Controlling communicable diseases in rural New South Wales - epidemiological research for directing health policy and practice

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A thesis submitted in partial fulfilment of the requirements of the degree of Doctor of Public Health within the School of Public Health and Tropical Medicine, James Cook University.

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Declaration on Ethics

The research presented and reported in this thesis was conducted within the guidelines for research ethics outlined in the National Statement on Ethics Conduct in Research Involving Humans (1999), the Joint NHMRC/AVCC Statement and Guidelines on Research Practice (1997), the James Cook University Policy on Experimentation Ethics, Standard Practices and Guidelines (2001), and the James Cook University Statement and Guidelines on Research Practice (2001). Specific ethics approval details are provided in each publication.

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Summary

The overall aim of this body of work was to expand the evidence base for controlling communicable diseases in regional and rural Australia, specifically conducting epidemiological research for directing health policy and practice. The diseases investigated are diverse but the setting and the risks are common, that is the Hunter New England area of New South Wales (NSW) and the people who live and work in this regional part of Australia.

The vision for health in rural, regional and remote Australia as articulated in the Healthy Horizons framework is:

"*People in rural, regional and remote Australia will be as healthy as other Australians and have the skills and capacity to maintain healthy communities*" [1].

Within the context of this vision for equitable health experience there is only a limited understanding of the epidemiology and impact of prevention strategies on communicable diseases in rural, regional and remote Australia. Of particular focus in this thesis were those communicable diseases that affect Aboriginal and Torres Strait Islander people, and people in close contact with livestock and feral animals. An operational research approach was used to better understand the epidemiology and control of pandemic influenza; rural communicable disease outbreaks; invasive meningococcal and pneumococcal diseases in Aboriginal and Torres Strait Islander people; tuberculosis; brucellosis; Q fever; and malaria in rural New South Wales communities.

The studies into pandemic influenza mainly used qualitative methods. Focus groups and in-depth interviews were used to explore Aboriginal and Torres Strait Islander people's experiences with the pandemic and to investigate more appropriate control strategies. This investigation occurred within a Participatory Action Research method that enabled communities to benefit through action and understanding. Structured interviews and focus groups were also used in the study into the prevention strategies for Brucellosis.

Other studies conducted within this thesis used quantitative methods including a cohort study, descriptive and analytical studies, and evaluation of outcomes. Structured surveys and medical record reviews were also used to explore the control of some communicable diseases.

This thesis presents a number of studies that display lateral and original approaches to communicable disease control. The use of a Participatory Action Research method, that included research capacity building with Aboriginal communities, and the qualitative work with feral pig hunters are unique methods in the development of communicable diseases control strategies in rural areas. In addition, the novel epidemiological approach in the submitted manuscript in Chapter 6, has not been reported elsewhere in the literature.

Pandemic influenza

A careful analysis of influenza pandemic epidemiology found that in New South Wales, Aboriginal and Torres Strait Islander people were four times more likely to be admitted to hospital with A(H1N1)pdm09 pandemic influenza than non-Aboriginal people.

Working within a Participatory Action Research framework, overseen by the Hunter New England Aboriginal Health Partnership, an interactive process of research engagement and negotiation with Aboriginal communities yielded pandemic influenza control strategies that were based on community understanding and recognition of the importance of families in the life of Aboriginal and Torres Strait Islander communities. Strategies included:

- the need for health services to undertake respectful engagement with communities;
- modifying home isolation and quarantine policies;
- family centred prevention; and
- communicating with and through grandmothers.

Prior to the 2009 pandemic considerable preparatory work was conducted in the Hunter New England regional area. Pandemic exercises were conducted and these included careful evaluation to inform a future response. The need to modify mass vaccination plans, particularly in rural areas, to effectively engage community partners was a major finding from a mass vaccination clinic exercise. A large-scale surveillance and response exercise clearly demonstrated the capacity of senior nursing staff to perform a surge function during a protracted public health response to pandemic influenza.

The epidemiological situation at the time that pandemic containment was discontinued suggests that during future events more thought should be given to the heterogeneity of disease occurrence across a state or nation. In addition the capacity of regional areas to respond needs to be considered before altering pandemic response phases.

Learning from outbreaks

Boarding schools, where people live in close proximity, are vulnerable to outbreaks of respiratory illness. A cluster of twenty-five community acquired pneumonia (CAP) in previously well adolescents attending a boarding school in rural New South Wales led to an epidemiological investigation of the outbreak. Strategies for improving influenza surveillance and control in this setting were identified. Clusters of pneumonia in boarding schools should alert clinicians to the possibility of *Streptococcus pneumoniae* complicating influenza infection and prompt appropriate laboratory investigations with notification to public health authorities. The outbreak in 2006 provided an excellent opportunity to test the newly set up Public Health Real-time Emergency Department Surveillance System (PHREDSS). This investigation found that using the current thresholds, PHREDSS would have trigged a signal for pneumonia syndrome in children aged 5-16 years four days earlier than the notification by the clinicians involved. Early notification of outbreaks can lead to reduction of the impact of an outbreak if control strategies can be applied.

Aboriginal and Torres Strait Islander status of people notified with invasive meningococcal and pneumococcal diseases

In New South Wales, Aboriginal and Torres Strait Islander children were not considered a particular high risk group for invasive bacterial disease. Careful analysis of invasive meningococcal disease notifications, between 1991 and 2005, found that Aboriginal and Torres Strait Islander children 0–4 years of age had a significantly higher risk when compared with non-Aboriginal children (relative risk 3.31, 2.35-4.68, 95%CI). Similarly, Aboriginal and Torres Strait Islander children aged 0-4 years had a two-to three-fold higher rate of invasive pneumococcal disease than non-Indigenous children (relative risk 2.68, 1.02–7.09, 95%CI). Linking notification data with routine hospital admission data proved a useful and time efficient surveillance strategy to increase the proportion of notifications with Aboriginal and Torres Strait Islander status recorded.

Tuberculosis (TB) and country of birth

TB rates in NSW take account of regional variations in age structure being usually presented as age-standardised rates. However the key determinant of TB risk in NSW is a resident's country of birth. Newly arrived migrants to Australia are increasingly being resettled into rural areas of Australia and may bring with them different levels of risk of TB.

During the period, 2006-2008, there were 1401 notified TB cases in NSW with 76.5% of cases born in a high-incidence country. The annualised TB rate for the high-incidence country-of-birth group was 61.2/100,000 population and compared to 1.8/100,000 population for the remainder of the population. The data were re-analysed to take account of population heterogeneity in country of origin.

Of the 152 local areas in NSW, nine had higher and four had lower TB rates in the high-incidence country-of-birth population than the high-incidence country-of-birth population for the rest of NSW. The accessibility of services in these areas is currently being explored by NSW TB Services.

Brucellosis

Historically NSW was considered free from *Brucella suis* in feral and domestic pig populations. Epidemiological investigations found that feral pig hunting in NSW was been the common risk factor for all human brucellosis in northwest NSW in the past five years.

During 2011 in-depth interviews with feral pig hunters in the local area explored particular high risk activities during evisceration in the scrub. Respondents identified a number of strategies for reducing risk including: taking more time and visualising their hands when cutting; ensuring good lighting; taking particular care when cutting near a sow's uterus; and using latex gloves to cover cuts on their hands. These strategies should now be field trialled.

Q fever

In a review of NSW Q fever notifications, data were analysed using 3-year study periods from 1993 to 2007 to investigate possible trends and explore reported risk exposures. The epidemiology of Q fever disease in New South Wales has changed and amongst notified cases the relative importance of non-abattoir contact with livestock, wildlife or feral animals has increased. The surveillance field 'Occupation' no longer alone adequately describes risk exposure for many people notified with Q fever and a new field that describes risk exposures is required.

Medical records of the 89 patients with Q fever admitted to hospitals in the Hunter New England area during 2005-2009 were reviewed. The low level of documented cardiac assessment for Q fever patients found during the review is of concern and efforts are required to limit preventable endocarditis.

Malaria prevention

A cohort study in 2006 found that six members of a group of 38 were diagnosed with malaria on return from Papua New Guinea. None of the 12 individuals who took chemoprophylaxis for the recommended period post-travel developed malaria compared to 4/24 travellers who terminated prophylaxis prematurely or 2/2 who took no chemoprophylaxis. These findings led to changes in formulary advice available to general practitioners who are the primary source of travel advice to rural Australian travellers.

Outcomes

The findings from the research in this thesis have led to a number of recommendations and changes in communicable diseases policy. The findings from the pandemic influenza work with Aboriginal communities are informing the development of new disease control strategies for NSW Health. Communication with boarding schools in north-west NSW about influenza has become part of the routine practice of the public health unit during each winter season. Aboriginal and Torres Strait Islander status is now routinely collected for all notifications of meningococcal disease. Analysing rates of TB by adjusting for high incidence country of birth has been accepted as part of the regular epidemiological reviews of TB in NSW. Q fever surveillance in NSW will include risk exposure in addition to occupation. The formulary advice available to general practitioners for malaria prevention is being changed to reflect current recommendations.

Structure of Thesis and Publications

An operational research framework was considered appropriate for investigating how communicable disease risks could be reduced in this setting and directing policy and practice. Implementing change and/or advocating for changes to policy and practice are integral to this operational research approach. This is enhanced when it is based on the strength of peer-reviewed publications. The aim of this work was to publish in peer-reviewed journals all findings of significance, thus this thesis is composed of papers published from the research.

Chapter Summaries

Chapter 1: Introduction

The context, place and social aspects of communicable diseases are often as important as the particular biological aspects of pathogens. This chapter describes the context of this work and argues for a greater understanding of communicable disease epidemiology, and evidence-based prevention and management approaches in rural, regional and remote Australia. If the communicable disease burden is to be reduced, and the urban/rural health divide challenged, than a more complete exploration is needed of the:

- particular risk groups;
- key transmission mechanisms and prevention strategies;
- important social and cultural aspects of life in rural, regional and remote Australia impacting on communicable disease transmission and control.

Chapter 2: Pandemic influenza and Aboriginal communities

Working within a Participatory Action Research framework, feasible and acceptable strategies to control pandemic influenza in Aboriginal communities are explored.

2.1 Potential risk and call for action

Massey PD, Miller A, Durrheim DN, Speare R, Saggers S, Eastwood K. Pandemic influenza containment and the cultural and social context of Indigenous communities. Pandemic influenza containment and the cultural and social context of Indigenous communities. *Rural and Remote Health*, 2009; **9**:1179.

2.2 Reducing the risk

Massey PD, Pearce G, Taylor KA, Orcher L, Saggers S, Durrheim DN. Reducing the risk of pandemic influenza in Aboriginal communities. Reducing the risk of pandemic influenza in Aboriginal communities. *Rural and Remote Health*, 2009; **9**: 1290.

2.3 Impact: Pandemic (H1N1) 2009 influenza and Aboriginal communities in NSW

Rudge S, Massey PD. Pandemic (H1N1) 2009 influenza and Aboriginal communities: strengthening collaboration between NSW Health and the Aboriginal community-controlled health sector. *New South Wales Public Health Bulletin* 2010; **21(2)**: 26–29.

2.4 Findings & Recommendations: Australian Aboriginal and Torres Strait Islander communities and the development of pandemic influenza containment strategies - community voices and community control.

Massey PD, Miller A, Saggers S, Durrheim DN, Speare R, Taylor K, Pearce G, Odo T, Broome J, Judd J, Kelly J, Blackley M, Clough A. Australian Aboriginal and Torres Strait Islander communities and the development of pandemic influenza containment strategies: community voices and community control. *Health Policy* (In Press)

2.5 Advocacy for changes in national pandemic plans

Miller A, Durrheim AD; Aboriginal and Torres Strait Islander Community Influenza Study Group: Massey PD, Pearce G, Taylor K, Blackley M, Broome J, Odo T, Purcell C, Clough A, Judd J, Kelly J, Speare R, Saggers S. Aboriginal and Torres Strait Islander communities forgotten in new Australian National Action Plan for Human Influenza Pandemic: "Ask us, listen to us, share with us". *Medical Journal of Australia* 2010;**193(6)**:316-317.

Chapter 3: Pandemic influenza – planning, surge capacity and response in a regional area

Pandemic planning within the context of a regional area of Australia is challenging, but through field exercises prior to the event and evaluation of responses during an event much can be learned.

3.1 Pandemic planning

Eastwood K, Massey P, Durrheim D. Pandemic planning at the coal face: responsibilities of the public health unit. *New South Wales Public Health Bulletin*, 2006; **17(7-8)**:117-120.

3.2 Mass vaccination exercise

Carr C, Durrheim DN, Eastwood K, Massey P, Jaggers D, Caelli M, Nicholl S, Winn L. Australia's first pandemic influenza mass vaccination clinic exercise. *Australian Journal of Emergency Management,* 2011; **26(1)**: 47-53.

3.3 Public Health surge capacity in a regional area

Hope K, Massey PD, Osbourn M, Durrheim DN, Kewley C, Turner C. Senior clinical nurses effectively contribute to the pandemic influenza public health response. *Australian Journal of Advanced Nursing,* 2011; **28(3)**:47-53.

3.4 Pandemic response in a regional area

Eastwood K, Durrheim DN, Massey PD, Kewley C. Australia's pandemic 'Protect' strategy: the tension between prevention and patient management. *Rural and Remote Health*, 2009; **9**:1288.

Chapter 4: Learning from outbreaks

Outbreaks of communicable diseases provide opportunities for learning about disease epidemiology, the appropriateness of surveillance and the effectiveness of response strategies. This chapter describes an outbreak of respiratory disease in a rural boarding school and lessons learned.

4.1 Surveillance and control of a respiratory outbreak in a high risk rural setting

Cashman P, Massey P, Durrheim D, Islam F, Merritt T, Eastwood K. Pneumonia cluster in a boarding school--implications for influenza control. *Communicable Diseases Intelligence*, 2007; **31(3)**:296-298.

4.2 Working with Emergency Department data to identify outbreaks earlier.

Hope K, Durrheim DN, Muscatello D, Merritt T, Zheng W, Massey P, Cashman P, Eastwood K. Identifying pneumonia outbreaks of public health importance: can emergency department data assist in earlier identification? *Australian and New Zealand Journal of Public Health*, 2008; **32(4)**:361-363.

Chapter 5: Aboriginal and Torres Strait Islander status and risk of invasive bacterial diseases

Improving the collection of Aboriginal and Torres Strait Islander status of people who have an invasive notifiable disease can provide better quality data for the implementation of disease control strategies.

5.1 Invasive Meningococcal Disease

Massey PD, Durrheim D. Aboriginal and Torres Strait Islander peoples at higher risk of invasive meningococcal disease in NSW. *New South Wales Public Health Bulletin*, 2008; **19(5-6)**:100-103.

5.2 Invasive Pneumococcal Disease

Massey PD, Todd K, Osbourn M, Taylor K, Durrheim DN. Completing Indigenous status for invasive pneumococcal disease (IPD) notifications provides a better epidemiological understanding. *Western Pacific Surveillance and Response Journal*, 2011; **2**: doi: 10.5365/wpsar.2011.2.1.007

Chapter 6: Tuberculosis and country of birth

Tuberculosis in rural areas is uncommon but is likely to reflect the country of birth mix of the population. A novel approach to considering tuberculosis rates could assist in designing more targeted disease control strategies.

6.1 Tuberculosis and country of birth

Massey PD, Durrheim DN, Stephens N, Christensen A. Using country of birth to better understand local TB epidemiology in a low incidence setting. *International Journal Tuberculosis and Lung Disease*, submitted.

Chapter 7: Brucellosis - an emerging threat in a regional area

Brucellosis is an emerging disease in northwest New South Wales. Understanding risk exposures and developing acceptable prevention strategies may assist in reducing this risk.

7.1 Feral pig hunting a risk factor for brucellosis

Irwin M, Massey PD, Walker B, Durrheim D. Feral pig hunting: a risk factor for human brucellosis in north-west NSW? *New South Wales Public Health Bulletin*, 2010; **20(12)**:192–194.

7.2 Preventing brucellosis

Massey PD, Polkinghorne BG, Durrheim DN, Lower T, Speare R. Blood, guts and knife cuts: reducing the risk of swine brucellosis in feral pig hunters in north-west New South Wales, Australia. *Rural and Remote Health*, submitted.

Chapter 8: Q fever –remaining queries in Query fever.

The epidemiology of Q fever has changed since the introduction of a vaccine for abattoir workers. Understanding the current epidemiology and how the risks of chronic Q fever are managed in people admitted to hospital with Q fever can inform improvements in policy and health.

8.1 Q fever vaccination – unfinished business

Massey PD, Durrheim DN, Way A. Q-fever vaccination--unfinished business in Australia. *Vaccine*, 2009; **27(29)**:3801.

8.2 Q fever risk exposure surveillance

Massey PD, Irwin M, Durrheim DN. Enhanced Q fever risk exposure surveillance may permit better informed vaccination policy. *Communicable Diseases Intelligence*, 2009; **33(1)**:41-45.

8.3 Prevention of Q fever endocarditis

Hess IM, Massey PD, Durrheim DN, O'Connor S, Graves SR. Preventing Q fever endocarditis: a review of cardiac assessment in hospitalised Q fever patients. *Rural and Remote Health*, submitted.

Chapter 9: Malaria prevention for travellers from rural Australia

Travellers from rural areas may have problems accessing travel health advice. A cohort study of travellers infected with malaria explores adequacy of prevention advice.

9.1 Malaria prevention

Massey P, Durrheim DN, Speare R. Inadequate chemoprophylaxis and the risk of malaria. *Australian Family Physician*, 2007; **36(12)**:1058-1060.

Chapter 10: Conclusion, outcomes and future research directions

Preface and Acknowledgements

The research studies included in this thesis involved many partners, collaborators and co-investigators. Achievements from this work are directly related to the passion, energy and dedication to “making a difference” of each of the people involved.

My supervisors Professors Richard Speare and David Durrheim have provided invaluable guidance, support, technical expertise and encouragement to me during this work. Their wisdom in supervision and strength of support was always provided with a wonderful sense of collegiality. Although I will unlikely ever achieve the depth of understanding and amazing capacity that my supervisors display, I was very honoured that they joined me on the journey of this work.

Of the many people involved with this work some particular acknowledgments are needed.

I acknowledge the people of north-west New South Wales, and especially the Kamillaroi people, elders past and present, with whom I have had the privilege of sharing life with for the last 25 years.

The communicable diseases team that I lead have been very supportive, keen and patient with the large amount of research work that has been involved in this thesis. Thanks.

A large part of the joy that I found in this research work was the friends and colleagues that I met along the way and who shared some of the journey with me. Particularly I acknowledge Adrian Miller, Sherry Saggers, Jenni Judd, Jenny Kelly, Melissa Irwin, Isabel Hess, Ben Polkinghorne, Stephen Graves and Keith Eastwood.

There were valuable contributions to various chapters of the thesis by many collaborators. The major collaborators are co-authors on the peer-reviewed publications that are included in this thesis. Their specific acknowledgements are detailed below.

