them in this presentation which was checked by the original interviewer for factual and interpretative accuracy.

Aims and limitations of the interview method

The interview questions were designed to assess whether and how GPs can act as 'climate change witnesses'. This pilot study is itself part of a sequence of research studies that involve the development of a Health Impact and Risk Assessment tool for climate change that rural local councils can use. It is envisaged that GPs will be part of such exercises. Specifically, the questions were designed to gather qualitative data about the kinds of clinical and nonclinical knowledge GPs could provide about health effects of climate change in their regions, useful to understanding their possible role in, and value to, regional health impact and risk assessments. In short, the researchers wanted to know, not what a representative sample of GPs thought about health impacts

and risks, but rather what kind of climate change witnessing GPs could offer in such larger community based exercises.

Given this purpose, the ostensible limitation of our method—that we did not sample and so cannot claim representativeness—may not be so important. While we acknowledge that our method would favour GPs who believe in and are more proactive about climate change, any GPs participating in any kind of impact and risk assessment exercise are likely to share this feature.

Findings: the nature of climate witnessing by rural GPs

Many of the GP observations our study obtained are not ‘data-driven’ in the narrow empirical sense of the term but rather are based on on-the-ground practice observations: that is the nature of climate witnessing. As such they do not so much predict longer-term risks but rather engage with more recent and immediate observable effects. Yet, the key message that emerges from these data is that GPs are willing and able to act as climate change witnesses, and that their capacity should be harnessed in a systematic way as part of broader regional adaptation processes (such as those led by local government).

In relation to *whether climate had specifically affected the health and wellbeing of people in their region*, two GPs referred to the drought:

The area has experienced prolonged drought and probably much worse than other parts of the state. As much of the local population depend on farming or forestry for their livelihoods this has created financial hardship for many. So clinically I probably see this manifest as mental health problems, particularly depression and anxiety.

Others advised that they had not observed major striking changes but rather more indirect and subtle health effects such as

- Shifts in seasonality leading to increases in allergic conditions such as hayfever (‘many people who haven’t had asthmatic exacerbations for years have been coming for treatment’)
- The unexpected nature of climatic events disrupting farming activities and interacting with global pressures and factors to indirectly affect community wellbeing (‘...one unseasonal hail storm can ruin a crop... this is closely linked to financial markets, dairy deregulation etc.’)
- ‘Burning off’ practices conducted by Forestry Tasmania (as part of bushfire control measures) leading to respiratory complaints (‘During the burn off period I notice a real spike in respiratory illness.’)

One GP advised that though it had brought people who ‘say they are climate change refugees’ climate change had not brought major direct health effects to that region ‘apart from episodic events, occasional large bushfires’. This GP detailed many indirect effects of climate change (unseasonal heavy rain had recently stressed farmers and disrupted farming activities; hayfever; occasional Cryptosporidium; heatstress in older people on a few hot days).

The *kinds of mental health issues GPs advised they see in their regions* were

- Depression that is possibly seasonal and possibly linked to low vitamin D levels (‘Depression is common and seems to be most strongly influenced by season, the winter time is worst. The group that seem most affected are middle aged women.’)
- Depression possibly linked to fears about climate change and social disconnection and loss in a new kind of rural Australian ‘climate change refugee’ (‘I left [name if interstate city] because [that city] is running out of water and getting hotter and I didn’t want to be there when Peak Oil hit...A lot of people move to this area for those reasons and those people who are more tuned in are also more sensitive to the unpredictability of life and can carry a sense of impending doom...I certainly see a greater amount of depression amongst those people’)

- Anxiety and depression linked to the prospect of major change and upheaval brought about by climate change and other possibly related global factors ('What I'm seeing [in patients with mental health issues] is a lot of people who have never contemplated the possibility of significant change in their lifetimes.)
- Depression linked to loss of livelihoods linked to mitigation measures ('Particularly in our region many people have relied on forestry for their livelihood and now with the significant changes that are occurring they're finding they're up against it).