Contributors and my role

Chapter 2: Pandemic influenza and Aboriginal communities

My role: During the routine Pandemic Influenza planning that was required of Public Health Units in 2006 it became obvious to me that Aboriginal communities would likely experience much higher risk of pandemic influenza. In addition it was clear that the proposed pandemic influenza control strategies had not been developed with Aboriginal communities and thus were likely to fail.

Talking through the issues with some Aboriginal colleagues, community members and my supervisors, the research agenda took shape. I was involved in the development of the research questions, community engagement, developing the methods, ethical approvals, training, data collection, data analysis, manuscript and report writing, reporting back to community and advocacy. I was the research leader for each of these components in New South Wales and co-led the national components. I was a Chief Investigator on the NHMRC project. This project was conducted over three years.

Important contributions were made to this work by:

- Kylie Taylor and Glenn Pearce, who have provided the cultural grounding and community connection that was essential for the work. In addition Kylie and Glenn collected most of the data, enabled interpretation of the data, supported the report writing and actively participated in the reporting back to community and advocacy.
- Lisa Orcher and Tony Martin, who provided support, community access and connection to the Hunter New England Aboriginal Health Partnership
- Adrian Miller co-led the national project, provided high level understanding of research with Aboriginal communities and community connection in North Queensland.
- Sherry Saggers lead the development of the methodology and co-led the national project.
- David Durrheim, Richard Speare, Jenni Judd, Jenny Kelly and Carmel Nelson co-led the national project and provided expertise from their fields of work.

My estimated contribution for each section within this chapter:

2.1 Potential risk and call for action 55%

2.2 Reducing the risk of pandemic influenza in Aboriginal communities 45%

2.3 Impact: Pandemic (H1N1) 2009 influenza and Aboriginal communities in NSW 50%

2.4 Findings & Recommendations: Australian Aboriginal and Torres Strait Islander communities and the development of pandemic influenza containment strategies - community voices and community control. 40%

2.5 Advocacy for changes in national pandemic plans 15%

Chapter 3: Pandemic influenza – planning, surge capacity and response in a regional area

My role: This chapter of work was conducted within my role as Program Manager Health Protection during the planning and response phase to pandemic influenza. Although I was not the lead author on these papers, I provided important input into the design, implementation and reporting of these projects. My role especially included providing a rural and regional focus to the pandemic work. Public Health work is almost always conducted in teams to enable a broader range of experience and skills to be applied to the problem at hand.

3.1 Pandemic planning. Working with Keith Eastwood and David Durrheim I had an active role in: the literature review; in developing the framework for the planning; providing the rural context for pandemic planning; drafting parts of the manuscript; and editing drafts and revisions of the manuscript.

My estimated contribution was 25%.

3.2 Mass vaccination planning. Working with Chris Carr, David Durrheim and Keith Eastwood my role in this project was: contributing to the planning; designing aspects of the project, including the data collection tools; collecting data during the exercise; assisting with

the data analysis; participating in the interpretation of the data; contributing parts of the manuscript; and editing drafts and revisions of the manuscript.

My estimated contribution was 25%.

3.3 Public Health surge capacity in a regional area. Working with Kirsty Hope, Maggi Osbourn and Kerry Todd my role in the project was: contributing to the planning; designing aspects of the project, including the data collection tools; collecting data; assisting with the data analysis; participating in the interpretation of the data; contributing parts of the manuscript; and editing drafts and revisions of the manuscript.

My estimated contribution was 35%.

3.4 Pandemic response in a regional area. Working with Keith Eastwood, David Durrheim and Chris Kewley my role in the project was: contributing to the planning; designing aspects of the project; assisting in the literature review; assisting with the data analysis; participating in the interpretation of the data; contributing parts of the manuscript; and editing drafts and revisions of the manuscript.

My estimated contribution was 25%.

Chapter 4: Learning from outbreaks

My role: Leading a team of people in the control of notifiable communicable diseases in a regional area of NSW provides me with opportunities to record and share lessons learnt from outbreaks of disease. These learnings then become part of the evidence base for public health operation.

4.1 Surveillance and control of a respiratory outbreak in a high risk rural setting. Working with Patrick Cashman, David Durrheim, Fakhrul Islam, Tony Merritt and Keith Eastwood my role in the project was: contributing to the planning; designing aspects of the project; assisting in the literature review; assisting with the data analysis; participating in the interpretation of the data; contributing parts of the manuscript; and editing drafts and revisions of the manuscript.

My estimated contribution was 35%.

4.2 Working with Emergency Department data to identify outbreaks earlier. Working with Kirsty Hope, David Durrheim, David Muscatello, Tony Merritt and Wei Zheng my role in the project was: contributing to the planning; participating in the interpretation of the data; contributing parts of the manuscript; and editing drafts and revisions of the manuscript.

My estimated contribution was 15%.

Chapter 5: Aboriginal and Torres Strait Islander status and risk of invasive bacterial diseases

My role: Improving the health of Aboriginal people is an integral part of this thesis. The impetus for these two projects was my experiences in seeing the disproportionate impact of notifiable invasive diseases in Aboriginal families and communities.

5.1 Invasive Meningococcal Disease. Working with David Durrheim my role in the project was: initial concept; planning; designing the project; conducting the literature review; collecting the data; conducting the data analysis; participating in the interpretation of the data; writing the manuscript; and editing drafts and revisions of the manuscript.

My estimated contribution was 80%.

5.2 Invasive Pneumococcal Disease. Working with Kerry Todd, Maggi Osbourn, Kylie Taylor and David Durrheim my role in the project was: initial concept; participating in the planning; designing the project; conducting the literature review; assisting with collecting the data; conducting the data analysis; participating in the interpretation of the data; writing the manuscript; and editing drafts and revisions of the manuscript.

My estimated contribution was 45%.

Chapter 6: Tuberculosis and country of birth

My role: Tuberculosis has been for many years an area of special interest to me as it is a preventable and treatable disease that combines social, economic, environmental, programmatic and biological factors.

Rural parts of NSW are experiencing changes in demography with newly arrived migrants to Australia increasingly being resettled into rural areas of Australia. Migrants from high incidence countries may bring with them different levels of risk of TB.

Working with David Durrheim, Nicola Stephens and Amanda Christensen my role in this project was: initial concept; planning; designing the project; conducting the literature review; collecting the data; conducting the data analysis; participating in the interpretation of the data; writing the manuscript; and editing drafts and revisions of the manuscript.

My estimated contribution was 80%.

Chapter 7: Brucellosis - an emerging threat in a regional area

My role: Investigating recently notified cases of Brucellosis led to the discovery that Brucellosis was an emerging threat in this regional area. I developed the initial concept and research questions.

7.1 Feral pig hunting a risk factor for Brucellosis. Working with Melissa Irwin, Belinda Walker and David Durrheim my role in this project was: initial concept; participating in the planning; designing the project; assisting in the literature review; assisting with collecting the data; participating in the interpretation of the data; participating in the writing of the manuscript; and editing drafts and revisions of the manuscript.

My estimated contribution was 45%.

7.2 Preventing brucellosis. Working with Ben Polkinghorne, David Durrheim, Tony Lower and Richard Speare my role in this project was: initial concept; planning; designing the project; assisting in the literature review; assisting with collecting the data; participating in the interpretation of the data; writing of the manuscript; and editing drafts and revisions of the manuscript.

My estimated contribution was 50%.

Chapter 8: Q fever –remaining queries in Query fever.

My role: Raising the profile of some of the zoonotic diseases faced by people in rural and regional Australia is one of the motivations of this thesis. Without improved evidence and strong advocacy, large city based health departments easily forget important rural health issues.

8.1 Q fever vaccination – unfinished business. Working with David Durrheim and Andrew Way my role in this project was: initial advocacy concept; participating in the development of the project; conducting the literature review; writing the manuscript; and editing drafts and revisions of the manuscript.

My estimated contribution was 50%.

8.2 Q fever risk exposure surveillance. Working with Melissa Irwin, David Durrheim my role in this project was: initial concept; participating in the planning; designing the project; assisting in the literature review; assisting with collecting the data; participating in the interpretation of the data; writing of the manuscript; and editing drafts and revisions of the manuscript.

My estimated contribution was 50%.

8.3 Prevention of Q fever endocarditis. Working with Isabel Hess, David Durrheim, Simon O'Connor and Stephen Graves my role in this project was: initial concept; planning; designing the project; assisting in the literature review; assisting with collecting the data; participating in the interpretation of the data; participating in the writing of the manuscript; and editing drafts and revisions of the manuscript.

My estimated contribution was 40%.

Chapter 9: Malaria prevention for travellers from rural Australia

My role: While investigating notified cases of malaria I identified a cluster of cases from the same travel group. I instigated the cohort study investigation.

Working with David Durrheim and Richard Speare my role in this project was: initial concept; planning; designing the project; conducting the literature review; collecting the data; conducting the data analysis; participating in the interpretation of the data; writing the manuscript; and editing drafts and revisions of the manuscript.

My estimated contribution was 70%.

Dedication

This doctoral thesis is dedicated with much love and appreciation to my lovely wife, Christine, and my wonderful children, Simon, Kait, Anna and Emily. It is within their love and within the love of God that this work has meaning.

Doctor of Public Health course structure

Unit Code	Unit	Description	Weight
TM5516	Biostatistics for public health	Masters unit	3
TM5527	Independent project	Massey P, Durrheim D. Income inequality and health status: a nursing issue. *Australian Journal of Advanced Nursing* 2007; 25(2):84-88.	3
TM6018	Doctoral Project 1	Review of DOTS in a remote area of PNG.	6
TM6019	Doctoral Project 2	Massey PD, Viney K, Kienene T, Tagaro M, Itogo N, Ituaso-Conway N, Durrheim DN. Ten years on: Highlights and challenges of Directly Observed Treatment Short-course as the recommended TB control strategy in four Pacific island nations. *Journal of Rural Tropical Public Health* 2011; 10: 44-47.	6
TM6015	Doctoral Conference Presentations	1. Changing Q fever epidemiology and burden of disease in a rural area of NSW. Rural Health Research Colloquium Oct 2009 2. Australian College of Veterinary Science – Epidemiology Chapter, Gold Coast, June 2010; Brucellosis 3. Influenza Studies with Indigenous Australian Communities. H1N1 Workshop, Health Research Council, Auckland, New Zealand.	6

PD7219	Professional Doctorate Research Thesis (Public Health - Generic)	Thesis	48
		Total	72

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2. Interview questions: Brucellosis risk reduction strategies for feral pig hunters.

3. Survey tool: Nature of risk exposure for Q fever in notified cases from Hunter New England

4. Survey tool: Risk factors for malaria in a group of travellers to Papua New Guinea.

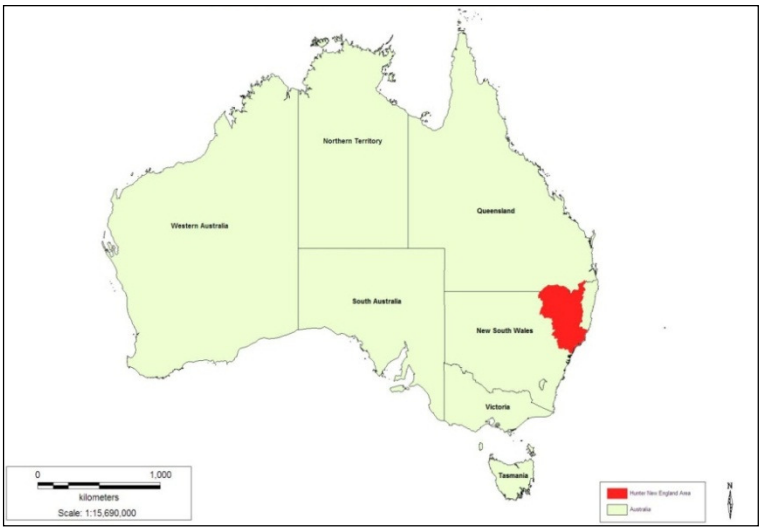
5. Ethics approvals:
    a. Pandemic influenza and Aboriginal communities
        i. Hunter New England Human Research Ethics
        ii. James Cook University Human Research Ethics
        iii. Aboriginal Health and Medical Research Council of NSW
    b. Brucellosis and feral pig hunters
        i. Hunter New England Human Research Ethics

CHAPTER 1. INTRODUCTION

Context

The research conducted in this thesis was undertaken at Hunter New England Population Health (HNEPH), which provides services to the regional Hunter New England Health Area, which is a large section of north eastern New South Wales, Australia (Figure 1.1). The Hunter New England health area covers approximately 130,000 km^2 of urban, rural and remote country with a population of nearly 865,000. Like much of Australia, the population of this area is concentrated on the coastline and moderately large inland towns are located throughout the rural areas. Small townships, including discrete Aboriginal communities, can be found in the more remote regions and offer particular challenges to controlling communicable diseases.

Figure 1.1. The Hunter New England health area of New South Wales, Australia.



Source: Hunter New England Population Health, Health in Hunter New England HealtheResource, Hunter New England Area Health Service, 2009. Available at: http://www1.hnehealth.nsw.gov.au/HNEPH/HHNE/toc/preAhsmap.htm (Accessed 1 June 2011)

Issues

The Australian population is unevenly distributed across the country, with approximately 85% of the total population living in capital cities or within 50 km of the coast [1]. The small numbers of people who do not live near the coast are spread across the inland areas of Australia. It is these people who are most likely to be affected by increasing rural /urban health inequalities [2].

There is no widely accepted definition of rural, regional or remote areas, nor is there a single rural definition that can serve all policy and research purposes. This makes comparisons of data from differently defined areas problematic. Definitions of a rural area have been based on population size, access to health care, occupation and other socioeconomic variables, and political proclamations but may not accurately reflect how people see themselves or government services are provided. [3,4]

'Rural' areas across the world are characterized by considerable internal variability based on their diversity of residents, communities, environments, and accessibility to services. [6] The concept of 'rural' is most commonly based upon some combination of geographical criteria, social criteria and economic criteria. So an area that is many hours drive from a major city, sees itself as a rural community and is mainly involved in agriculture or other primary industry, would be likely be recognised as rural. But the concept of rural is complex, multidimensional, and often vague. [5]

The Australian Standard Geographical Classification Remoteness Areas (ASGC RA) classification allocates one of five remoteness categories to areas depending on their distance from a range of five types of population centres. Areas are classified as Major Cities, Inner Regional, Outer Regional, Remote and Very Remote. [6] This is at times further grouped as Major Cities, Regional and Remote in some reports.

For the purposes of this thesis 'Rural' will mean anywhere outside of the Major Cities, in line with ASGC RA Level 1 classification. Regional and remote will refer to the areas as defined by the ASGC RA Level 3 classification, that is Inner Regional and Outer Regional combined and Remote and Vey remote combined. [6] But the word 'rural' will continue to describe a

setting that is outside of the major cities, where the main economic activity is agriculture, forestry or fisheries.

In the most recent published analysis of the Australian population, the life expectancy of people living in regional and remote Australia was 1-2 years and up to 7 years lower than people living in major cities in Australia during 2002-2004 [7]. Life expectancy decreased with increasing remoteness [7]. In 2004–2005, people in regional and remote areas of Australia were significantly less (0.9 times as) likely to report excellent or very good health, compared with those in major cities. Conversely people in regional and remote areas were significantly more (1.2 times) likely to report fair or poor health, compared with those in major cities [7].

Chronic disease, cancer, injury, tobacco use, risky or high-risk alcohol consumption and a range of other indicators show a lower health status for people living in rural, regional and remote Australia [7][8]. The health inequalities experienced by rural populations in developed nations are recognised internationally as an issue worthy of addressing [9]. In Canada the differences in mortality across the urban–rural divide is largely driven by younger deaths, particularly those due to injury and poisoning, motor vehicle accident, and suicide [10]. A recent review of health disadvantage of Australian rural populations indicated that higher levels of socioeconomic disadvantage, less access to health services, and a higher prevalence of personal risk behaviours, environmental, occupational and transport risks largely explained the mortality differential rather than rurality itself [11].

Place is recognised to have an important effect on health [12]. Place consists of economic, physical, social, environmental and sociocultural factors that interact to define health and influence health behaviours [13]. Place and the pattern of health status are recognised as a complex relationship, which is expressed in health disadvantage in rural locations in developed countries such as Australia, Canada, and the United States [14].

The vision for health in rural, regional and remote Australia as articulated in the Healthy Horizons framework is:

"*People in rural, regional and remote Australia will be as healthy as other Australians and have the skills and capacity to maintain healthy communities*" [15].

From the evidence available this vision is yet to be achieved.

Within the context of this vision for equitable health experience there is only a limited understanding of the epidemiology and impact of prevention strategies on communicable diseases in rural, regional and remote Australia.

In settings similar to Australia there is also little published in the literature on controlling communicable diseases in rural or remote areas. In a study of the native people of the Chugach Region of Alaska, how people perceive their own communities' health and wellbeing, particularly in regard to infectious diseases was investigated. [16] The researchers found that there was a good working knowledge of the common infectious diseases but with some misconceptions. Importantly they found the people in this remote area wanted more information and dialogue about new infectious diseases.

In a review by Menzies and Singleton [17] many similarities were found regarding the health status of Indigenous people in the four English-speaking developed countries of North America and the Pacific (United States, Canada, Australia and New Zealand). Although vaccines have contributed to the reduction or elimination of disease disparities for many infections, the review found that Indigenous people continue to have higher morbidity and mortality from many chronic and infectious diseases compared with the general populations in their countries. Developing communicable disease control strategies with the Indigenous peoples was not discussed.

Outbreaks of Q fever have recently been reported internationally in rural areas of Scotland, France and Netherlands. [18-20] Control strategies discussed included increasing hygiene measures, re-educating farm workers and considering vaccination of workers. The appropriateness and effectiveness of these strategies were not tested.

Notifiable communicable diseases

The distribution of notifiable communicable diseases in Australia is not homogenous and factors such as distance, access to health services, pathology testing patterns and social issues impact on disease reporting. The main barrier to representativeness in the notifiable communicable diseases surveillance system across Australia has been reported as geography [21]. But even within rural area surveillance data, people with poorer health may be hidden within favourable health and socio-economic measure averages [22].

Representativeness of surveillance data

Chlamydial infection is one of very few communicable diseases where rural, regional and remote issues have been reported. Chlamydial infection is an example of a disease where the representativeness of current surveillance is problematic. Less testing, and thus fewer notifications, occurs in rural areas based on the current passive surveillance system [23]. In addition, in under-resourced settings, problems with passive surveillance are exacerbated by high turnover of staff and lack of awareness of some notifiable conditions [24]. Although this thesis does not consider chlamydiae these reported issues are likely to be replicated with other notifiable communicable diseases.

Under-reporting of outbreaks

Under-reporting of outbreaks and notifiable diseases have been reported in rural areas in a number of settings including Kenya and Thailand [25][26]. No similar reports for Australia have been published. Responding to outbreaks of disease can be particularly challenging in rural areas with limited available resources. During the SARS outbreak rural areas were viewed as the weakest link in containing the spread [27]. In Scotland during the recent A/California/04/2009(H1N1) influenza pandemic, rural health services were able to adequately respond only when they received appropriate specialist support from the major centres [28].