In relation to *asthma or allergic conditions linked to seasonal pollens and weeds* at least one GP had not seen an increase of these but other GPs advised that climate change was positively affecting allergies:

...it's probably more prominent now (January) in [my region] where we had quite wet conditions, thanks to that pollination was delayed, then all of a sudden it became dry and great for producing pollens. So all of a sudden we saw hayfever presentations in December, whereas before we might have seen the presentations in October.

In relation to *kinds of health conditions seen that relate to insect-borne diseases (such as Ross River Virus)*, GPs advised that they had

- seen people with insect bites and various skin reactions to insects but did not know if this was linked to climate change ('We do get a number of tick bites but I'm unsure how the patterns are changing')
- observed instances of Ross River virus ('Essentially a wetter year, like this one, will translate into more cases of Ross River Virus. This will become more apparent later in summer. It will require surveillance and careful history taking to identify an increased incidence of Ross River Virus...I have had one incident case of Ross River Virus, where there was no history of travel. In a former life I was heavily involved in infectious diseases treatment and monitoring.') ('I've had a number of cases of Ross River Virus, it's considered endemic here. I couldn't tell you if I'm seeing more cases as the numbers of affected patients aren't high and it seems to vary with different seasons.')

In relation to *whether water supply was concern in their region*, GPs advised water supply issues were a major concern in their regions in both obvious and not so obvious ways, both in terms of the quality of water and the limited supply of water, shaped by more subtle factors themselves possibly linked to climate change:

'Water is definitely an issue for our region. We have water restrictions in the main town and have had a number of boil water alerts. These relate mostly to high levels of E-coli found in the water supplies'

'It's a bit of a catch twenty two out here. Those on tank water seem to be paying more every year to bring in the water tanker and if you rely on the town supply barely a year goes by without a boil water alert.'

'I've seen mostly the guys that live on water tanks, when water tanks are quite low based on the drought pattern. All of a sudden we get parasites such as blastocystis, at the end of winter when the tanks were quite low.'

'Yes, we've had a big upheaval in the last few years. A couple of years ago the council decided to go for a big 20 million dollar solution, to pipe water...because the population of this area is growing and they say it will be a more sure supply. We have drought years and sometimes the water supply has been a bit precarious...With this change the people who have lived quite happily on tank water for decades are now forced to connect, even if they keep their existing tanks, which translates into additional annual rates, water meters and charges. This impacts negatively on personal finances and wellbeing for many who have previously survived on low budgets.'

In terms of *presentations related to environmental extremes, such as heat stroke* GPs advised that these were limited, however, at least one GP advised that s/he had seen many cases of severe sunburn 'probably in the lower spectrum of severity' and another advised that 'I've seen some very bad cases of sunburn in visitors who have come to spend the hot days at the beach.'

When asked about whether changes in climate in their region were interacting with poverty to make people close to the land, such as farmers, more vulnerable, including in terms of their health, GPs advised that

- This was more true during the recent drought i.e. not in 2010
- Problems with water supply influenced by climate change could shape economic wellbeing with mental health 'knock on' effects ('We have a proportion of farmers who suffer when there have been restrictions on water with drier summers. The financial pressures tend to spill over into relationship difficulties and then anxiety and depression are what I find myself dealing with in clinical practice.')
- The unpredictability of weather events could affect community wellbeing and farm viability ('It's a farming area around here, dairy, potatoes, stone fruits, apricots, apples etc...There's more unexpected events...The old timers who have been growing apples for 50 years, or cherries, they've never had to worry about hail for example, in the middle of summer or frosts coming at unexpected times, or months without reliable rain....')
- Climate change could be considered one of a range of interacting factors causing hardship in a region ('Many farmers have changed their practices in an attempt to adapt, for example there is much less dairying in the region than when I first started doing locums. Many switched over to running sheep as these tend to survive a little better in the hot, dry conditions. Then the market fell off which created more hardship.')

There were frequent references to the ways that climate change and global factors had interacted to force farming families to diversify with not always good results:

'I have a cherry farmer in [name of region] who has his orchards in [name of another region], he drives 1 ½ hours each way every day and now has come in with chest pain. We talk about that and we talk about stress and 'why are you doing it' and his response is 'because I have to, you have to diversify, otherwise I can't get any income for my family'. It's a typical pattern, where families would previously not do this sort of thing and rely on savings instead, but now it's not the case, they've used up their reserves and I wouldn't be surprised if we start seeing a higher incidence of cardiovascular disease as a consequence.'

In relation to *new health threats that people in their regions faced* GPs had a great deal to say. They identified the following health effects:

- Skin cancer ('Living in a cool-temperate climate I don't think people realise how easily we can get too much sun exposure and sunburnt.')
- Asthma and other allergic conditions as well as other seasonally-linked health conditions such as flu ('Flu season seems to have changed as well. Previously I have seen my first cases of flu when the vaccine has become available in March, last year I didn't see my first case until May.')
- Mental health issues, particularly depression in many groups at every life stage linked to a fatalistic sense of impending doom though the shorter term impacts are from markets (for nitrogen fertiliser and oil)
- Insect borne diseases that may become more prevalent including through new 'climate change tourist' and 'climate change refugee' demographics ('We don't have the conditions or the mosquito carrier for it [Dengue Fever] to become endemic but the ready mobility of people these days means there's an increased likelihood of us seeing it here. We get a lot of travellers from Queensland and Western Australia who come to escape the heat up north.')

In relation to *whether the climate is changing in ways that affect human health in their regions or other regions in Australia*, GPs advised that they saw climate change as a real threat with impacts on how they practiced. They were concerned about

- Extremes of temperature, particularly hotter conditions, with more very hot days

- Droughts and flooding and other climatic events such as cyclones ('The current flooding in Queensland is almost certainly a reflection of a changing climate. There are so many health implications, the immediate threat of drowning or getting injured, the risk of getting bitten by snakes as they also try to escape to higher ground, then issues of access to quality water supply, food, increased risk of infections as people's septic or town sewer systems get inundated and spill raw sewerage into the open environment, insect borne diseases as there will be a lot of water hanging around for a long time. Loss of livelihoods, mental health consequences then continue for years after the event')
- Insect borne diseases such as mosquito borne infections
- Climate change refugees ('There may be pressure for people to move to the coast where the temperatures often don't vary as much as inland regions. This will add to overpopulation in some parts, compounding pressure on water supplies.')

One GP advised that 'without a doubt the climate is affecting health in other parts of Australia. I think being a locum and seeing so many towns facing similar problems has given me this insight.'

Further, the GP who had advised climate change had not brought major health impacts to his/her region also advised that the health problems brought by climate change in Queensland 'are going to be huge, in so many layers.'

In relation to *whether climate change had changed the way they practice*, GPs advised that they

- felt climate change would alter how modern medicine is being practiced and that GPs needed to be prepared for this ('I'm stuck in a paradox of having to work in a system that is unsustainable...there's a real paradox of spending thousands fiddling with the edges of people's health, with polly-pharmacy, expensive investigations etc., when climate change is going to radically alter the circumstances in which we live and try to practice health care.')
- placed increasing value on prevention in general practice ('I believe one contribution I can make is to increase the general awareness of these challenges among patients and colleagues.')
- had developed more attuned diagnostic practices to monitor possible climate-linked conditions in the region, from insect borne disease to new underlying causes of depression ('I'm certainly paying more attention to taking a good history when someone comes in with muscles and joint aches. Essentially being more vigilant to the occurrence of Ross River Virus.')('For the people who come in, the fifth generation farmers who never had a problem before and would never admit to having the mental health problems, all of a sudden you have these middle aged men coming in who quite openly admit that there are having anxiety, feeling low and are distressed. That is probably something I wouldn't have suspected some years ago, so now I am more sensitive to the possibility of mental health issues in these people.')
- felt mitigation had shaped prescribing practices and practice operation more generally with doctors seeing they had a role within their practices to help reduce carbon emissions ('I think about how our practice operates, such as the amount of paper used and waste generating. The E-waste that comes from the practice and large volumes of non-recyclable packaging. As I'm relatively junior in the practice I don't feel I have as much influence on such things as I would like. I would also advocate for sourcing things as locally as possible to reduce transport emissions. Responsible prescribing is an important area that I have direct influence on. Reducing the number of unnecessary prescriptions will help to reduce emissions and waste.')
- felt greater pressure to be advocates for more responsive health services in their local area precisely because they were aware of regional-level health impacts from climate change.