Notifiable disease overview

Within the constraints of the notifiable diseases surveillance system higher rates of some communicable diseases are still reported in rural, regional and remote areas of Australia. These include bacterial and parasitic gastroenteritis, Ross River fever, pertussis, syphilis and chlamydial infection [29]. Factors such as greater exposure to pathogens from animal hosts and to vectors, and the challenge of maintaining the vaccine cold chain in rural areas, may explain some of this difference. *Salmonella* infections were reported at rates four times higher than urban areas; Ross River fever three to nine times higher, and pertussis up to two fold higher. This pattern is also prominent for certain sexually transmitted infections; rates of syphilis increase up to twelve times higher as remoteness increases; and chlamydia rates up to four times higher in rural areas [9].

Hospitalisation rates for diseases that are vaccine preventable, such as pertussis, have been reported as three times higher in very remote areas when compared with major cities [30]. Some communicable diseases, including strongyloidiasis [31], acute rheumatic fever [32] and trachoma [33] are particular infections that are rarely found in developed countries but that are still prevalent in remote Australia.

Pandemic Influenza

Australian Aboriginal and Torres Strait Islander peoples, particularly in rural and remote areas, experience profound social disparity, including overcrowding, excess co-morbidity, poor access to health care, communication difficulties with health professionals, reduced access to pharmaceuticals, and institutionalized racism [34]. History clearly demonstrates the devastating toll of previous influenza pandemics on Australian Aboriginal and Torres Strait Islander peoples. During the 1918–1919 pandemic, mortality rates approaching 50% were reported in some Aboriginal communities.[35].

Many rural areas have greater levels of socio-economic disadvantage and higher proportions of Aboriginal and Torres Strait Islander people. These communities may struggle during a pandemic, and pandemic planning should therefore ensure that their particular needs are considered.

Aboriginal and Torres Strait Islander peoples and invasive meningococcal and pneumococcal diseases

Invasive meningococcal disease (IMD) and invasive pneumococcal disease (IPD) are very serious bacterial infections that can cause meningitis, septicaemia and other life threatening diseases [36].

Previously IMD & IPD surveillance data for Aboriginal and Torres Strait Islander people from New South Wales was excluded from national reports due to low levels of data completeness on Indigenous status. The rates of IMD in Aboriginal people in NSW had not been previously reported. A recent study of IPD using the available data highlighted that, despite the introduction of vaccination programs, a disparate disease burden exists between Aboriginal and Torres Strait Islander peoples and non-Indigenous people, particularly in young adults and in rural, regional and remote Australia [37]. For IPD the higher rates in Aboriginal and Torres Strait Islander people explains most of the increased relative risk in rural, regional and remote Australia. However, the surveillance data for IPD in New South Wales for the age groups between 5 years and 49 years does not include Aboriginal and Torres Strait Islander status.

Tuberculosis in rural, regional and remote Australia

In many low incidence countries such as Australia, Canada, New Zealand and the United Kingdom, higher rates of tuberculosis (TB) are reported in recent migrants to the country [38-41]. Lower overall rates of disease are reported in rural and regional Australia [38], but the demographic mix of the populations in rural and regional areas likely explains the lower rates. Newly arrived migrants to Australia are increasingly being resettled into rural areas of Australia [42] and may bring with them different levels of risk of TB.

Tuberculosis incidence rates that take into account the different origin of sub-populations in local areas would enable health services to strategically target tuberculosis control measures to ethnic communities that have less access to services. [43]

Zoonotic diseases in rural areas

A number of zoonotic diseases are important contributors to the disease burden in rural, regional and remote Australia [44]. These include anthrax, Australian bat lyssavirus infection, brucellosis, Hendra virus infection, leptospirosis and Q fever. Rural occupations such as

farming and animal handling are risk factors for zoonotic infections that occur in rural, regional and remote areas of Australia [45]. Many new, emerging and re-emerging diseases of humans in the Asia-Pacific region and Australia are zoonoses [46]. Emergence of zoonoses is likely to persist as long as human–animal interactions increase, particularly with destruction of, or encroachment into, wildlife habitat [47].

Brucellosis and Q fever are two zoonotic diseases that occur in the study area. Brucellosis is an emerging issue in NSW, while Q fever has been a long-standing risk, especially for livestock handlers. Understanding the current epidemiology and acceptability of prevention measures could facilitate development and implementation of risk reduction measures.

Operational research

Operational research and implementation research are action-oriented research approaches that respond to operational problems or implementation challenges, and work towards developing targeted solutions [48].

The Operational Research (OR) framework, as described by The Global Fund to Fight AIDS, Tuberculosis and Malaria [49], has as its first step the identification of an appropriate research question that will serve to improve the functioning of a health program. Questions addressed by OR should arise from the actual implementation of a health or disease control program and should emerge from discussions with program managers, researchers and clients of the services. OR questions should relate to specific challenges faced in implementing and managing health programs, such as service delivery or program uptake problems, and should thus provide answers that will improve overall program performance.

Three steps in the OR framework are:

1. Identifying the health program implementation issue or problem,

2. Considering underlying reasons for the issue or problem that can be examined through OR, and

3. Proposing possible solutions to address the issue or problem that can be tested.

The OR framework will be used throughout this thesis to consider aspects of notifiable communicable diseases of importance in a regional area of New South Wales.

Conclusion

Communicable diseases remain an important contributor to preventable morbidity in rural, regional and remote Australia. Vulnerability to communicable diseases results from several major overlapping factors, including socioeconomic, biological, and environmental factors [50]. An improved epidemiological understanding will assist in fashioning effective control measures to reduce this vulnerability. It is important that communicable diseases are seen within the broader ecological, socioeconomic and cultural fabric of rural Australia, as these are key influences on the health of people living in these areas [51].

A greater understanding of communicable disease prevention and management approaches in rural, regional and remote Australia is essential to mitigate risk. If the communicable disease burden is to be reduced, and the urban/rural health divide challenged, then a more complete exploration is needed of the:

- particular risk groups;
- key transmission mechanisms and prevention strategies;
- important social and cultural aspects of life in rural, regional and remote Australia impacting on communicable disease transmission and control.

Reference list

1. Australian Bureau of Statistics. *Census of population and housing: Population growth and distribution, Australia 2001.* Australian Bureau of Statistics, Canberra: AGPS, 2003.
2. Alston M. Globalisation, rural restructuring and health service delivery in Australia: policy failure and the role of social work? *Health and Social Care in the Community* 2007; **15:** 195-202.
3. Muula AS. How do we define 'rurality' in the teaching on medical demography? Rural and Remote Health 7: 653. (Online) 2007. Available: http://www.rrh.org.au
4. Hart LG, Larson EH, Lishner DM. Rural Definitions for Health Policy and Research. American Journal of Public Health. 2005; 95: 1149–1155.
5. Humphreys JS & Solarsh G, Populations at Special Health Risk: Rural Populations, p242-253, in Heggenhougen and Quah: International Encyclopedia of Public Health, Academic Press, San Diego, 2008.
6. Australian Institute of Health and Welfare. *Rural, regional and remote health: indicators of health status and determinants of health*. Rural Health Series no. 9. Cat. no. PHE 97. Canberra: AIHW. 2008.
7. Australian Institute of Health and Welfare. *Rural, Regional and Remote Health: Indicators of Health Status and Determinants of Health*. Canberra: AIHW, 2008.
8. Phillips A. Health status differentials across rural and remote Australia. *Australian Journal of Rural Health* 2009; **17:** 2-9.
9. United Nations University World Institute for Development Economics Research. *Rural-Urban Dimensions of Inequality Change*. Helsinki: UNU/WIDER, 2000.
10. Ostry AS. The mortality gap between urban and rural Canadians: a gendered analysis. *Rural and Remote Health* 2009; 9 (online): 1286. Available from: http://www.rrh.org.au (Accessed 7 December 2010).
11. Smith KB, Humphreys JS, Wilson MGA. Addressing the health disadvantage of rural populations: How does epidemiological evidence inform rural health policies and research? *Australian Journal of Rural Health* 2009; **16:** 56-66.
12. Macintyre S, Ellaway A, Cummins S. Place effects on health: how can we conceptualise, operationalise and measure them? *Social Science and Medicine* 2002; **55:** 125-139.
13. Dixon J, Welch N. Researching the rural-metropolitan health differential using the 'social determinants of health'. *Australian Journal Rural Health* 2000; **8:** 254-260.

14. Humphreys JS, Solarsh G. Populations at Special Health Risk: Rural Populations, In: Heggenhougen K (Ed). *International Encyclopedia of Public Health*. Oxford: Academic Press, 2008; 242-253.
15. National Rural Health Alliance. *Healthy Horizons Outlook 2003-2007. A Framework for Improving the Health of Rural, Regional and Remote Australians* (online). Deakin: NRHA, 2003. Available from: http://nrha.ruralhealth.org.au/cms/uploads/publications/hh_2003_03.pdf (Accessed 7 Dec 2010).
16. Speier TL. Community wellbeing and infectious diseases among Alaska Native communities in the Chugach Region. International Journal of Circumpolar Health. 2001; **60**:659-75.
17. Menzies RI, Singleton RJ. Vaccine preventable diseases and vaccination policy for indigenous populations. Pediatric Clinics of North America. 2009; **56**:1263-83.
18. Wilson LE, Couper S, Prempeh H, Young D, Pollock KG, Stewart WC, Browning LM, Donaghy M. Investigation of a Q fever outbreak in a Scottish co-located slaughterhouse and cutting plant. *Zoonoses and Public Health*. 2010; **57**:493-8.
19. King LA, Goirand L, Tissot-Dupont H, Giunta B, Giraud C, Colardelle C, Duquesne V, Rousset E, Aubert M, Thiéry R, Calatayud L, Daurat G, Hocqueloux L, Cicchelero V, Golliot F, de Valk H. Outbreak of Q fever, Florac, Southern France, Spring 2007. *Vector Borne Zoonotic Diseases*. 2011; **11**:341-7.
20. Karagiannis I, Schimmer B, Van Lier A, Timen A, Schneeberger P, Van Rotterdam B, De Bruin A, Wijkmans C, Rietveld A, Van Duynhoven Y. Investigation of a Q fever outbreak in a rural area of The Netherlands. *Epidemiology and Infection*. 2009; **137**:1283-94.
21. Miller M, Roche P, Spencer J, Deeble M. Evaluation of Australia's national notifiable disease surveillance system. *Communicable Diseases Intelligence* 2004; **28:** 311-323.
22. Haynes R, Gale S. Deprivation and poor health in rural areas: inequalities hidden by averages. *Health & Place* 2000; **6(4):** 275-285.
23. Hocking J, Fairley C, Counahan M, Crofts N. The pattern of notification and testing for genital Chlamydia trachomatis infection in Victoria, 1998–2000: an ecological analysis. *Australian and New Zealand Journal of Public Health* 2003; **27(4):** 405-408.
24. National Heart Foundation of Australia and the Cardiac Society of Australia and New Zealand. *Diagnosis and management of acute rheumatic fever and rheumatic heart disease in Australia – an evidence-based review.* Sydney: National Heart Foundation, 2006 Available from: http://www.heartfoundation.org.au/SiteCollectionDocuments/PP-590%20Diagnosis-

Management%20ARF-RHD%20Evidence-Based%20Review.pdf (Accessed 4 January 2011).

25. Bigogo G, Audi A, Aura B, Aol G, Breiman RF, Feikin DR. Health-seeking patterns among participants of population-based morbidity surveillance in rural western Kenya: implications for calculating disease rates. *International Journal of Infectious Diseases* 2010; **14(11):** e967-973.
26. Jordan HT, Prapasiri P, Areerat P, Anand S, Clague B, Sutthirattana S, Chamany S, Flannery B, Olsen SJ. A comparison of population-based pneumonia surveillance and health-seeking behavior in two provinces in rural Thailand. *International Journal of Infectious Diseases* 2009; **13(3):** 355-361.
27. Knobler S, Mahmoud A, Lemon S, Mack A, Sivitz L, Oberholtzer K, eds. *Learning from SARS: preparing for the next disease outbreak. Workshop summary.* Washington, DC: National Academies Press; 2004.
28. Stark C, Garman E, McMenamin J, McCormick D, Oates K. Major incidents in rural areas: managing a pandemic A/H1N1/2009 cluster. *Rural and Remote Health* 2010; 10 (online): 1413. Available from: http://www.rrh.org.au (Accessed 4 January 2011).
29. Australian Institute of Health and Welfare. *Rural, regional and remote health—Indicators of health*. Rural Health Series no.5. Canberra: AIHW, 2005.
30. Australian Institute of Health and Welfare. *Australia's health 2010*. Canberra: AIHW, 2010. (online) Available from: http://www.aihw.gov.au/publications/aus/ah10/11374-c05.pdf. (Accessed 4 January 2011).
31. Adams M, Page W, Speare R. Strongyloidiasis: an issue in Aboriginal communities. *Rural and Remote Health* 2003; 3 (online): 152. Available from: http://www.rrh.org.au (Accessed 4 January 2011).
32. Australian Institute of Health and Welfare. *Rheumatic heart disease: all but forgotten in Australia except among Aboriginal and Torres Strait Islander peoples.* Canberra: AIHW, 2004.
33. Mak, DB. Better late than never: a national approach to trachoma control. *Medical Journal of Australia*; 2006; **184(10):** 487-488.
34. Aldrich R, Zwi AB, Short S. Advance Australia Fair: social democratic and conservative politicians' discourses concerning Aboriginal and Torres Strait Islander peoples and their health 1972- 2001. *Social Science and Medicine* 2007; **64:** 125-137.5.
35. Curson P, McCracken K. An Australian perspective of the 1918- 1919 influenza Pandemic. *NSW Public Health Bulletin* 2006; **17:** 103-107.

36. NNDS Annual Report Writing Group. Australia's notifiable diseases status, 2007: Annual report of the National Notifiable Diseases Surveillance System. *Communicable Diseases Intelligence* 2009; **33(2):** 89-154.
37. Roche P, Krause V, Cook H. Invasive pneumococcal disease in Australia, 2006. *Communicable Diseases Intelligence* 2008; **32(1):** 18-30.
38. Luck GW, Black R, Race D. Demographic Change in Rural Australia: Future Opportunities and Challenges, in Demographic Change in Australia's Rural Landscapes, Landscape series; Volume12: 375-384; Springer, Netherlands, 2010.
39. de Vries G, van Hest NA, Baars HW, Sebek MM, Richardus JH. Factors associated with the high tuberculosis case rate in an urban area. International Journal of Tuberculosis and Lung Disease. 2010; **14**:859-865.
40. Barry C, Konstantinos A; National Tuberculosis Advisory Committee. Tuberculosis notifications in Australia, 2007. *Communicable Diseases Intelligence* 2009; **33(3):** 304-315.
41. Ellis E, Gallant V, Scholten D, Dawson K, Phypers M. *Tuberculosis in Canada 2009 – Pre-release.* Public Health Agency of Canada, Ottawa. 2010 http://www.phac-aspc.gc.ca/tbpc-latb/pubs/tbcan08pre/index-eng.php (Accessed 21 Feb 2011)
42. Lopez L, Sexton K, Heffernan H. *Tuberculosis in New Zealand Annual Report 2009.* Institute of Environmental Science and Research Limited. Auckland. 2010. http://www.surv.esr.cri.nz/surveillance/AnnualTBReports.php (Accessed 21 Feb 2011.
43. Anderson SR, Maguire H, Carless J. Tuberculosis in London: a decade and a half of no decline. *Thorax* 2007; **62:** 162–167.
44. Owen R, Roche PW, Hope K, Yohannes K, Roberts A, Liu C, Stirzaker S, Kong F, Bartlett M, Donovan B, East I, Fitzsimmons G, McDonald A, McIntyre PB, Menzies RI. Australia's notifiable diseases status, 2005: Annual report of the National Notifiable Diseases Surveillance System. *Communicable Diseases Intelligence*; 2007; **31:** 1–70.
45. NNDS Annual Report Writing Group. Australia's notifiable diseases status, 2007: Annual report of the National Notifiable Diseases Surveillance System. *Communicable Diseases Intelligence*; 2009; **33(2):** 89-154.
46. Meslin FX, Stohr K, Heymann D. Public health implications of emerging zoonoses. *Revue Scientifique et Technique de L' Office Interational des Epizooties* 2000; **19:** 310-317.
47. Kimball AM. Factors Influencing the Emergence of New (and 'Old') Diseases, In: Heggenhougen K (Ed). *International Encyclopedia of Public Health*. Oxford: Academic Press, 2008; 552-563.

48. Tikki Pang, Robert F. Terry, and The PLoS Medicine Editors. WHO/PLoS Collection "No Health Without Research": A Call for Papers. *PLoS Medicine* 2011; **8(1):** e1001008. Published online 2011 January 25. doi: 10.1371/journal.pmed.1001008
49. WHO-TDR and the Global Fund to fight AIDS, Tuberculosis and Malaria. *Framework for Operations and Implementation Research in Health and Disease Control Programs.* WHO, Geneva. 2008.
50. Sommerfeld J, Social Dimensions of Infectious Diseases, In: Heggenhougen K (Ed). *International Encyclopedia of Public Health*. Oxford: Academic Press, 2008; 69-74.
51. Beard JR, Tomasaka N, Eanest A, Summerhayes R, Morgan G. Influence of socioeconomic and cultural factors on rural health. *Australian Journal of Rural Health* 2009; **17:** 10-15.

Certain literature references cited in this chapter were sourced after the thesis had commenced and are included in the interest of providing currency and completeness to the thesis background

CHAPTER 2: PANDEMIC INFLUENZA AND ABORIGINAL COMMUNITIES

Preamble

Background

Indigenous Australians, particularly in rural and remote areas, experience profound social disparity, including overcrowding, excess co-morbidity, poor access to health care, communication difficulties with health professionals, reduced access to pharmaceuticals, and institutionalized racism. [1] The work in this chapter seeks to address some of the inequitable risk of pandemic influenza in Aboriginal communities utilising a community-based approach.

The pandemic A(H1N1)2009 influenza virus has become a seasonal virus, continuing to circulate with other seasonal viruses since August 2010 when the World Health Organization (WHO) declared the end of the (H1N1) 2009 pandemic. But the nomenclature of the virus had not been standardized until September 2011. [2] As a result there are diverse names for the same virus across the literature and including the published work of this thesis. The unpublished writing of this thesis will use the WHO endorsed influenza virus nomenclature: A(H1N1)pdm09.

Studies presented

The work of this chapter commenced prior to the 2009 Influenza Pandemic caused by the virus A(H1N1)pdm09, and continued through the pandemic period. Understanding the impact of pandemic influenza from an Aboriginal community perspective provided a foundation on which prevention and mitigation approaches could be explored. Participatory Action Research methodology proved a valuable approach for this research (Appendix 1 - Research Protocol).

The risks and concerns for Aboriginal communities of a potential influenza pandemic were identified in the first paper of this chapter. In the early phases of the 2009 influenza pandemic the community based research in the second paper identified a number of disease control strategies that needed to be further looked at. The following paper then described some of the impact of pandemic influenza in Aboriginal communities. The final three papers report on findings and methodology of the national project that emerged from the earlier work of this chapter.