Among most GPs interviewed, there was a sense of uncertainty about what needed to be done to prepare their communities, including (and perhaps especially) from those GPs who spoke of climate change as a critical force shaping their region: 'Even though I am aware that change is coming I don't know how to respond right now.'

Conclusions: Critical challenges in assessing the regional-level health impacts and risks brought by climate change and the role of rural GPs in meeting those challenges

The literature on climate change suggests the great complexity with which contemporary health systems now need to engage.²²⁻²⁶ In responding to the health effects of climate change, it is not enough to assess impacts and develop reactive health care system responses. Information about future risks also need to be evaluated.^{27,28} Not only that, but impact and risk assessments need to develop knowledge about the existing health care systems and policy priorities that are actionable at different levels, in ways that add value to existing adaptive mechanisms.^{28,29} This pilot study suggests that GPs could play an important role in such regional-level HIA studies led by councils (or other broader collaborations), ideally as a kind of regional climate change witness.

There are also broader conclusions to be drawn from our discussion of international HIA methods and Tasmanian pilot study. These relate to the importance of being informed by existing HIA methods and best practice as identified in section 2 of this presentation, especially in relation to the importance of community engagement and intersectoral collaboration. Effective risk management in local communities will require locale specific assessment and adaptation responses. We feel this is the framework within which the GP witness role best sits.

While the challenges are considerable in this field, the possible contribution of GPs can be seen in meeting the key challenges.

A critical challenge of regional-level impact and risk assessment exercises lies in *the nature of the health impacts and risks that need to be both evaluated and predicted* (as well as mediated and ideally prevented). These will include direct health effects such as deaths and injuries from extreme events like flooding, bushfires and heatwaves. They will also include indirect health effects such as asthma and allergies that may be the secondary effects of these extreme events or arising from more subtle changes in climate such as shifts in the distribution and seasonality of flora and fauna.^{1,4,30-40} Our pilot study suggests that *GPs are potentially vital climate change witnesses who have an understanding of both the direct and indirect mechanisms by which climate change affects health in their regions*. By implication, it suggests also that there are likely to be other kinds of climate change witnesses who can support regional-level impact and risk assessments: other primary health care and community services practitioners, environmentalists, farmers, Aboriginal people, members of community groups and as the CWA, and so on.

Impact and risk assessments need to engage with complex issues that are not about climate as such but about the ways interactions between climate and other factors will shape what happens, when, how, to whom, where.^{41,42} The complexity and specificity of these interactions for individual regions means that often a body of published scholarly research will have limited generalisability for assessing impacts and risk in any one region. Each local region or municipality will have their own configurations of socio-economically vulnerable populations, health services and health workforce adequacies. Such studies need to identify not simply the critical deficiencies in public health and emergency services that will prevent a particular community from effectively responding to climate change. They also need to identify the feasible adaptation (and ideally mitigation) responses, the nature and form of those responses, for climate vulnerable groups in that particular community. Inevitably, feasible responses will be need to be determined with reference not simply to tangible costs and benefits, but also the more intangible costs and benefits.²⁹ *Our pilot study suggests that GPs have regional level knowledge that contributes to practical understandings of such local dynamics. They are able to offer integrated expert opinions based on their clinical observations that could help assess impacts on their communities and foresee relevant risks, and identify necessary health service actions.*

Traditional approaches to studying climate change involving climate change modelling and scenario-building can have limited value for 'on the ground' regional impact and risk assessments.^{43,44} This is because such regional-level studies involve judgments about how to handle missing data and other 'real world' uncertainties to do with what will happen in any one region in the future. Much of this uncertainty is related to how people and services will act locally to mediate the effects of climate change. This is suggested by unreliable epidemiological predictions for the effects of malaria that have not taken such human factors into account.⁴⁵⁻⁴⁷ ²⁹ Thus, a critical challenge in developing health impact and risk assessments for climate change lies in engaging with system-level interactions and effects that are meaningful in a particular region—effects that are not traditionally the mainstay of big-*N* epidemiological studies dominating public health research agendas or

traditional global climate change research approaches. *Our study suggests that the use of GPs as one kind of climate change witness can supplement and complement other big-N climate change research methods, particularly in relation to local mediating factors.*

Health impact and risk assessment for smaller vulnerable populations at the regional level requires more than a notion of internal validity. It will also require external validity: local communities need to become climate-ready in a way that makes research an agent for achieving heightened community awareness and responsiveness to the public health measures that need to be taken. This is why small-N qualitative approaches have value, especially if they incorporate well-developed community consultation techniques.⁴⁸ However, there are known divisions in communities around climate change, belief in which is highly politicised and may bias what impacts and risk are acknowledged by community members.^{49 50} Thus designs for community-based research involving regional stakeholders need to account for the ways in which climate change has become a cultural and political entity that shapes what people can see happening in their communities. While our pilot study does not resolve all these issues, it does suggest that involving GPs as stakeholders in HIAs is possible if done in ways that account for busy practice environments, in interviewing programs implemented by medical practitioners i.e. they might well be receptive to such a role. The inclusion in our study of a question (Question 9) designed to explore the willingness of GPs to acknowledge climate change was affecting health generally suggests the value of such 'climate testing' questions. Our study also raises the interesting question whether it is possible that, as one of our GP interviewees suggested, the so-called 'bias' of GP climate believers could in fact mean they offer more accurate observations than GP non believers: 'I guess that people who don't believe in climate change don't necessarily look out for these changes'.

Thus, the singular challenge of regional-level climate impact and risk assessment for public health is about developing excellence in translational, applied community-based research methods. There is no single research method or expert groups that can meet such a challenge. However, our pilot project suggests that GPs do possess clinical and non clinical knowledge about climate change that can make them one of a range of important 'climate change witnesses' in such regional-level studies. Our study suggests that rural primary health care practitioners have far more sophisticated clinical and non clinical understandings of climate change than has sometimes been assumed. In Tasmania these have been developed in response to the direct and indirect effects of climate change on farming communities. It seems likely that primary health care practitioners represent a critical 'frontline' of climate change health impacts that challenge and extend existing big-N epidemiological understandings of why and when climate change affects health, where, and what responses are needed.