Impacts

Outcomes from the research in this chapter include:

- Community participation in the design and application of communicable disease control strategies in the Hunter New England area, is now a requirement ;
- The New South Wales Ministry of Health has appointed the candidate to chair a working party to develop state-wide pandemic response protocols that reflect the findings of the research.
- In line with the findings, specific workshops have been conducted during 2011 for community "go-to" people in Aboriginal communities in the study area.

The findings from the studies have been communicated with the Aboriginal communities involved, other communities within the Hunter New England area and were also shared with a national audience through a poster presentation at the Coalition for Research to Improve Aboriginal Health Aboriginal Health Research Conference in May 2011.

One of the outcomes of the research into pandemic influenza and Aboriginal communities was the conducting of an international workshop in Cairns, in September 2011. At this workshop colleagues from Canada and New Zealand were invited to share their experiences and to hear about the process and outcomes of the research in this thesis.

Advocacy for changes to the National Plan for Human Influenza Pandemic have occurred following the studies. Further policy changes are also being instigated as a result of the findings. New South Wales Health has requested the research team to advise on and participate in the development of the revised state Public Health protocols on pandemic influenza and Aboriginal communities.

Publications arising from this chapter

2.1 Potential risk and call for action

Massey PD, Miller A, Durrheim DN, Speare R, Saggers S, Eastwood K. Pandemic influenza containment and the cultural and social context of Indigenous communities. *Rural and Remote Health* 2009; **9(1):** 1179.

My estimated contribution was 55%.

2.2 Reducing the risk of pandemic influenza in Aboriginal communities

Massey PD, Pearce G, Taylor KA, Orcher L, Saggers S, Durrheim DN. Reducing the risk of pandemic influenza in Aboriginal communities. *Rural and Remote Health* 2009; **9(3):** 1290.

My estimated contribution was 45%.

2.3 Impact: Pandemic (H1N1) 2009 influenza and Aboriginal communities in NSW

Rudge S, Massey PD. Pandemic (H1N1) 2009 influenza and Aboriginal communities: strengthening collaboration between NSW Health and the Aboriginal community-controlled health sector. *New South Wales Public Health Bulletin* 2010; **21(2):** 26–29.

My estimated contribution was 50%.

2.4 Findings & Recommendations: Australian Aboriginal and Torres Strait Islander communities and the development of pandemic influenza containment strategies - community voices and community control.

Massey PD, Miller A, Saggers S, Durrheim DN, Speare R, Taylor K, Pearce G, Odo T, Broome J, Judd J, Kelly J, Blackley M, Clough A. Australian Aboriginal and Torres Strait Islander communities and the development of pandemic influenza containment strategies - community voices and community control. *Health Policy* (In Press).

My estimated contribution was 40%.

2.5 Advocacy for changes in national pandemic plans

Miller A, Durrheim AD; Aboriginal and Torres Strait Islander Community Influenza Study Group: Massey PD, Pearce G, Taylor K, Blackley M, Broome J, Odo T, Purcell C, Clough A, Judd J, Kelly J, Speare R, Saggers S. *Medical Journal of Australia* 2010; **193(6):** 316-317. Aboriginal and Torres Strait Islander communities forgotten in new Australian National Action Plan for Human Influenza Pandemic: "Ask us, listen to us, share with us".

My estimated contribution was 15%.

References

1. Aldrich R, Zwi AB, Short S. Advance Australia Fair: social democratic and conservative politicians' discourses concerning Aboriginal and Torres Strait Islander peoples and their health 1972- 2001. Social Science & Medicine 2007; 64: 125-137.
2. World Health Organization. Standardization of terminology of the pandemic A(H1N1)2009 virus. WHO, Geneva, 2011. (http://www.who.int/influenza/gisrs_laboratory/terminology_ah1n1pdm09/en/index.html accessed 26 Oct 2011)

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LETTER TO THE EDITOR

Pandemic influenza containment and the cultural and social context of Indigenous communities

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Massey PD, Miller A, Durrheim DN, Speare R, Saggers S, Eastwood K

Pandemic influenza containment and the cultural and social context of Indigenous communities
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Available from: http://www.rrh.org.au

Dear Editor

The World Health Organization has directed nations to prepare for a future influenza pandemic. While many countries have developed comprehensive plans, the needs of marginalized communities have often been neglected. In recognition of these weaknesses in current planning practice we strongly support the call that 'the time is now' for genuine and respectful partnerships to redress yet another omission for Indigenous people[1,2].

Pandemic plans emphasise non-pharmaceutical containment measures, including early recognition and isolation of suspected cases, quarantining of contacts, and social distancing. Although the Australian plan recognizes the increased risk for Indigenous people, it does not acknowledge that Indigenous Australians must inform containment strategies if these are to be appropriate and effective for all Australians[3]. A review of 37 national pandemic plans found that plans, including the Australian plan, inadequately addressed the needs of socially and economically disadvantaged communities in their disease containment policies[4].

Indigenous Australians, particularly in rural and remote areas, experience profound social disparity, including overcrowding, excess co-morbidity, poor access to health care, communication difficulties with health professionals, reduced access to pharmaceuticals, and institutionalized racism[5]. History clearly demonstrates the devastating toll of previous influenza pandemics on Indigenous Australians. During the 1918–1919 pandemic, mortality rates approaching 50% were reported in some Australian

Indigenous communities, compared with the national rate of 0.3%[6]. The leprosy control program used in Aboriginal communities in the past included isolation, incarceration and other punitive measures that caused much fear. The fear drove people into hiding and increased the disease risk for families and communities[7].

In order to avoid further marginalization, stigmatization and inequality, we must ensure that the call to 'close the gap' does not become another shallow slogan[1]. Decisions on appropriate pandemic containment measures need to be made in genuine partnership with communities, recognizing that some cultural practices may amplify or reduce infection risk[8].

During a recent focus group discussion with Indigenous people from Aboriginal medical services and Aboriginal health services in a rural area of Australia, concerns were raised about the currently recommended pandemic social distancing and other infection control strategies. Many of these concerns were associated with individual and group memories of intrusive government surveillance and control of Indigenous people in the past. These memories impacted on people's responses to contemporary government policy. Planned policies to control and contain outbreaks may meet with the same passive and active resistance that past government policies provoked[9].

Public health experts must work with communities in genuine and respectful partnership to define what pandemic containment measures are culturally appropriate and acceptable. The basis of genuine and respectful partnerships is captured in the human rights approach, which demands that individuals and communities are adequately involved in the decisions that affect their wellbeing. These are essential first steps[10]. History has shown that Indigenous Australians must be involved in decision-making processes that impact on their health in order to link genuine and respectful partnerships to aspirations for self-determination of Indigenous communities and organisations. The consequences of inflexibly enforcing a non-Indigenous model of containment will be dire.

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References

1. Mackean T, Adams M, Goold S, Bourke C, Calma T. Partnerships in action: addressing the health challenge for Aboriginal and Torres Strait Islander peoples. *Medical Journal of Australia* 2008; 188: 554-555.

2. Huppatz C. 'Sorry' – in word and actions. Improving health in rural and remote Indigenous communities. *Rural & Remote Health* **8:** 876. (Online) 2008. Available: www.rrh.org.au (Accessed 23 March 2009).

3. Commonwealth of Australia. *Australian management plan for pandemic influenza, 2008*. Canberra, ACT: AGPS, 2008.

4. Uscher-Pines L, Duggan P, Garoon JP, Karron RA, Faden RR. Planning for an influenza pandemic, social Justice and disadvantaged groups. *The Hastings Center Report* 2007; **37(4)**. Available: http://www.thehastingscenter.org/Publications/HCR/Default.aspx?id=752 (Accessed 23 March 2009).

5. Aldrich R, Zwi AB, Short S. Advance Australia Fair: social democratic and conservative politicians' discourses concerning Aboriginal and Torres Strait Islander peoples and their health 1972-2001. *Social Science & Medicine* 2007; **64:** 125-137.

6. Curson P, McCraken K. An Australian perspective of the 1918-1919 influenza Pandemic. *NSW Public Health Bulletin* 2006; **17:** 103-107.

7. Parry S. Of Vital Importance to the Community': The control of leprosy in the Northern Territory. *Health & History* 2003; **5(1):** 1-21.

8. Maher P. A review of 'traditional' Aboriginal health beliefs. *Australian Journal of Rural Health* 1999; **7:** 229-236.

9. Broome R. *Aboriginal Australians: Black responses to white domination 1788-2001*. Sydney: Allen & Unwin, 1982.

10. Jackson Pulver LR, Fitzpatrick SA. Beyond sorry – the first steps in laying claim to a future that embraces all Australians. *Medical Journal of Australia* 2008; **188:** 556-558.

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PROJECT REPORT

Reducing the risk of pandemic influenza in Aboriginal communities

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ABSTRACT

Context: Aboriginal people are particularly vulnerable to pandemic influenza A, H1N109. This was first recognized in the First Nations of Canada. There have been calls for close planning with Aboriginal people to manage these risks. This article describes the process and findings from preliminary community consultations into reducing influenza risk, including pandemic H1N1(09) swine influenza, in Aboriginal communities in the Hunter New England area of northern New South Wales, Australia.

Issue: Consultation was conducted with 6 Aboriginal communities in response to the rapidly evolving pandemic and was designed to further develop shared understanding between health services and Aboriginal communities about appropriate and culturally safe ways to reduce the influenza risk in communities. Agreed risk mitigation measures identified in partnership are being introduced throughout Hunter New England area.

Lessons learned: Five theme areas were identified that posed particular challenges to limiting the negative impact of pandemic influenza; and a number of potential solutions emerged from focus group discussions: (1) local resource person: local identified 'go to' people are heard and trusted, but need to have an understanding of H1N109; (2) clear communication: information must be presented simply, clearly and demonstrating respect for local culture; (3) access to health services: sick people need to know where to get help and how to get there without infecting others; (4) households and funerals: infection control messages should be aligned

with the reality of life in Aboriginal communities, and the importance of attending family and cultural gatherings; (5) social and community support issues: Aboriginal people need to have a say in how support is provided. Influenza pandemics are a serious threat to the health and social functioning of Aboriginal communities. Measures to reduce the risk of influenza in communities must be developed with the communities to maximise their acceptance. The process of engagement and ongoing respectful negotiations with communities is critical to developing culturally appropriate pandemic mitigation and management strategies.

Key words: Aboriginal communities, Australia, H1N1(09) swine influenza, pandemic.

Context

Human swine influenza (influenza A H1N109) has resulted in the first pandemic of the 21st Century. The symptoms of human swine influenza are similar to seasonal influenza and include: fever, cough, fatigue, myalgia, pharyngitis, chills, dyspnoea, coryza and headache. Complications include pneumonia, and even death in severe cases[1].

Influenza is principally transmitted through respiratory droplets from a symptomatic individual. Until a vaccine becomes available, it is necessary to increase community infection control measures to limit transmission. Social distancing through limiting community activities has also been advocated.

The Australian Health Management Plan for Pandemic Influenza 2008[2] was prepared to protect all Australians and reduce the impact of a pandemic on social function and the economy. Recent experience suggests that control measures may be imposed on all communities, including rural and remote Aboriginal communities, in a 'one size fits all' approach. It is suspected that certain advocated strategies were not adapted or informed by Aboriginal voices.

During the pandemic of 1918-1919, Australian Indigenous populations were severely affected with a mortality rate approaching 50% in some communities[3]. In contrast, the mortality rate in Australia overall was less than 0.4%[4]. Social, ecological and geographical factors, as well as increased prevalence of co-morbidities, may provide an explanation for the disproportionately high mortality rates in Aboriginal communities.

H1N109 notifications indicate that Indigenous people are over-represented in the Australian cases (current at 6 August 2009). Statistics indicate that Indigenous people are approximately five times more likely than non-Indigenous Australians to be hospitalised for swine influenza and a similar proportion required intensive care treatment[5].

Other countries have also found higher risks of severe disease in Indigenous people groups, for example the First Nations of Canada, and this has led to calls for close planning with Aboriginal people in response to these risks[6].

Quarantine and isolation are public health measures that were used in the early response to H1N109. Although the mainstream Australian community has indicated support for these containment strategies[7], there is no evidence that the measures have been developed in respectful negotiation with Indigenous communities.

In northern New South Wales (NSW) a shared understanding of the threats of pandemic influenza has been developing since 2006. In a pilot project conducted during 2008 under the auspices of the Hunter New England (HNE) Aboriginal Health Partnership – collaboration between the Area Health Service and all Aboriginal Community Controlled Health Services (ACCHS) – a focus group identified many difficulties posed by the national containment strategy in Indigenous communities[8].

Issue

The purpose of the current work was to consult Aboriginal communities in response to the rapidly emerging H1N109 pandemic, and further develop understanding in health services and Aboriginal communities about appropriate and culturally safer ways to reduce the risk of influenza in communities. Measures identified in partnership to reduce the risk to individuals and community were then implemented.

The HNE Aboriginal Health Partnership encouraged consultation with communities served by the NSW ACCHS of Awabakal (Newcastle), Armajun (Inverell), Armidale, Biripi (Taree), Tamworth and Tobwabba (Forster). Community groups, including Lands Councils, Elders groups, and playgroups, Aboriginal health service staff and ACCHS Board members participated in the consultation. Input was also encouraged from the broader local Aboriginal community by email distribution of the consultation paper to key informants. Key stakeholders in these communities identified by the ACCHS and key informants were approached to input into the influenza consultation.

Typically the consultation focus group discussions took place in the community during normal activities, and were facilitated by two team members. The team provided input about the nature of influenza, its transmission, and the evolving pandemic. The community representatives were then encouraged to identify potential issues before further discussion was facilitated to allow identification of possible solutions.

The initial phase of the consultation took place over a 3 week period leading up to the National Aboriginal and Islander Days Of Celebration 2009 when many community events were scheduled. The consultation occurred during the 'contain' and early 'protect' phases of the Australian pandemic response. The consultation focused on reducing the risk of influenza at home and at community gatherings such as funerals; and providing access to health services.

Scenarios in each of these focus areas were used to seed the conversations. The scenarios were constructed by the project team and trialled with Aboriginal health staff prior to field use. Examples of scenarios used include:

> *When a person has the new influenza strain everyone who lives in the house with the person will need to stay home and go onto influenza medication. There are all sorts of challenges with doing this; one of them is working out who lives in the household. Health services often think from a non-Aboriginal way instead of an Aboriginal way, so need a better process for talking with households or communities.*

Or

> *If a family member comes and stays at a home that is in home isolation they will be at an increased risk of getting the disease. People coming to stay will either have to find somewhere else to stay or have to also go into quarantine and go onto the influenza medication.*

As a starting point for the conversation people were asked:

> *What do you see as the main problems in this scenario? What could be done to work through these issues to help reduce risk of influenza in the community?*

Field notes were recorded during these focus groups discussions. Themes from the consultation were identified by the project team in consultation with the HNE Aboriginal Health Partnership.

The consultation took the form of participatory action research (PAR), a research process used to initiate positive change, not simply to investigate an issue. The research process is based on the equal and collaborative involvement of the community in which the issue is located[9-14] and allows Indigenous people to determine and control the research. PAR is based on a continuous research cycle of planning,

action, observation and reflection to ensure that the recipients of the planned change are involved at every stage of the research, from the definition of the 'problem' to the implementation of a 'solution'.

Lessons learned

During the period 15 June–17 July 2009, 19 community groups from across the area participated in the consultation. In addition, a small number of individuals provided written input or phoned through with their thoughts on the consultation issues.

Five issue theme areas and a number of potential solutions emerged from the conversations:

1. Local resource person
2. Clear communication
3. Access to health services
4. Households and funerals
5. Social and community support issues.

'Go to' (local contact) persons

The importance of having local people who are well informed and can advise on what to do in the event of an infectious disease incident, was expressed in every conversation with community groups. Having a local person meant that people in the community would have someone they could trust and could access easily. They were much less likely to contact someone from another community or area with whom they were not familiar. The local person would need training and support from the health service to meet this need. When asked about who these local contacts should be, most people identified Aboriginal health workers and ACCHS staff as the best 'go to' people.

Clear communication

Every focus group emphasised the need for clear communication with each community. Information was required in a clear and simple format, while demonstrating respect for the local culture. Specifically, people wanted to know what symptoms of illness they should be alert to and what they should do in the event of these symptoms appearing. Aboriginal radio programs and newsletters from Aboriginal organisations with locally made announcements were considered necessary if the messages were to be successful. Written information, such as posters and pamphlets with key messages, was considered helpful but needed to be supported by local people with photos or quotes to illustrate that these messages were supported by local, trusted people.

Groups consulted identified the need for specific information for particular risk groups, such as pregnant mothers and their babies.

Each community consulted indicated that conversations at community level were very important in sharing understanding.

Access to health services

Key informants consulted expressed their concern about their community's access to health services during a pandemic. Many people indicated already having trouble having their health needs met and felt that if the system was under more pressure this might mean it would be even more difficult to access health services. They expressed the need for clear guidance as to the particular service that was most appropriate: ACCHS, GPs or the hospital. After-hours access was considered a particular problem due to safety concerns related to past experiences. People felt discriminated against and that their needs were ignored. Having extended hours or clinics available on weekends through ACCHSs, specific GPs or clinics was considered a potential alternative.

Transport to health services was also identified as posing problems in all areas because many community members relied on a few drivers and only a few registered cars to transport them to health services. The drivers were considered very important people who needed to be

protected from influenza. Suggestions included making sure that masks were available for the main drivers providing transport to health services, and to consider opening car windows.

Access to appropriate medications, particularly Tamiflu™ suspension, was raised as an important issue due to distance to hospitals. It was suggested that Tamiflu™ suspension should be kept at local ACCHSs and by GPs who support Aboriginal communities.

Households and funerals

In the focus group consultations people talked about large social gatherings, such as funerals and cultural celebrations, and the risk these posed for infection spread. Hand-wash or hand gel supplies were considered necessary for community events, with local contacts such as Aboriginal health workers being available to demonstrate to attendees how these should be used. The health services may have a role in supporting this prevention strategy by providing the products and training in their use at gatherings.

In each area key informants and groups reported that many households do not have tissues because these were too expensive and therefore not generally used. As a result the message about using tissues needs to be changed.

Masks were considered a possible option by some respondents but these would be particularly acceptable if provided in Aboriginal colours. Some respondents indicated that masks would not be used.

For funerals and other important family gatherings, the community members consulted indicated that people who are sick were still very likely to attend. When asked how infection might be reduced during these events, focus groups suggested that standing back from the others would be acceptable as long as it was considered to be a sign of respect and not disrespect. Elders could provide this interpretation for the community if they were provided with this information and support by Aboriginal health workers before the funeral.

When asked what the person sick with influenza should do at funerals and other family gatherings, some suggested not kissing, not hugging and not handshaking but this was not supported by others during the consultation.

Concern was expressed in each community about the risks for pregnant women, breastfeeding mothers and the risks for young children and Elders with pandemic influenza. These special groups in the community were felt to be very important. Further discussions are needed to determine appropriate measures for reducing the risk of pandemic influenza in these groups.