References

1. Costello A, Allen A, Ball S, Bell S, Bellamy R, Friel S, et al. Managing the health effects of climate change. *The Lancet*. 2009;373:1693-733.
2. ABARE. Australian farm survey results 2006-07 to 2008-09. Canberra: Australian Bureau of Agricultural and Resource Economics, Commonwealth of Australia 2009 April.
3. Turk R, Battle C, Hanna E, Spickett JR, B. The scoping of climate change impacts on population health and vulnerabilities—benchmarking. Melbourne: Department of Health 2010.
4. Global Humanitarian Forum. Human Impact Report Climate Change: The Anatomy of a Silent Crisis. Geneva: Global Humanitarian Forum 2009.
5. Patz J, Campbell-Lendrum D, Gibbs H, Woodruff R. Health impact assessment of global climate change: expanding on comparative risk assessment approaches for policy-making. *Annual Review of Public Health*. 2008;29:27-39.
6. Séguin J, editor. Human Health in a Changing Climate: A Canadian Assessment of Vulnerabilities and Adaptive Capacity. Ottawa, Canada: Health Canada; 2008.
7. Spickett J, Brown H, Katscherian D. Health impacts of climate change: Adaptation strategies for Western Australia. Perth: Environmental Health Directorate, Department of Health, Government of Western Australia 2008.
8. Vanclay F. Principles for Social Impact Assessment: a critical comparison between the international and US documents. *Environmental Impact Assessment Review*. 2006;26(1):3-14.
9. Esteves A, Vanclay F. Social Development Needs Analysis as a tool for SIA to guide corporate-community investment: applications in the minerals industry *Environmental Impact Assessment Review*. 2009;29(2):137-45.
10. Confalonieri U. Environmental change and human health in the Brazilian Amazon. *Global Change & Human Health*. 2000;1:174-83.
11. European Centre for Health Policy. Health Impact Assessment: main concepts and suggested approach. In: WHO Regional Office for Europe, editor. *The Gothenburg Consensus Paper* 1999.
12. National Public Health Partnership. Health Impact Assessment Guidelines. Canberra, 2001: Commonwealth Department of Health and Aged Care, Commonwealth of Australia 2001.