Preventing infection at home was considered challenging by each focus group, because many houses had large numbers of inhabitants, with inadequate bathrooms and bedrooms, and limited space. The presence of many visitors and extended family made limiting infection transmission difficult. Further discussion is clearly needed to develop acceptable and effective strategies.

Social and community support issues

Some people talked about the impact of influenza on other aspects of their lives. There was concern about being absent from work due to illness and not being paid because of casual employment status. Guidance is required from CentreLink (the social security agency), and key people in the community should be consulted for accurate information on addressing this concern.

Concern was also expressed about how to obtain a medical certificate if someone was sick at home and was not able to see a doctor. One suggestion was that, where necessary, the ACCHS nurses could write isolation certificates.

Conclusion

Influenza pandemics are a serious threat to the health and social functioning of Aboriginal communities. Measures to reduce the risk of influenza in communities need to be developed with communities to maximise their acceptance. The process of engagement and ongoing respectful consultation with communities is critical to identifying effective and culturally acceptable strategies. These understandings will now be used as the foundation for community PAR in northern NSW, North Queensland and the Kimberly areas of Australia.

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References

1. Novel Swine-Origin Influenza A (H1N1) Virus Investigation Team. Emergence of a novel swine-origin influenza A (H1N1) virus in humans. *New England Journal of Medicine* 2009; **360:** 2605-2615.

2. Commonwealth of Australia. *Australian Health Management Plan for Pandemic Influenza 2008*. Canberra, ACT: Department Health & Ageing, 2008.

3. Cleland Burton J. Disease among the Australian Aborigines. *Journal of Tropical Medicine and Hygiene* 1928; **6:** 65.

4. Curson P, McCracken K. An Australian perspective of the 1918-1919 influenza pandemic. *NSW Public Health Bulletin* 2006; **17:** 103-107.

5. Australian Government Department of Health and Ageing. *Australian influenza surveillance 2009*. (Online) 2009. Available: http://www.healthemergency.gov.au/internet/healthemergency/publishing.nsf/Content/ozflucurrent.htm (Accessed 6 August 2009).

6. Groom AV, Jim C, LaRoque M, Mason C, McLaughlin J, Neel L et al. Pandemic influenza preparedness and vulnerable populations in tribal communities. *American Journal of Public Health* 2009; **99(S2):** 2-8.

7. Eastwood K, Durrheim D, Francis JL, Tursan d'Espaignet E, Duncan S, Islam F et al. Knowledge about pandemic influenza and compliance with containment measures among Australians. *Bulletin of the World Health Organisation* 2009; **87(8):** 565-644. Available: http://www.who.int/bulletin/volumes/87/8/08-060772/en/index.html (Accessed 1 September 2009).

8. Massey PD, Miller A, Durrheim DN, Speare R, Saggers S, Eastwood K. Pandemic influenza containment and the cultural and social context of Indigenous communities. *Rural and Remote Health* **9:** 1179. (Online) 2009. Available: http://www.rrh.org.au/ (Accessed 1 September 2009).

9. Kemmis S, McTaggart R (Eds). *The action research planner*. Geelong, Vic: Deakin University, 1998.

10. Stringer E. *Action research*, 2nd edn. Thousand Oaks, CA: Sage, 1999.

11. O'Kane A, Tsey K. Towards a needs based mental health resource allocation and service development in rural and remote Australia. *Australasian Psychiatry* 2004; **12:** 390-395.

12. Tsey K, Patterson D, Whiteside M, Baird L, Baird B. A micro analysis of a participatory action research process with a rural Aboriginal men's health group. *Australian Journal of Primary Health* 2004; **10:** 64-71.

13. Tsey K, Wenitong M, McCalman J, Baird L, Patterson D, Baird B et al. A participatory action research process with a rural indigenous men's group: monitoring and reinforcing change. *Australian Journal of Primary Health* 2004; **10(3):** 130-136.

14. Saggers S. Negotiating definitions of Indigenous participation in community development. In: R Eversole, J Martin (Eds.). *Participation and governance in regional development* Aldershot: Ashgate, 2005.

Responding to pandemic (H1N1) 2009 influenza in Aboriginal communities in NSW through collaboration between NSW Health and the Aboriginal community-controlled health sector

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Abstract: As a vulnerable population, Aboriginal people in NSW were thought likely to be at more risk of serious illness from pandemic (H1N1) 2009 influenza than non-Aboriginal people. As such, the importance of consulting with Aboriginal people and communities was recognised early in the pandemic. This consultation was to enable key messages to be disseminated appropriately and to facilitate access to health care. Key stakeholders in the response were the NSW Department of Health, Area Health Services, the NSW Aboriginal Health and Medical Research Council, and Aboriginal Community Controlled Health Services. Regular teleconferences between the key stakeholders facilitated the flow of information and assisted with the identification of issues. A consultation process between Hunter New England Area Health Service and six Aboriginal communities helped inform the development of resources as well as the planning and delivery of pandemic-related services.

Aboriginal people were four times more likely to be admitted to hospital with pandemic (H1N1) 2009 influenza than non-Aboriginal people.

Pandemic (H1N1) 2009 influenza poses a risk to the health of Aboriginal people and communities in NSW. The disease is more infectious then seasonal influenza[1] and can cause severe illness and death. Many of the health conditions associated with influenza complications are more common among Aboriginal people.[2] Aboriginal communities have suffered more than other communities in past pandemics.[3] Initial data for this pandemic from several countries showed increased rates of hospitalisation and deaths associated with H1N1 in Indigenous populations.[4,5]

As such, there was an awareness within NSW Health and the NSW Aboriginal Health and Medical Research Council (AH&MRC) at the beginning of the pandemic of the importance of ensuring that important messages were communicated appropriately and access to care facilitated. The engagement of Aboriginal people and services in the development and implementation of pandemic responses has been an essential part of the public health response.

This article describes: the epidemiology of the pandemic (H1N1) 2009 influenza among Aboriginal people in NSW; the collaboration between NSW Health and the Aboriginal community-controlled health sector to develop an appropriate response to protect Aboriginal people; the consultation process between the Hunter New England Area Health Service and local Aboriginal communities; and the application of an emergency management framework to manage a pandemic within Aboriginal communities.

Pandemic (H1N1) 2009 influenza in Aboriginal people in NSW

Methods

Information on people with pandemic (H1N1) 2009 influenza was collected by NSW Health public health units and collated through NetEpi, the web-based NSW Health surveillance and outbreak data collection system.[6] With the national move to the PROTECT phase of the

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Table 1. Confirmed cases of pandemic (H1N1) 2009 influenza for Aboriginal[1] and non-Aboriginal people in NSW to 31 August[2] 2009

Outcome	Aboriginal		Non-Aboriginal		Rate ratio of Aboriginal to non-Aboriginal people	Standardised morbidity or mortality ratio
	People *n*	Crude rate per 100 000	People *n*	Crude rate per 100 000		
Admitted to hospital	96	62.6	1035	15.0	4.2	3.2
Admitted to intensive care unit[3]	14	9.1	189	2.3	3.9	4.0
Died	5	3.3	40	0.6	5.6	4.5

[1]Aboriginal refers to Aboriginal or Torres Strait Islander people.
[2]As reported to 21 September 2009.
[3]Source: INFINITE study register, Australian and New Zealand Intensive Care Research Centre, Monash University, Melbourne.

public health response, the focus of testing shifted to people who were hospitalised with influenza-like illness. Consequently reported numbers of confirmed cases describe only a proportion of the total number of people who were infected with pandemic influenza. The rate of hospitalisation associated with the pandemic however, provides a more accurate indication of the epidemiology and spread of pandemic (H1N1) 2009 influenza. The NSW public health network investigated Aboriginal status and risk factors on all admissions through inpatient data systems and direct contact with families and the person's medical officer.

Results

A total of 1214 people were hospitalised in NSW with pandemic (H1N1) 2009 influenza to 31 August 2009, including 225 people admitted to intensive care units (ICUs). Aboriginal status was reported for 93.2% ($n = 1131$) of people hospitalised; 90.2% ($n = 203$) of ICU admissions; and for 93.8% ($n = 45$) of pandemic influenza-related deaths. Of those admitted to hospital, 96 (7.8%) identified as Aboriginal and/or Torres Strait Islander. The rate ratios for admission to hospital, admission to ICUs and death were higher in the Aboriginal population compared with the non-Aboriginal population in NSW (Table 1).

Aboriginal people hospitalised with pandemic (H1N1) 2009 influenza were younger than non-Aboriginal people (median age of 24.5 years compared with 31.7 years). The ratio of males to females was similar for Aboriginal and non-Aboriginal people admitted to hospital.

While risk factor data were incomplete, 72 (75%) Aboriginal people hospitalised with pandemic (H1N1) 2009 influenza were reported to have known risk factors. Risk factors reported in the Aboriginal people admitted to hospital included: asthma; chronic obstructive pulmonary disease; chronic diseases of the heart, liver and kidneys; diabetes, neurological disease and smoking; pregnancy and recent delivery; and other morbidities. Twenty-four Aboriginal people admitted to hospital had no underlying risk factors reported. Risk factor data for non-Aboriginal people hospitalised in NSW have not yet been published.

Box 1. Case summary*

Harry is a middle-aged Aboriginal man from an isolated community in NSW. He works in the community and seldom leaves town. Harry shares a small three bedroom house with his wife, his two sons, their partners and six grandchildren. Harry has a chronic lung disease but is otherwise in reasonable health. He developed a fever in mid-July and his usual cough got worse. Harry waited 3 days until the weekly visit by the doctor to the community. By this time Harry was quite sick with shortness of breath and fatigue and was transferred by ambulance to the hospital two towns away. His condition became worse and he required ventilation and management in an intensive care unit located more than 8 hours drive from his home. He was diagnosed with pandemic (H1N1) 2009 influenza and eventually recovered. In the meantime, 70 other people from Harry's community were sick with pandemic (H1N1) influenza 2009.

*Some details have been changed to ensure confidentiality.

Collaboration between NSW Health and the Aboriginal community-controlled health sector to control pandemic (H1N1) 2009 influenza

Some of the challenges of managing the influenza pandemic in Aboriginal communities are illustrated by the case study presented in Box 1.

The AH&MRC, Aboriginal Community Controlled Health Services (ACCHSs), and NSW Department of Health and area health services (AHSs) were key partners during the response to and recovery from the pandemic. While relationships existed between these partners before the pandemic, the urgency created by the response to the pandemic required a rapid development or strengthening of these relationships.

In NSW regular teleconferences between the partners were established early in the response to the pandemic. These were found to be valuable in supporting the partnership, determining the priority issues, identifying gaps in communication, and developing and making available common resources. Within the NSW Department of Health, the teleconferences were initiated and lead by the Chief Health Officer. A liaison officer role was established to: facilitate information flow between the key partners; identify and follow-up with issues related to anti-influenza medication orders; and assist with the preparation and dissemination of resources and messages for Aboriginal people and health services.

Prior to the pandemic public health units in NSW, which have a direct role in the public health management of disease outbreaks for the area health services, had differing levels of engagement with the Aboriginal community-controlled health sector. Here we focus on the response by the Hunter New England Area Health Service (HNEAHS), which has a long-standing relationship with the ACCHSs that are located within its geographical boundaries.

Consultation process between HNEAHS and Aboriginal communities

As a result of HNEAHS's strong, existing partnership concerns associated with controlling pandemic (H1N1) 2009 influenza were able to be gathered through a rapid consultation process with six Aboriginal communities. The communities served by the ACCHSs in Newcastle, Inverell, Armidale, Taree, Tamworth and Forster were consulted. Input was gained from stakeholders and key informants in these communities were approached to participate in the influenza consultation.

The consultations consisted of focus group discussions which were included in community activities and group meetings. The groups were facilitated by at least one Aboriginal team member. During the focus group information was provided about the nature of influenza, its transmission, and the evolving pandemic. The community members were then encouraged to talk about potential issues and solutions.

The consultation identified issues which were subsequently grouped into five areas, with a number of potential solutions:

- local identified 'go to' people need to have an understanding of pandemic influenza. 'Go to' people are local people who are trusted and easily accessed, and who the community already go to for advice. They may be health workers who can advise on what to do in the event of an infectious disease incident
- information must be presented simply, clearly and demonstrate respect for local culture
- sick people need to know where to go to get help and how to get there without infecting others
- infection control messages should be aligned with the reality of life in Aboriginal communities, and recognise the importance of attending family and cultural gatherings
- Aboriginal people need to have a say in how support is provided.[8]

This consultation helped inform resource development as well as the planning and delivery of pandemic-related services by the AHS. These findings were shared more widely with the pandemic response key stakeholder group, and resources were disseminated for use by other AHSs and ACCHSs.

Managing a pandemic through an emergency framework with Aboriginal communities

An emergency or disaster response framework offers the opportunity to address many of the issues associated with a rapidly emerging disease. Respectful collaboration with Aboriginal communities is vital in responding in an appropriate way to an emergency situation.

The principles that underpin the National Emergency Strategy for Remote Indigenous Communities, *Keeping our mob safe*[7] are built around respectful collaboration. The principles include:

- communication relating to emergency management is based on culturally friendly language and the use of different and appropriate communication media for remote Indigenous communities
- community emergency management plans are developed in consultation and partnership with remote Indigenous communities and local governance structures
- community emergency management in remote Indigenous communities is included as part of the mainstream service provision work plans of all agencies
- flexible models of service delivery are used to meet the emergency management needs of remote Indigenous communities.

Although a large part of NSW is classified as being remote, most of the NSW Aboriginal Australian population live in rural, regional and urban NSW. However, many Aboriginal communities in NSW have community structures and community-based services that enable the principles used in remote areas to be applied.

Further strengthening of collaboration

The response to the pandemic highlighted the strengths of the existing partnerships between the Aboriginal community-controlled health sector and NSW Health. The

response also identified, at a state and AHS level, where support for both day to day management of public health issues and public health emergencies could be improved.

The issues identified by the communities in the rapid consultation process with HNEAHS are now forming the basis of a large national project to reduce the future risk of pandemic influenza to Aboriginal communities. Funded by the National Health and Medical Research Council, the project is using a participatory action research methodology to hear from communities and build understanding. The aims of the project are to: identify barriers to mainstream management strategies and treatment plans in communities; develop culturally appropriate and effective management strategies and treatment plans by consulting with communities; and share what is found with other Indigenous communities across Australia.

Conclusion

Aboriginal people were admitted to hospital with pandemic (H1N1) 2009 influenza at rates more than four times higher than non-Aboriginal people. This highlights the importance of providing a co-ordinated and respectful response with partners for this vulnerable population. The rapidly emerging disease required an emergency strategy that was developed in collaboration with Aboriginal communities.

As a result of the influenza pandemic, engagement between the NSW Department of Health, AHSs, ACCHSs and Aboriginal communities has been strengthened. The strength of this engagement will continue to grow if the NSW public health network can prioritise this work and invest in the challenges posed by future public health emergencies to ensure that public health responses are effective and sustainable.

Acknowledgments

We acknowledge the AH&MRC, the NSW public health network, and the Area Health Services Managers for Aboriginal Health for their work in this field. We also acknowledge the work of the Australian and New Zealand Intensive Care Research Centre of Monash University, Melbourne for the development of the intensive care influenza A (INFINITE study) register and co-ordination of the intensive care data collection.

References

1. Fraser C, Donnelly CA, Cauchemez S, Hanage WP, Van Kerkhove MD, Hollingsworth TD et al. Pandemic potential of a strain of influenza A (H1N1): early findings. *Science* 2009; 324(5934): 1557–61. doi:10.1126/science.1176062
2. Australian Bureau of Statistics (2006). 4715.0 – National Aboriginal and Torres Strait Islander Health Survey, 2004–05. Available from: http://www.abs.gov.au/AUSSTATS/abs@.nsf/ProductsbyTopic/C36E019CD56EDE1FCA256C76007A9D36 (Cited 9 October 2009.)
3. Curson P, McCracken K. An Australian perspective of the 1918–1919 influenza pandemic. *N S W Public Health Bull* 2006; 17: 103–7. doi:10.1071/NB06025
4. Public Health Agency of Canada. Fluwatch: September 20, 2009 to September 26, 2009 (Week 38). http://www.phac-aspc.gc.ca/fluwatch/09-10/w38_09/index-eng.php
5. Arizona Department of Health Services. Office of Infectious Disease Services. 2009 novel H1N1 influenza virus update. 16 September 2009. http://www.azdhs.gov/phs/oids/epi/flu/
6. NetEpi Case Manager open source web-based outbreak database system. Accessed 29 September 2009. Available from: http://netepi.sourceforge.net
7. Commonwealth of Australia. Keeping our mob safe. The principles that underpin the National Emergency Strategy for Remote Indigenous Communities, 2007; AGPS, Canberra.
8. Massey PD, Pearce G, Taylor KA, Orcher L, Saggers S, Durrheim DN. Reducing the risk of pandemic influenza in Aboriginal communities. *Rural and Remote Health* 9 (online); 2009: 1290. Available from: http://www.rrh.org.au (Cited 03/09/2009.)

Massey PD, Pearce G, Taylor K, Blackley M, Broome J, Odo T, Purcell C, Clough A, Judd J, Kelly J, Speare R, Saggers S. *Medical Journal of Australia* 2010; **193(6):** 316-317.

CHAPTER 3: PANDEMIC INFLUENZA – PLANNING, SURGE CAPACITY AND RESPONSE IN A REGIONAL AREA

Preamble

Background

Pandemic influenza is a significant threat to health and public health services around the world. Planning for and responding to this threat in a regional area of Australia is challenging. The social, economic, programmatic and environmental aspects of the disease in this setting required more in-depth understanding.

Public health units have a number of vital roles during a pandemic, including: surveillance, community education, communication, case ascertainment, case management (but not clinical management), infection control, contact tracing, monitoring contacts in home quarantine, surveillance at administrative borders, epidemiological studies and immunisation. An increased workload, with potentially decreased staff numbers, occurs during a pandemic and these impacts on the capacity of a public health unit to respond optimally.

Population density is an important determinant of the spread of communicable diseases, hence influenza attack rates in rural communities, are expected to be lower than in urban settings. However, attack rates may be very high in specific communities. Many rural areas have greater levels of socio-economic disadvantage and higher proportions of Aboriginal and Torres Strait Islander people and are thus at higher risk. As these communities struggle during pandemic periods, planning and response should therefore ensure that their particular needs are considered.

Studies presented

The work of this chapter involves considering and investigating aspects of public health pandemic planning, surge capacity and response in a regional area.

A range of issues in planning for the response to a potential influenza pandemic were identified in the first paper of this chapter. The subsequent field exercise to test a mass vaccination response is described in the second paper. The third paper looks at the surge

capacity for public health emergencies through an influenza pandemic field exercise. The final paper in this chapter investigates some aspects of the response to the 2009 pandemic.

Impacts

Pandemic planning processes and recommendations arising from exercises have been implemented in the study area to reduce the risk of pandemic influenza. The publications have been used in advocacy with the state health department to enhance the planning and approaches taken state-wide.

Publications arising from this chapter

3.1 Pandemic planning

Eastwood K, Massey P, Durrheim D. Pandemic planning at the coal face: responsibilities of the public health unit. *New South Wales Public Health Bulletin* 2006; **17(7-8):** 117-120.

My estimated contribution was 25%.

3.2 Mass vaccination exercise

Carr C, Durrheim DN, Eastwood K, Massey P, Jaggers D, Caelli M, Nicholl S, Winn L. Australia's first pandemic influenza mass vaccination clinic exercise. *Australian Journal of Emergency Management* 2011; **26(1):** 47-53.

My estimated contribution was 25%.

3.3 Public Health surge capacity in a regional area

Hope K, Massey PD, Osbourn M, Durrheim DN, Kewley C, Turner C. Senior clinical nurses effectively contribute to the pandemic influenza public health response. *Australian Journal of Advanced Nursing* 2011: **28(3):** 47-53.

My estimated contribution was 35%.

3.4 Pandemic response in a regional area

Eastwood K, Durrheim DN, Massey PD, Kewley C. Australia's pandemic 'Protect' strategy: the tension between prevention and patient management. *Rural and Remote Health* 2009; **9:** 1288.

My estimated contribution was 25%.

resources/publications/influenza/WHO_CDS_CSR_GIP_2005_5/en/, accessed 15 September 2006.
6. Commonwealth of Australia. *Australian health management plan for pandemic influenza.* 2006. Available at: www.health.gov.au/internet/wcms/publishing.nsf/Content/ohp-pandemic-ahmppi.htm, accessed 15 September 2006.
7. Commonwealth of Australia. *Australian management plan for pandemic influenza*. 2005.
8. NSW Health. *NSW Health interim influenza pandemic action plan*. 2005. Available at: www.health.nsw.gov.au/pubs/2005/pdf/pandemic_ap.pdf, accessed 15 September 2006.
9. Commonwealth of Australia. *National action plan for human influenza pandemic.* 2006. Available at: www.dpmc.gov.au/publications/pandemic/index.htm, accessed 15 September 2006.
10. NSW Government. *New South Wales interim human influenza pandemic plan. Available at:* www.health.nsw.gov.au/pandemic/docs/nswplan.pdf, accessed 15 September 2006.

PANDEMIC PLANNING AT THE COAL FACE: RESPONSIBILITIES OF THE PUBLIC HEALTH UNIT

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ABSTRACT

Responding to an infectious disease pandemic requires a coordinated approach from all essential services. Public health units across NSW will play an important role in a range of control activities. These include: surveillance, education, communication, case ascertainment, case management (excluding clinical management), infection control, contact tracing, monitoring contacts in home quarantine, surveillance at borders, epidemiological studies and immunisation. Public health units are currently planning for such an emergency and these plans will need to be tested and refined under simulated conditions.

A well functioning disease surveillance system is necessary to ensure that the first cases of pandemic influenza are rapidly identified. Following this, control strategies will be implemented to retard the transmission of the virus while a vaccine is being developed. Surveillance will also detect the last case, signifying an end to the crisis. In between these two watershed surveillance events, public health units will play a pivotal role in responding to a pandemic. The purpose of this paper is to describe this role.

INTERNATIONAL, AUSTRALIAN AND NSW PLANS FOR A PANDEMIC

The World Health Organization has vigorously advocated global readiness for an influenza pandemic and planning by individual nations.[1] The Australian Government has adopted an inclusive process of policy-making with states and territories. Some of the strategies and plans developed by the Australian Government Department of Health and Ageing are described in the contribution by the Chief Medical Officer in this issue of the *Bulletin*.

For emergencies occurring in NSW, coordination of the response is governed by the *State Emergency and Rescue Management Act*, with the NSW Department of Health legislated to serve as the lead agency in responding to infectious disease emergencies. As all of society will be affected by a pandemic, the NSW Premier's Department is overseeing the involvement of other government departments and agencies in NSW.

Area health services across NSW will play a front-line role in providing clinical care in the event of a pandemic and ensuring appropriate local public health and mental health responses. Once the first few cases of pandemic influenza are identified, emergency departments will be placed on heightened alert to identify suspected pandemic cases. Dedicated influenza clinics will be opened when human-to-human spread has occurred within Australia. These clinics will manage all patients with symptoms suggestive of influenza to reduce the risk of infection to patients attending hospital for other reasons. Fever hospitals and staging facilities are planned for the clinical management of cases when existing acute care facilities are likely to be overwhelmed.

Since 2003, the World Health Organization has been monitoring the status of the avian influenza H5N1 strain that has caused deaths in people who have been in close contact with infected poultry.[2] It is fair to say that this concern has accelerated global pandemic preparedness.

THE ROLE OF THE PUBLIC HEALTH UNIT

Public health units will have a number of vital roles during a pandemic, including: surveillance, education, communication, case ascertainment, case management (but not clinical management), infection control, contact tracing, monitoring contacts in home quarantine, surveillance at borders, epidemiological studies and immunisation. While these duties are not foreign to public health units, the potential number of cases and urgency of response, and the need to maintain large databases, makes pandemic influenza a particular challenge. The full scope of implementation of certain of these activities is yet to be determined and the responsibility for delivery may be shared with other

TABLE 1

STAGES AND PHASES OF A PANDEMIC, AND THE AIM OF THE AUSTRALIAN GOVERNMENT RESPONSE

Pandemic stages	Phases of the pandemic	Aim of Australian Government response
Pandemic influenza containment stage	Localised human to human spread: Australian phases 3, 4, 5 & 6a	To aggressively contain and eliminate the disease. If this is unachievable, the secondary aim is to retard transmission and provide additional time for vaccine development
Pandemic influenza post-containment stage	Widespread transmission in the general population: Australian phase 6b	To maintain health services and other core services within the limitations of remaining resources

agencies. Public health unit planning must continue to interrelate with broader area health service planning.[3]

The Australian Government Department of Health and Ageing has implemented a phased approach to responding to a pandemic threat that corresponds to the epidemiological situation of novel influenza strains. The activity of public health units is governed by these designated phases[4], while the specific response obligations are described in the NSW Health Interim Influenza Pandemic Action Plan[5] and the Pandemic Influenza Response Protocol contained in the *NSW Notifiable Diseases Manual*. At the time of writing we are in Australian phase 0 and Overseas phase 3.

The Australian government response to a pandemic is divided into two broad stages according to local epidemic progression: containment and post-containment. The aim of these two stages, and how they relate to the pandemic phases, is provided in Table 1. The activities and plans of public health units vary during these two different stages as described in the rest of this article.

DIAGNOSIS, SURVEILLANCE AND NOTIFICATION OF CASES OF PANDEMIC INFLUENZA

Containment stage

During the containment stage of a pandemic, public health units will notify the NSW Communicable Diseases Branch of any human cases meeting the current case definition for suspected avian or pandemic influenza. When influenza clinics have been activated, public health units will work with clinical services to ensure accurate collection of data related to suspected cases, contacts and deaths for epidemiological and statistical purposes.

To achieve prompt recognition of the introduction into NSW of a pandemic influenza strain, public health units are reliant on notification by clinicians of cases of disease that are compatible both clinically and epidemiologically with the prevailing case definition. As this definition changes, the updated definition will be available at www.health.nsw.gov.au/pandemic/.

All patients that meet the case definition should have respiratory viral culture swabs collected for laboratory testing. Specimen quality is important for successful diagnosis. Testing for influenza by reverse transcriptase polymerase chain reaction (PCR) permits confirmation of the influenza subtype within 24 hours of receipt of a suitable specimen. This test is currently offered at a limited number of reference laboratories and is only available on an urgent basis after consultation with a clinical microbiologist.

All pathology requests for the H5N1 or pandemic strain should be notified to the local public health unit by the receiving laboratory or requesting doctor (prior to referral of the specimen to the reference laboratory) so that prompt investigation, including contact tracing, can be initiated. An effective surveillance system is reliant on fostering and maintaining a strong collaborative network with GPs, emergency departments, laboratories and respiratory physicians. Influenza viruses can also be cultured and sub-typed, although the timeframe required precludes this as a practical surveillance or initial diagnostic tool. Samples that are negative for the pandemic strain should be tested for seasonal influenza and other respiratory pathogens. The laboratory can recommend other samples or testing strategies to the referring doctor or public health unit. Once the pandemic strain has become established in Australia or a region of this country, the need for urgent laboratory diagnosis may not be necessary or practical on a large-scale basis. The case definition used for surveillance, notification and treatment will reflect the changing model of control.

Post-containment stage

During the post-containment stage public health units may only be required to provide tallies of new cases and deaths.

CASE MANAGEMENT, CONTACT TRACING AND HOME QUARANTINE

Containment stage

During the containment stage the public health unit's role will be to work with clinicians to facilitate the urgent investigation of suspected cases that accord with the case definition. They will ensure:

- appropriate specimen collection
- rapid laboratory testing
- appropriate management of cases to reduce infectiousness
- contact tracing
- provision of information to cases and contacts
- provision of prophylaxis to contacts
- infection control advice to cases, contacts and health care workers

- coordination of the management of cases and contacts in home isolation or quarantine for the residual of the incubation period determined by the Australian Government.

Post-containment stage

During the post-containment stage the contact tracing measures listed above will not generally be required because of the ubiquitous nature of infection and overwhelming workload; however, they may be effective in protecting isolated communities.

The public health units across NSW will be testing case management and contact tracing protocols through field exercises such as the Cumpston national exercise carried out in October 2006 and the Paton exercise in NSW to be carried out in November 2006.

IMMUNISATION

The development and delivery of an effective vaccine will be vital for limiting the impact of a pandemic although it is not anticipated that one will be available until late in the containment stage or, more likely, the post-containment stage. The logistics of immunising large numbers of people from varying socioeconomic and cultural backgrounds across a broad geographical area, whilst managing issues such as security and prioritisation of supply, must be determined beforehand and tested under simulated conditions.[6] Currently the mass vaccination plan has not been developed; however, the public health units' role will be to manage the logistics of vaccine supply and mass vaccination clinics in a timely, efficient and orderly fashion. Increasing the number of staff who are able to immunise, and developing and testing mass vaccination plans, are imperative to the success of the community vaccination program.

In addition, public health units will continue to encourage uptake of the pneumococcal vaccine to reduce the risk of concomitant bacterial infection. Vaccination against seasonal influenza is always recommended for people in 'at risk' groups but is particularly important during a pandemic alert period as it reduces the possibility of misdiagnosis with the pandemic strain and the potential for hybridisation.

SURVEILLANCE AT BORDERS

The Commonwealth Quarantine Act (1908) requires international ships and aircraft to report all suspected cases of influenza-like illness amongst passengers or crew to the Australian Quarantine Inspection Service before landing or berthing as part of routine pratique. This information is communicated through the Director of the Communicable Diseases Branch—in the Director's capacity as NSW Chief Human Quarantine Officer—to the local public health unit for management of cases and contacts. This system should be equally functional during a pandemic, although the captain of an international ship or aircraft will be expected to actively report the health status of their passengers.

Once human-to-human spread of a novel influenza strain has been confirmed and Overseas Phase 4 has been declared, area health services that contain an international air or sea port may be requested to participate in active surveillance of incoming (and possibly outgoing) passengers for influenza signs and symptoms. Thus collaborative planning with the Australian Quarantine Inspection Service and port authorities is necessary during the pandemic alert phase. During the containment stage the public health unit will be responsible for case assessment and appropriate infection control. In addition, where a person meets the case definition, there will need to be active follow up of all fellow passengers and crew that meet the Australian Government definition of a contact that is current at that point in time.

SURGE CAPACITY AND WORKLOAD PRIORITISATION

A dramatically increased workload with potentially decreased staff numbers (due to sickness or family commitments) should be anticipated during a pandemic. All area health services, including the public health units, are expected to develop business continuity plans, and these plans will need to include a workforce plan that addresses the need to supplement staffing during a pandemic. Alternative practices such as working from home where feasible may assist whilst also reducing exposure risks. In addition, prior consideration should be given to identifying essential tasks that must be continued within the emergency.

EDUCATION AND COMMUNICATION

It is impossible to predict the degree of personal anxiety and social disruption during a pandemic event, but maintaining proactive communication will help.[7] Early preparation should include using diverse media outlets and forums to disseminate fact sheets and infection control advice to the public and health workers so that a relationship of trust is established prior to the pandemic.[8] To facilitate dissemination and receipt of information, public health units should establish communication systems including contact lists, contracts with telecommunication suppliers, menu driven telephone services, 1800 numbers, websites, fact sheets and fax alerts.

The public education message is primarily the responsibility of the Australian Government as this ensures uniformity of advice. These messages may need to be tailored at a state or local level, for instance by providing area-specific telephone numbers and the addresses of influenza clinics and other facilities. The public health unit will play a role in ensuring adequate local coverage has occurred.

PANDEMIC INFLUENZA IN RURAL COMMUNITIES

Population density is an important determinant of the spread of communicable diseases, hence influenza attack rates in rural communities, are expected to be lower than

in urban settings. However, attack rates may be very high in specific communities, with a profound effect on medical and essential service infrastructure should key personnel be affected. Pandemic preparation and planning places a considerable additional burden on available health staff.[9] This is challenging in relatively well resourced metropolitan areas but even more demanding in country towns with fewer staff.

Planning to mitigate the impact of pandemic influenza in rural areas must address the issue of transporting people, personal protective equipment, antiviral therapy and vaccines over large distances within a short timeframe. This may require the adoption of innovative courier networks, including local transport companies, service agencies and volunteer groups.

Many rural areas have greater levels of socio-economic disadvantage and higher proportions of Aboriginal and Torres Strait Islander people. These communities may struggle during a pandemic, and planning should therefore ensure that their particular needs are considered.

DISCUSSION

Even with mathematical modeling and the lessons of history, it is impossible to predict the full impact of an influenza pandemic. Strategic planning should anticipate a profound disruption to social and health infrastructure. Currently, the focus of world attention is on a relatively small number of human cases of infection with the avian influenza H5N1 subtype, but the next pandemic strain may demonstrate distinctly different clinical and epidemiological features. Public health planning and preparation should be suitably adaptable to respond to evolving disease characteristics and challenging logistical situations. Indeed, the measure of a successful plan is its capacity to adapt to a range of serious infectious and environmental emergencies. This can only be achieved by meticulous planning and the practical experience gained through simulated exercises. Although a number of exercises have been organised and enacted at a local, state and national level, further exercises are necessary to practically test potentially fragile links in the response chain.

ACKNOWLEDGEMENTS

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REFERENCES

1. World Health Organization. *WHO pandemic influenza draft protocol for rapid response and containment*. Geneva: WHO, 2006. Available at: www.who.int/csr/disease/avian_influenza/guidelines/draftprotocol/en/index.html, accessed 17 October 2006.
2. World Health Organization. *Confirmed human cases of Avian Influenza A(H5N1).* Available at: www.who.int/csr/disease/avian_influenza/country/en/, accessed 17 October 2006.
3. NSW Health. *Checklist for area health service plans for an influenza pandemic*. Available at: www.health.nsw.gov.au/infect/pdf/checklist_plans.pdf, accessed 17 October 2006.
4. Commonwealth Department of Health and Ageing. *Australian health management plan for pandemic influenza*. May 2006. Available at: www.health.gov.au/internet/wcms/Publishing.nsf/Content/ohp-pandemic-ahmppi.htm, accessed 17 October 2006.
5. NSW Health. *NSW Health interim influenza pandemic action plan*. November 2005. Available at: www.health.nsw.gov.au/pubs/2005/pdf/pandemic_ap.pdf, accessed 17 October 2006.
6. Daems R, Del Giudice G, Rappuoli R. Anticipating crisis: Towards a pandemic flu vaccination strategy through alignment of public health and industrial policy. *Vaccine* 2005; 23: 5732–42.
7. World Health Organization. Non pharmaceutical interventions for pandemic influenza, national and community measures. *Emerg Infect Dis* 2006;12: 988–94.
8. NSW Health. Influenza and communicable diseases communications plan. Version 2.0, October 2005.
9. Harnden A. Dealing with uncertainty: perspective from primary care. *Br Med J* 2006; 332: 791–2.

Australia's first pandemic influenza mass vaccination clinic exercise

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ABSTRACT

In 2009 a novel influenza strain, pandemic influenza A H1N1 California 7/09 (pH1N1), "swine flu", emerged worldwide. Australia rapidly developed a pH1N1-specific vaccine which was distributed to public health services and general practices in September 2009. Should a second severe pandemic wave affect Australia there may be a need to rapidly deliver vaccine through mass vaccination clinics. Mass clinics must be efficient and safe. In 2008 a field exercise was undertaken to simulate a pandemic mass vaccination clinic using seasonal influenza vaccination in a rural community in the Hunter Valley using the New South Wales mass vaccination clinic response protocols. The exercise identified significant opportunities to streamline operations to increase clinic capacity, reduce client throughput time, enhance involvement of external agencies, and modify clinic roles, with a resulting revision of the State mass vaccination plan.

Introduction

In 2009 a novel influenza strain, A H1N1 California 7/09 (pH1N1), "swine flu", emerged in Mexico and rapidly spread worldwide. Although generally causing mild disease, pH1N1 resulted in severe illness in some individuals. On 11 June 2009 the WHO officially declared an influenza pandemic in recognition of the global impact of the novel strain. (World Health Organization, 2005; Bishop, J., 2009)

The Australian public health response to pH1N1 was aimed at protecting individuals and mitigating the impact on social function and the economy. (Australia Government Department of Health and Ageing, 2009)

Initially, containment phase plans in Australia were focussed on limiting transmission through social distancing measures and the widespread use of antiviral drugs for both prophylaxis and treatment. However, with the escalation of local transmission and evidence suggesting that disease was not as serious as initially believed, the containment measures were relaxed while awaiting the development of a tailored vaccine, focussing on early treatment of individuals with underlying high-risk conditions. (Eastwood, K., et al, 2009)

In Australia, following safety and efficacy trials, a pH1N1-specific vaccine was registered by the Therapeutic Goods Administration in September 2009. Health authorities agreed that given the decrease in pH1N1 disease activity the use of mass clinics was not immediately necessary and that the rollout could be achieved principally through general practices and existing public health services. Whilst stated willingness to accept the vaccine is reportedly high the actual uptake thus far is unlikely to achieve adequate 'herd immunity'. (Eastwood, K., et al, 2009) Should a second pandemic wave occur or mutation resulting in a strain with more serious health consequences, then mass vaccination delivery through community clinics will need to be considered.

Although real-time field exercises are considered the gold standard for evaluating disaster response capabilities, until now, no Australian State or Territory had tested the effectiveness of their mass vaccination plans by field exercise. (Aaby, K., et al, 2008) In this report we describe our experiences in conducting a large field exercise in March 2008 in which we provided seasonal influenza vaccine to a circumscribed rural community of 1800 people in the Hunter Valley, NSW, which included the town of Aberdeen. Our aim was to provide the current seasonal influenza vaccine rapidly and safely. Two key summary measures of mass clinic effectiveness are clinic capacity (the number of patients successfully vaccinated per hour) and throughput time (time spent by a patient in the clinic). (World Health Organization, 2008) The exercise tested the NSW pandemic influenza mass vaccination clinic response protocols. (New South Wales Health, 2005)

Methods

The aim of this exercise was to evaluate and refine mass vaccination clinic plans under the NSW Health Interim Influenza Pandemic Action Plan. The exercise assessed the capacity of the existing Plan to efficiently and safely implement a local mass vaccination clinic operational plan and evaluate the capacity to deliver adequate and timely treatment of mass presentations. The Hunter New England Human Research Ethics Committee considered the exercise a quality assurance exercise and formal ethics approval was not required.