13. Mindell JS, Boltong A, Forde I. A review of health impact assessment frameworks. *Public Health*. 2008 Nov;122(11):1177-87.
14. Fehr R. Environmental health impact assessment: evaluation of a ten-step model. *Health Impact Assessment*. 1999;10(5):618-25.
15. Harris-Roxas BF, Harris PJ. Learning by doing: the value of case studies of health impact assessment. *N S W Public Health Bull*. 2007 Sep-Oct;18(9-10):161-3.
16. London Health Observatory. Report on the qualitative evaluation of four health impact assessments on draft mayoral strategies for London London,: London Health Commission2003.
17. Cole BL, Fielding JE. Health impact assessment: a tool to help policy makers understand health beyond health care. *Annu Rev Public Health*. 2007;28:393-412.
18. Penny Wong [Minister for Climate Change and Water]. Media Release: Funding for local councils to plan for climate change risk. Canberra: Department of Climate Change; 2009 [cited 2010 10 February]; Available from: www.climatechange.gov.au.
19. Department of Climate Change. Climate Change Adaptation Actions for Local Government. Canberra: Commonwealth of Australia2009.
20. ICLEI Oceania. Local Government Climate Change Adaptation Toolkit. Melbourne: International Council for Local Environmental Initiatives–Australia/New Zealand Limited2008.
21. Australian Greenhouse Office [now the Department of Climate Change]. Climate Change Impacts and Risk Management – A Guide for Business and Government. Canberra: Department of Environment and Heritage2006.
22. McMichael A, Powles J, Butler C, Uauy R. Food, livestock production, energy, climate change, and health. *Lancet*. 2007;370(9594):1253-63.
23. McMichael A, Neira M, Heymann D. World Health Assembly 2008: climate change and health. *Lancet*. 2008;371(9628):1895-6.
24. McMichael A, Woodruff R, Hales S. Climate change and human health: present and future risks. *Lancet*. 2006;367(9513):859-69.
25. Archer D, Rahmstorf S. *The Climate Crisis: An Introductory Guide to Climate Change*. Cambridge: Cambridge University Press; 2010.
26. Balbus J, Ebi K, Finzer L, Malina C, Chadwick A, McBride D, et al. Are we ready?: Preparing for the public health challenges of climate change. New York: Environmental Defence Fund2008.
27. Campbell-Lendrum D, Woodruff R. Comparative risk assessment of the burden of disease from climate change. *Environmental Health Perspectives*. 2006;114:1935-41.
28. Carthey J, Chandra V, Loosemore M. Adapting Australian health facilities to cope with climate-related extreme weather events. *Journal of Facilities Management*. 2009;7(1):1472-5967.
29. Bell E. Making health services 'climate-ready': a policy framework for regional development. *American Journal of Public Health*. 2011;DOI 10.2105/AJPH.2010.202820
30. Haile M. Weather patterns, food security and humanitarian response in sub-Saharan Africa. *Philos Trans R Soc Lond B Biol Sci*. 2005 Nov 29;360(1463):2169-82.
31. McMichael A, Campbell-Lendrum D, Corvalan C, Ebi K, Githeko A, Scheraga J, et al. *Climate Change and Human Health: Risk and Responses*. Geneva: World Health Organisation; 2003.
32. Menne B, Ebi K. *Climate Change and Adaptation Strategies for Human Health*. Heidelberg, Germany: World Health Organisation2006.
33. Menne B, Apfel F, Kovats S, Racioppi F, editors. *Protecting Health in Europe from Climate Change*. Copenhagen: World Health Organisation Regional Office for Europe 2008.
34. Campbell D, Stafford Smith M, Davies J, Kuipers P, Wakeman J, McGregor MJ. Responding to health impacts of climate change in the Australian desert. *Rural Remote Health*. 2008 Jul-Sep;8(3):1008.
35. Jackson R, Shields KN. Preparing the U.S. health community for climate change. *Annu Rev Public Health*. 2008;29:57-73.
36. MacCracken M. Prospects for future climate change and the reasons for early action. *J Air Waste Manag Assoc*. 2008 Jun;58(6):735-86.
37. Schmidhuber J, Tubiello FN. Global food security under climate change. *Proc Natl Acad Sci U S A*. 2007 Dec 11;104(50):19703-8.
38. McMichael AJ, Woodruff RE, Hales S. Climate change and human health: present and future risks. *Lancet*. 2006 Mar 11;367(9513):859-69.
39. Greer A, Ng V, Fisman D. Climate change and infectious diseases in North America: the road ahead. *Cmaj*. 2008 Mar 11;178(6):715-22.
40. Bell E, editor. Climate change: Is Australian rural and remote medical education ready for the age of consequences? Rural Health: the place to be –10th National Rural Health Alliance Conference Cairns 2009 17 – 20 May Cairns, Queensland National Rural Health Alliance.
41. McMichael AJ, Friel S, Nyong A, Corvalan C. Global environmental change and health: impacts, inequalities, and the health sector. *BMJ*. 2008 January 26, 2008;336(7637):191-4.
42. Bell E. The GFC, climate change and rural child health: Where to for rural health policy? In: Bell E, Seidel B, Merrick J, editors. *Climate Change and Rural Child Health*. New York: Nova Science; 2011.

43. Dessler A, Parson E. The science and politics of climate change: A guide to the debate. 2nd ed. Cambridge: Cambridge University Press; 2010.
44. Patz JA, Campbell-Lendrum D, Holloway T, Foley JA. Impact of regional climate change on human health. *Nature*. 2005 Nov 17;438(7066):310-7.
45. Ledford H. Malaria may not rise as world warms. *Nature*. 2010;465(20 May):280-1.
46. Chaves LF, Koenraadt CJ. Climate change and highland malaria: fresh air for a hot debate. *Q Rev Biol. Mar*;85(1):27-55.
47. Gething PW, Smith DL, Patil AP, Tatem AJ, Snow RW, Hay SI. Climate change and the global malaria recession. *Nature*. May 20;465(7296):342-5.
48. Minkler M, Wallerstein N, editors. *Community Based Participatory Research for Health*. San Francisco: Jossey-Bass; 2003.
49. Directorate-General for Communication of the European Commission. *Europeans' attitudes towards climate change*. Belgium: European Commission and the European Parliament 2009.
50. Andrew Kohut A, Scott Keeter S, Doherty C, Dimock M, Parker K, Menasce Horowitz J, et al. *A deeper partisan divide over global warming*. Washington, D.C.: Pew Research Center 2008.