The coordinating group consulted extensively with Local Emergency Management Committee (LEMC) representatives, the Upper Hunter Shire Council, the local Division of General Practice, the town's general practitioner, the local school which provided the venue, security contractors and local volunteer organisations. Additionally, local hospital staff and community nurses participated in the exercise.

The Philadelphia Health Department, USA, provided valuable advice from their previous experiences of mass drug distribution. (Philadelphia Department of Public Health Division of Disease Control, Bio-terrorism and Public Health Emergency Preparedness Consultants, 2005) For staff participating in the clinic, multi-agency training and briefings were conducted in the weeks prior to the exercise. The Chief Umpire was the Local Emergency Operations Controller (LEOCON), a senior officer from the local Police Command, who was supported by seven umpires/evaluators from NSW Health and three NSW Area Health Services.

The target population was approximately 1800 individuals representing the entire postal code cohort of individuals aged greater than 6 months. Children aged 6 months to 9 years who had not received an influenza vaccine in previous years were offered a second influenza dose six weeks after the exercise.

After Action Reviews (AARs) were convened immediately following the exercise to solicit key points of impact in the running of the exercise. A strategic consultative meeting with NSW Health's Biopreparedness and Immunisation Units was convened two months following the exercise to agree on protocol changes identified by exercise findings.

Clinic operations

A community advertising campaign was initiated three weeks prior to the clinic through all local print and electronic media. It was clearly stated that besides being an opportunity to obtain free and current seasonal influenza vaccine the participants would also be involved in an exercise to test pandemic plans. The vaccination clinic was conducted on 11 March 2008 at the local high school between 14h00 and 20h00. The clinic framework utilised a reproducible pod (small team unit) structure to enable the expansion of the

FIGURE 1: Flow of clinic operations used in Exercise as per existing Plan.

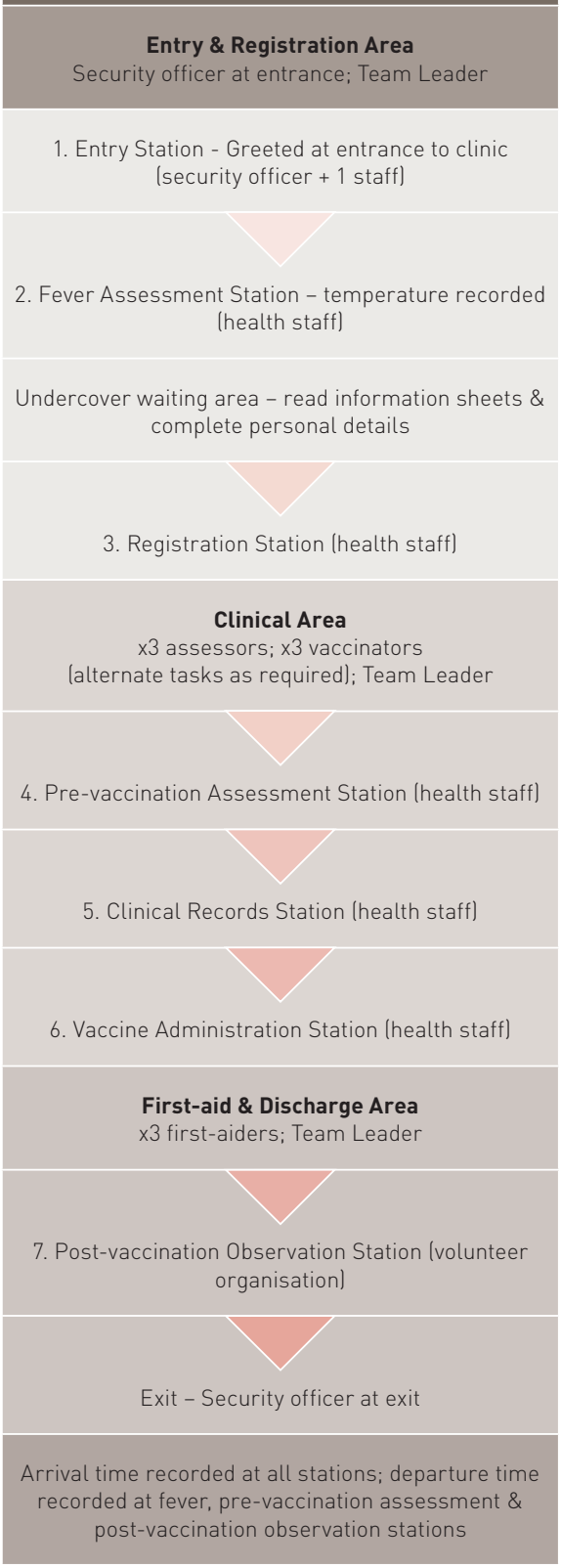
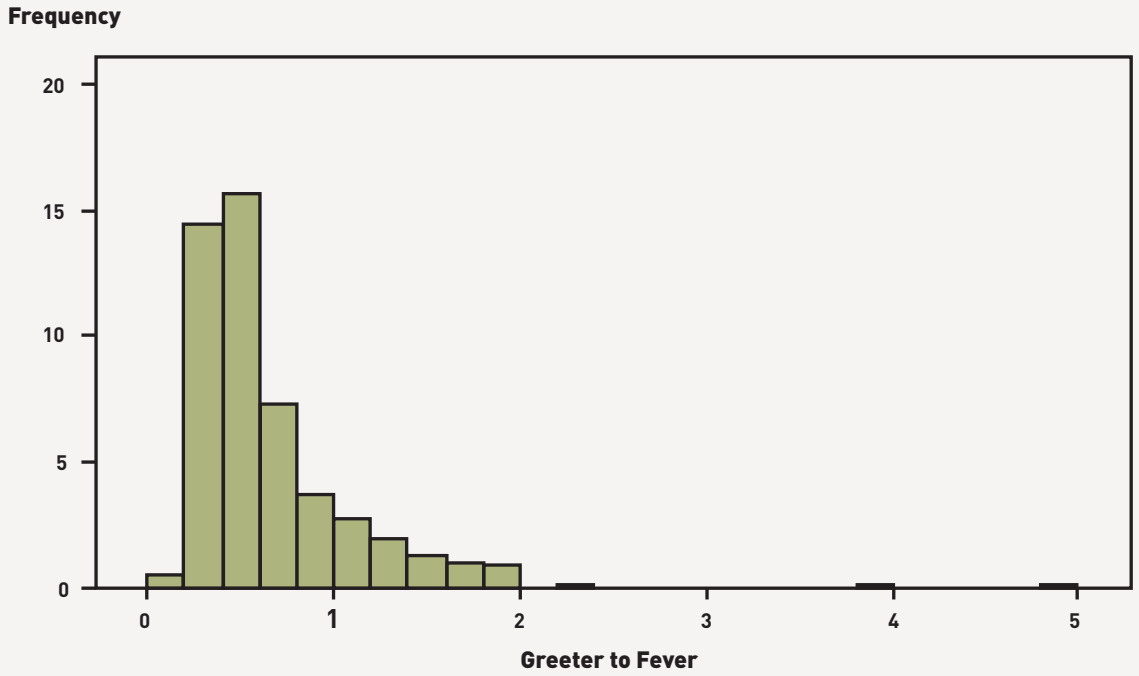


FIGURE 2. Time (in minutes) by each individual between Greeter and Fever Assessor.



response to meet increasing numbers of community presentations. The school front entrance was used as the clinic entry point and each individual was directed and timed through seven stations as per the State Plan: (1) greet, (2) fever assessment, (3) registration, (4) pre-vaccination assessment, (5) clinical administration station, (6) vaccine administration and (7) post-vaccination observation and exit.

The clinic was staffed by nurse immunisers and other personnel from local rural health services, and members of local volunteer organisations. (Figure 1) Registered nurses rotated between the roles of vaccinator and pre-vaccination assessor to alleviate the repetitive nature of tasks and to maximise proficiency. Vaccines were provided in pre-filled syringes and were transported from the State Vaccine Centre to local vaccine storage facilities through the state's existing vaccine transportation system which provides for specifically trained personnel to receive, store and monitor vaccines. Vaccines were monitored from point of despatch to vaccine administration to ensure cold-chain acceptability.

Exercise evaluation

Three key aspects of the current Plan – effectiveness, safety, and client participation – were evaluated by seven evaluators who rotated through clinic stations hourly, using a standardised reporting tool for recording observations. Evaluators reviewed each clinic function against the effectiveness and efficiency of each position as described in pre-prepared Job Action Sheets.

Client satisfaction data was obtained using a semi-structured self-administered survey which was completed during the post-vaccination observation period. Exercise situation reports and briefings from the AARs captured data from the staff and volunteers involved in the exercise. Detailed time and flow analysis data was collected from each of the seven clinic stations using calibrated clocks to standardise arrival and departure times.

Statistical analysis

Quantitative data were analysed with Microsoft Excel and SPSS version 12 (IBM, 2005) Analysis included calculation of flow rates through specific vaccination stations and the conducting of a cohort analysis to identify "flow bottlenecks".

Results

Effectiveness

Four hundred and ninety eight clients were vaccinated at the clinic over the six hour period. The greatest number of presentations was seen in the first hour of the clinic (n=108) and an increase of adults was also noted between 17h00 and 19h00 coinciding with the end of shifts at local businesses and local news media coverage.

Standardised observations by umpires and AARs indicated that the chain of command and communication channels as described in the Plan were strictly adhered to by all staff during the clinic.

TABLE 1: Time (in minutes) through clinic stations.

Time (minutes)	**Station 1-2** Greeter to Fever Assessment	**Station 2-3** Fever Assessment to Registration	**Station 3-4** Registration to Pre-Vaccination	**Station 4** Pre-Vaccination to Vaccination	**Station 5-6** Vaccination to Post- observation	**Station 1-2** Greeter to Post-observation
Median	5	7	4	1	4	22
IQR	4	5	4	0	3	12
Range	49	26	15	7	16	78
Maximum	50	26	15	7	16	82

The current Team Leaders' Job Action Sheets however did not adequately reflect the leadership role required to effectively manage the clinic operations and client flow. Umpires reported that client flow was managed in accordance with safe operational plans and that a school facility had the necessary infrastructure required for successful mass clinic deployment.

There was considerable variation in the movement through the various stages of the clinic which resulted in periodic bottle-necks during high throughput periods (Table 1). Although all transition times were positively skewed this was particularly pronounced for the time taken from greeter to fever assessor, which was the least actively shepherded transition.

Analysis of variance demonstrated statistically significant differences in median times between most stations during the clinic. The pre-vaccination assessment station was the most efficient. Of the 498 clients vaccinated at the clinic over the six hour period 81.1% (404) spent less than two minutes at the pre-vaccination station and 97.4% (485) spent less than three minutes. A third of clients (162) failed to leave after the appointed fifteen minutes post-vaccination observation period despite experiencing no vaccine adverse effects. Although there was an overall improvement in median time taken through the clinic for clients during the exercise there was still considerable variation.

Evaluators reported that clinic staff effectively activated the contingency plan for resource utilisation and surge staff when a need was identified, and staff members were effectively re-deployed to other tasks to meet changes in demand at specific stations.

Safety

No significant adverse event following vaccination and no safety incidents were reported during the exercise. One mild reaction following vaccination was self-limiting and required no treatment. Licensed security officers stationed at the entrance were observed to provide support to those clinic staff members who were isolated from the main clinic stations. Vaccinators were initially seated but after the first

FIGURE 3. Time (in minutes) from Greeter to arrival at Post-vaccination Observation.

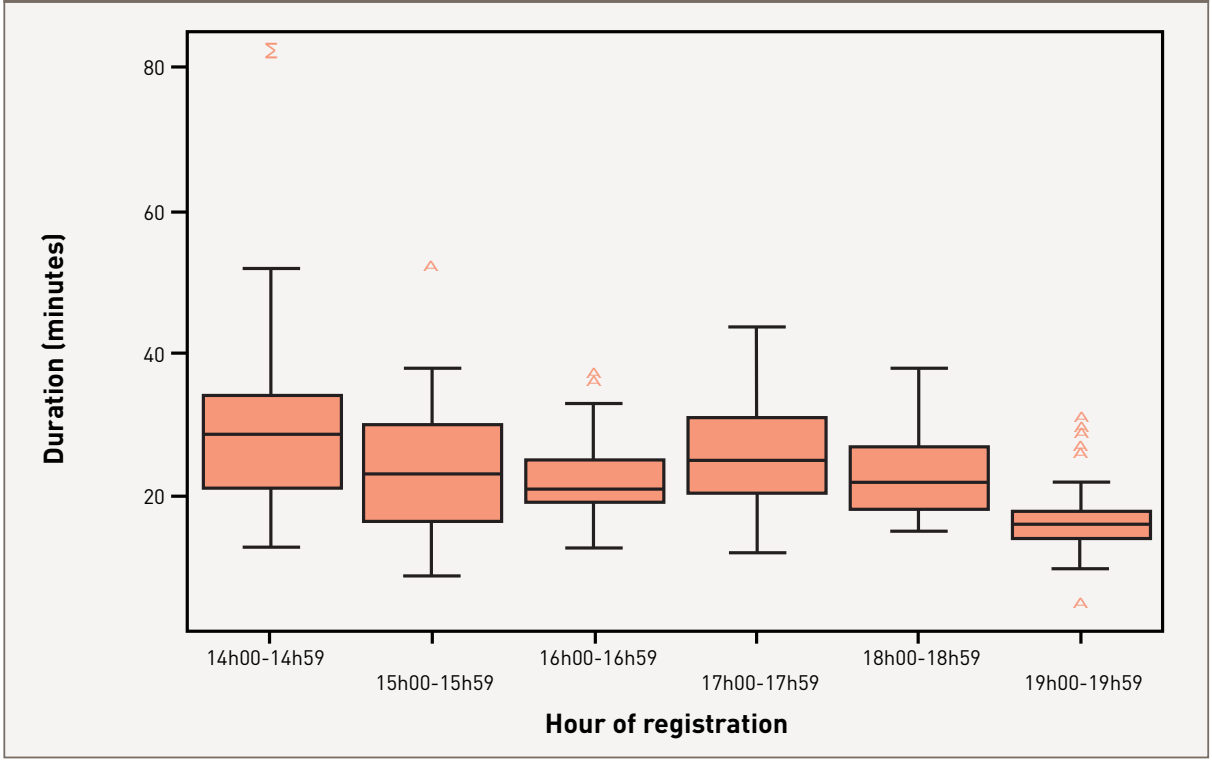
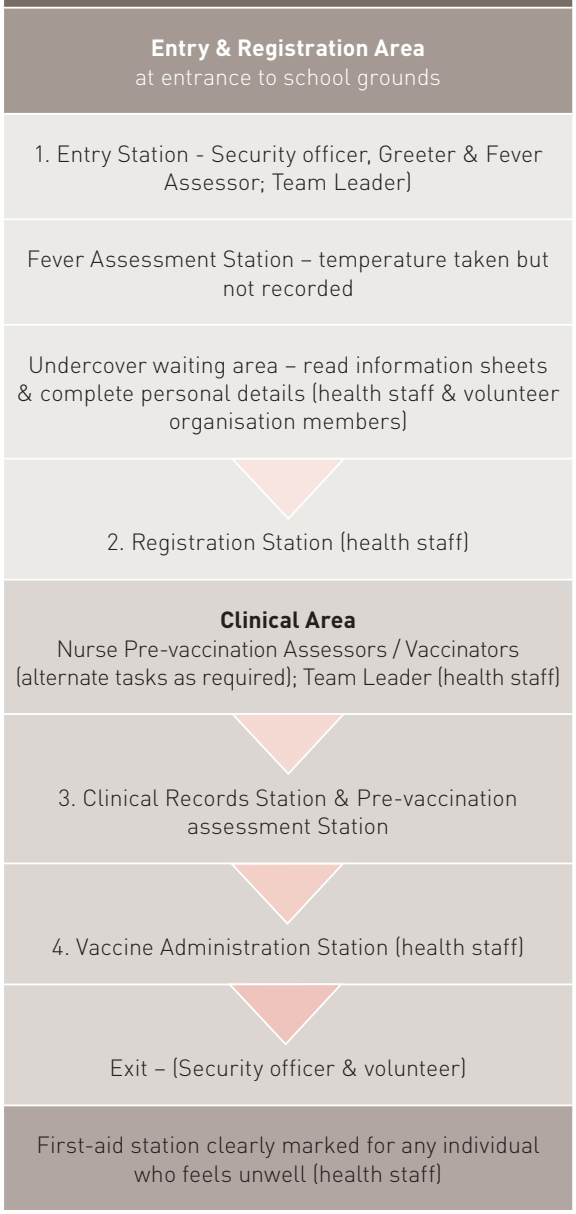


FIGURE 4: Flow of revised clinic operations.



hour were requested by their Team Leader to stand in order to increase the throughput of their station. Some vaccinators subsequently reported leg and back strain after continual bending to sign vaccination record cards and service records.

Vaccine temperatures were observed by evaluators to be under continuous monitoring and were documented as satisfactory prior to and during clinic operations.

Client Participation

The self-administered satisfaction survey showed a high level of acceptance (98-99%) in all categories assessed: method of communication, clinic management, influenza and vaccine information, answers to questions posed by clients, treatment of clients by clinic staff, and waiting times. Ninety-nine percent of clients rated overall clinic management as excellent or good (482/489). Ninety-eight percent (472/484) of clients rated the information sheet provided on influenza as excellent or good, while 98% (479/488) of clients also rated information provided on influenza vaccination as excellent or good. Ninety-nine percent (482/485) of respondents regarded staff responses to their questions and concerns regarding the clinic, the vaccine or the disease, as excellent or good. Ninety-nine percent of participants (485/488) rated treatment by clinic staff as excellent or good. Most respondents indicated high satisfaction with waiting times, with 97% (472/488) considering this aspect as excellent or good.

Discussion

The exercise proved valuable in evaluating the existing Mass Vaccination Clinic Plan and identifying opportunities to improve it. The exercise demonstrated that although the existing Plan could be operationalised safely there was considerable scope for improving efficiency. Streamlining the existing structure, functions, procedures and communications to enhance client flow, and enhancing the involvement of other agencies and volunteers, were identified as essential for improved throughput at future mass clinics. The school proved an ideal venue for deploying a mass clinic. Reducing the number of stations as described in Figure 3, limiting the physical distance between stations, and employing more rigorous marshalling of individuals to prevent straying, would improve efficiency and throughput.

The high level of client compliance and satisfaction with the clinic process and waiting times may not be reflected in a pandemic situation when community anxiety is heightened, therefore in pandemic situations, enhanced queuing management, improved clinic signage outside and within, and movable physical barriers to match demand, would improve clinic management and assist clients to move swiftly through the stations.

Following the AAR, Job Action Sheets for team leaders were modified to highlight their leadership role, specifically regarding enhancing communications and managing emerging situations. The consent and registration process should be streamlined by dispensing with documentation by both clients (written consent) and vaccinators (signing vaccination records).

Volunteers could effectively replace health staff for all but clinical roles (pre-vaccination assessors and vaccinators) which would minimise the burden on health services during a pandemic. Having the ability to re-deploy staff within the clinic to meet surge at particular stations positively impacted on client flow during the Exercise.

The short time spent in the pre-vaccination assessment station by most vaccinees suggests that the information sheet effectively addressed community concerns about the disease and the vaccine. The importance of ensuring that the community is well informed about pandemic influenza and the risks

and benefits (including safety concerns) of a tailored pandemic vaccine cannot be overstated.

To further improve through-put, vaccinators' role should be limited to vaccinating. Dispensing with the vaccinator's requirement to document (date/batch numbers) and to sign record cards, would also reduce the occupational risk of back and limb fatigue for vaccinators.

With only one mild reaction following vaccination, together with the overwhelming evidence of the low incidence of immediate adverse events following vaccination in Australia over the past decade, it is reasonable to replace the observation station with a first-aid point for anyone feeling unwell. (Australian Government Department of Health and Ageing, 2008) This would increase the clinic's capacity by prevent bottle-necks post-vaccination, while simultaneously reducing the risk of contact with undiagnosed cases of pandemic influenza.

Conclusions

This field exercise demonstrated inefficiencies in the current Mass Vaccination Plan. Key issues included the number and location of stations, formal consent and vaccinator documentation requirements, the lengthy post-vaccination observation period and the need for surge capacity that can be rapidly deployed to maintain clinic flow. The Exercise provided us with the opportunity to streamline existing plans and procedures after a practical evaluation. The lessons from this field exercise, the first of its kind in Australia, have the potential to improve future application of the mass vaccination clinic model should a second wave of pH1N1 occur or in the event of a large-scale public health response requiring mass administration of medications. (Durrheim, D., Ferson, M., 2006; Ferguson, N., et al, 2006)

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References

Aaby K., Cook, D., Herrmann, J., Jordan, C., Wood, K., (2008), *Simulating a mass vaccination clinic: Health Care Management Science, http://www.isr.umd.edu/Labs/CIM/projects/clinic/hcms.pdf (accessed Dec 30, 2008).*

Australian Government Department of Health and Ageing, (2008), *The Australian Immunisation Handbook, 9th Edition, Canberra.*

Australian Government Department of Health and Ageing, (2009), *Australian Health Management Plan for Pandemic Influenza; Commonwealth of Australia, Canberra.*

Bishop, J., (2009), *Managing Pandemic (H1N1) 2009 Influenza: A national health response, The Australian Journal of Emergency Management, Vol. 24, No.3, pp.5-6.*

Durrheim, D., Ferson, M., (2006), *Preparing for the inevitable - an influenza pandemic. NSW Public Health Bulletin, Vol. 17, pp. 97-98.*

Eastwood, K., Durrheim, D.N., Massey, P.D., Kewley, C., (2009), *Australia's pandemic protect strategy: the tension between prevention and patient management. Rural and Remote Health 2009; 9: 1288.*

Eastwood, K., Durrheim, D., Jones, A., Butler, A., (2009) *Acceptance of Pandemic (H1N1) 2009 Influenza Vaccination by the Australian Public, Medical Journal of Australia, eMJA Rapid Online Publication 4 November 2009.*

Ferguson, N., Cummings, D., Fraser, C., Cajka, J., Cooley, P., Burke, D., (2006), *Strategies for mitigating an influenza pandemic. Nature, Vol. 442, pp. 448–452.*

IBM, (2005), *Statistical Package for the Social Sciences for Window version 12. Illinois: Chicago.*

New South Wales Health, (2005), *NSW Health Interim Influenza Pandemic Action Plan; NSW Government Printing, Sydney.*

Philadelphia Department of Public Health Division of Disease Control, Bio-terrorism and Public Health Emergency Preparedness Consultants, (2005), *Roundtable Discussion After-Action Review of PDPH Dispensing Site Exercise October 14, 2005 Updated / Final-Report November 26, 2005, Emergency Management Innovations.*

World Health Organization, 2005 Global influenza preparedness plan; (2005). *World Health Organization, Geneva.*

World Health Organization, (2008), *Weekly Epidemiological Record southern hemisphere strain 2008.*

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Hope K, Massey PD, Osbourn M, Durrheim DN, Kewley C, Turner C. Senior clinical nurses effectively contribute to the pandemic influenza public health response. *Australian Journal of Advanced Nursing* 2011: **28(3):** 47-53.

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COMMENTARY

Australia's pandemic 'Protect' strategy: the tension between prevention and patient management

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ABSTRACT

Recent experience during Australia's initial public health response to the swine influenza pandemic provides valuable lessons for the future. An intense containment effort lasting 7 weeks was unable to prevent local community transmission in some areas of Australia; however, despite the mobility of many people living in rural and remote parts of the country, much of the outback was unaffected. By the end of the Containment Phase, most parts of rural New South Wales only recorded low rates of confirmed H1N109 infection. As Australians living in rural areas often have poorer access to health services than their urban counterparts, they are likely to be more affected by an extended emergency, even one as moderate as the present H1N109 swine influenza pandemic. There may have been benefits in extending containment measures in these less affected areas and in communities where large numbers of vulnerable people such as Indigenous Australians reside. Containment is worthwhile in limiting the spread of disease in specific situations but is unlikely to change the course of a pandemic unless it can be sustained until a large proportion of the population is vaccinated. Strenuous containment efforts should certainly be applied in outbreaks of severe disease, particularly

those caused by novel infectious agents with a low reproductive rate (R_0). Should advances in vaccine manufacture reduce the time taken to produce a new vaccine, then increased effort to extend containment will be even more worthwhile.

Key words: Australia, H1N1, human influenza, pandemic, swine influenza, transmission, prevention and control.

Background

To many who work in biopreparedness, the advent of the H1N109 swine influenza pandemic did not come as a surprise. Australian health services have been actively engaged in developing pandemic plans and conducting field exercises for some years[1-3]. One of the key motivators has been the potential risk posed by the highly virulent but poorly transmissible H5N1 avian influenza strain, which has been circulating globally for more than a decade and has a reported fatality rate among confirmed cases exceeding 60%[4]. Planning has focused on a worst-case scenario and, thus, the comparatively more moderate infection reported in H1N109 cases meant some incongruence between the perceived level of threat and the public health response.

The inconvenience of social distancing measures and the potential economic impact attracted criticism from the public, media and some sectors of the health community, and there were calls for allowing the pandemic to run its course[5-7]. However, it must be recognised that Australia was among the first affected countries in the world and soon posted one of the highest infection rates. Unlike North America and Europe, Australia was rapidly heading into its peak winter influenza season. Criticism of its public health response has to be tempered against the fact that little sound epidemiologic information was available when Australia's first cases were identified. Indeed, early data from Mexico suggested a mortality rate that warranted stringent containment measures.

H1N109 Swine influenza

The WHO declared a public health event of international importance on 24 April 2009 in recognition of human transmission of the novel influenza strain, H1N109[8]. Public health units (PHUs) in Australia were instructed to actively seek cases and apply containment measures, including home isolation/quarantine of confirmed cases and high risk contacts. Antiviral drugs from the national medical stockpile were used to treat cases and reduce the period of infectivity, and also for prophylaxis of high risk contacts. The containment response built on experience gained through field pandemic exercises conducted at Commonwealth, state and area health service level[1-3].

The first confirmed Australian swine influenza case arrived in Brisbane on 7 May 2009 on an international flight; by the end of the month 306 cases had been identified across the nation. Local Australian transmission was identified in early June 2009. Global figures reported by WHO showed a 4.4-fold increase in confirmed cases during June 2009 from 17 410 to 77 201, while in Australia, there was a 13.4-fold increase to 4090 confirmed cases over the same period. The disparity between these rates may be related to various factors, including surveillance, laboratory capacity and the progression of the epidemic but there may be other unrecognised explanations. The introduction of a novel influenza strain into countries in the southern hemisphere at the onset of their usual influenza seasons was considered a particular challenge. In Australia the peak influenza period is between July and September, when social factors such as more activities conducted indoors results in crowding and increases the risk of transmission, and low temperatures and humidity aid survival of the influenza virion[9].

Reports from North America, including Mexico, provided valuable epidemiological data[10-12]. The mortality rate of 1.1% reported from Mexico at the early stage of the outbreak was probably inflated by surveillance artefacts and biased towards recognition of cases exhibiting more severe disease.

Estimations suggest that the H1N109 virus has a high propensity for transmission with a R_0 of 1.4–3.5 compared with 1.2–1.4 for seasonal influenza[13]. Fifty to 80% of severe cases have had underlying conditions, including pregnancy, asthma or other lung pathology, cardiovascular disease, diabetes, immunosuppression and neurological disorders[14,15]. Extreme obesity is also being investigated as a potential risk factor[16]. Severe cases and deaths have occurred in young and previously healthy adults, and less often in children.

The Protect Phase

By mid-June 2009 there was widespread transmission in Victoria and this picture was starting to become evident in New South Wales (NSW), largely in western Sydney and south-western NSW bordering Victoria[17]. Infection rates varied widely across the country (Table 1) and also within states such as NSW (Table 2). On 4 June, Victoria reported 521 confirmed cases, principally from Melbourne, and this increased to 1011 by 8 June. On 17 June, the Australian Commonwealth's Department of Health and Ageing introduced the 'Protect Phase' across all states, although some parts of Queensland remained in the Contain Phase beyond this date. The Protect Phase focuses on identifying and actively managing vulnerable people with suspected swine influenza infection[17]. At this stage, testing to confirm H1N1 infection was restricted to people hospitalised for possible influenza.

During the Containment Phase considerable effort was made to actively identify cases. Media coverage advised symptomatic people with possible swine influenza risk exposures to seek medical assistance. Information was circulated to GPs and emergency departments regarding the clinical and epidemiological recognition of swine influenza and doctors were encouraged to contact their local PHU if a suspected case presented. More than 2000 people were tested in NSW alone. Data recorded in Tables 1 and 2 suggest considerable areas of Australia were spared large-scale introduction or were successful in containing the early spread of the disease, although surveillance is unlikely to capture all cases of H1N109. The heterogeneous spread of swine influenza also reflects the experience of previous pandemics, and provides further motivation for surging public health resources to bolster local containment[18]. In addition, it is appropriate to share resources with more affected areas in order to sustain containment, particularly when local capacity is compromised.

Do containment strategies provide long-term benefit?

When the Protect Phase was declared, case rates were less than 9/100 000 for most areas of Australia, except Victoria and the Australian Capital Territory which were 22-23/100 000. This raises the question of whether it was appropriate for all Australian regions to terminate their containment strategies simultaneously when many PHUs appeared to be effectively controlling transmission? A variety of factors need to be considered in the decision, including the value of persevering with containment in the face of escalating transmission in neighbouring areas, the cost of enforcing quarantine and social distancing, the ability to surge laboratory capacity and maintain other essential diagnostic services, the virulence and clinical impact of the influenza strain, the effectiveness and availability of antiviral treatment, and the timeframe for developing a targeted vaccine.

In a country as large as Australia with natural barriers of distance and geography, it is reasonable to expect that some areas can be isolated from the impact of a novel infectious disease, even if wide-scale activity is occurring elsewhere. Reducing the spread of the novel virus is in part dependent on people complying with social distancing measures, and there is evidence that Australians will cooperate with public health requests[19]. As only rare cases of antiviral resistance to H1N109 have been observed, treatment and prophylaxis must be regarded as effective control measures in this instance[20].

Table 1: Confirmed H1N109 infection rates in Australian states and territories at the end of the Contain Phase, 17 June 2009

State	State population†	Confirmed cases	Rate per 100 000
New South Wales	7 041 400	313	4.4
Victoria	5 364 800	1230	22.9
Queensland	4 349 500	194	4.5
Australian Capital Territory	347 800	75	21.6
South Australia	1 612 000	107	6.6
Western Australia	2 204 000	117	5.3
Northern Territory	221 700	35	15.8
Tasmania	500 300	41	8.2
Australia total¶	21 644 000	2112	9.8

†Population figures are based on estimated residential population 31 December 2008
¶The Australian total includes all territories.

Table 2: Confirmed H1N109 infection rates in the eight New South Wales area health services at the end of the Contain Phase, 17 June 2009

New South Wales area health service	Population†	Confirmed cases	Rate per 100 000
Rural			
Hunter New England	862 967	8	0.9
Greater Southern	483 282	42	8.7
Greater Western	301 052	9	3.0
North Coast	495 329	10	2.0
Metropolitan			
Northern Sydney/Central Coast	1 134 200	33	2.9
South Eastern Sydney Illawarra	1 209 111	46	3.8
Sydney South West	1 394 652	82	5.9
Sydney West	1 131 294	83	7.3
New South Wales total¶	7 011 886	313	4.5

†Population figures are based on estimated residential population 31 December 2008
¶The discrepancy with the NSW total in Table 1 is due to differences in population projections.

Two weeks after the introduction of the Protect Phase the number of confirmed cases in Australia doubled, despite confirmatory testing (and hence surveillance) only being focused on severe cases. In NSW, 10 cases were hospitalised in the Containment Phase and 187 in the following 2 weeks. Approximately 20% of those hospitalised have required treatment in an intensive care unit[21]. The first H1N109-associated death was reported from South Australia on 19 June and the toll has steadily increased. These statistics suggest that H1N109 influenza will result in many cases of severe disease when there is widespread community infection, an argument for containment if it could have been sustained. Similarly, rigorous containment measures are appropriate to protect vulnerable individuals and communities. This includes people with underlying medical conditions and also Indigenous Australians, a group which historically has borne a heavy burden during introductions of novel influenza infections[22]. Statistics indicate that Indigenous people are approximately five times more likely than non-Indigenous Australians to be hospitalised for swine influenza[21]. Currently (1 September 2009), the cumulative hospitalisation figures indicate that there have been

4440 swine influenza admissions to Australian hospitals, with 13.8% being Indigenous Australians, and at least 20 of the 154 people who have died with confirmed H1N109 infection are known to be Indigenous[21]. The proportion of people identifying as Indigenous in the Australian population is 2.5%[23].

Rural experiences

During the Containment Phase many towns in rural and remote parts of Australia were spared from swine influenza. Our experience dealing with GPs from country areas suggests that they were enthusiastically engaged in active case ascertainment and assisted public health authorities with the implementation of control measures. Many were reluctant to accept the relaxed measures described in the Protect Phase guidelines[24]. Furthermore, their intimate local knowledge often provided the effective surveillance necessary for successful containment. A particular concern for managing large numbers of pandemic cases once established in rural areas is the issue of inequitable access to health services and the well recognised shortage of medical officers[25]. In addition, delays in providing confirmation of cases from country towns were evident during the Containment Phase because of specimen transportation difficulties and laboratory turnaround times. The GPs in these areas may have to rely more heavily on clinical acumen to recognise cases and encourage isolation before pathology results are available.

Vaccines

The principal measure for controlling viral infections is comprehensive coverage with an effective vaccine. In the case of influenza, this has necessitated annual development of a vaccine tailored to the forecasted seasonal strains and derived from viral antigen cultured in eggs. While the influenza vaccine is generally effective, the limitations are obvious when rapid production is required for a novel influenza strain. It can take months to develop a suitable vaccine and further delays are experienced in confirming safety and efficacy through clinical trials. In addition, an effective immune response may require two doses. For some countries the vaccine may be ready as soon as mid-September 2009[14]; however, it is important that the public has confidence in its safety and that full therapeutic goods registration is obtained before it is made available. In the future, cell-line derived and genetically engineered vaccines may significantly reduce the period of time to develop a strain-specific vaccine[26]. During the swine influenza response it is possible that some areas could have maintained containment until the H1N1 vaccine was available, and this could have mitigated the impact of the novel virus, but such a strategy needs to be weighed against the increased cost, social disruption, and demand on the local health workforce.

Conclusion

Although containment measures were universally applied across Australia, their impact during the initial response to the H1N109 swine influenza pandemic was diverse. It is debatable whether the Australian health sector could have maintained the intense containment approach for long enough to preserve all areas from the affects of community wide transmission. However, a compelling argument can be lodged for an approach of maintaining containment in unaffected areas in future pandemic responses, particularly in country areas where access to health care may be problematic and there is a high proportion of at-risk individuals, including Aboriginal and Torres Strait Islanders.

In a country the size of Australia, disease patterns are influenced by a multitude of factors including population density, demographics, cultural traditions and behaviours, transport routes, geographical barriers and health service capacity. Thus, heterogeneous application of containment measures using an ‘area quarantine’ approach should be included in pandemic plans for future occasions when community transmission affects certain parts of the country but spares others. A heterogeneous approach could decrease the inherent inequities of an approach of managing only individuals at higher risk of complications. Area quarantine

would be particularly appropriate for a virulent infectious agent where the overall aim is to reduce morbidity and mortality.

References

1. Australian Government Department of Health and Ageing. *National Pandemic Influenza Exercise, Exercise Cumpston 06 Report*. (Online) 2009. Available: http://www.health.gov.au/internet/panflu/publishing.nsf/Content/34B24A2E2E6018E9CA2573D7000006D2/$File/exercise-cumpston-report.pdf (Accessed 1 September 2009).

2. Craig AT, Armstrong PK. Exercise Paton: A simulation exercise to test New South Wales emergency departments' response to pandemic influenza. *Communicable Diseases Intelligence* 2007; **31:** 310-313. Available: http://www.health.gov.au/internet/main/publishing.nsf/Content/cda-cdi3103-pdf-cnt.htm/$FILE/cdi3103i.pdf (Accessed 1 September 2009).

3. Hunter New England Population Health. *Hunter New England XFG Pandemic Influenza Exercise, 22-26 September 2008, Interim Exercise Report December 2008*. (Online) 2009. Available: http://www.hnehealth.nsw.gov.au/__data/assets/pdf_file/0017/53180/HNEH_XFG_Final_Summary_Report_Dec_2008.pdf (Accessed 1 September 2009).

4. WHO. *Cumulative Number of Confirmed Human Cases of Avian Influenza A/(H5N1) Reported to WHO*. (Online) 2009. Available: http://www.who.int/csr/disease/avian_influenza/country/en/ (Accessed 1 September 2009).

5. Robinson N. Just when we all thought it was a hoax of World Health Organisation Level 6 pandemic proportions, Australia is in the grip of swine flu and nobody seems to care. (Online) May 28, 2009. *The Australian*. Available: http://www.theaustralian.news.com.au/story/0,,25547677-25090,00.html (Accessed 1 September 2009).

6. Collignon P. Take a deep breath, Swine flu's not that bad. (Online) 25 May 2009. *Crikey*. Available: http://www.crikey.com.au/2009/05/25/take-a-deep-breath-swine-flus-not-that-bad/ (Accessed 1 September 2009).

7. Barlow K. Let swine flu run its course: expert. *ABC News, Lateline*. (Online) 2009. Available: http://www.abc.net.au/news/stories/2009/05/29/2585109.htm (Accessed 1 September 2009).

8. WHO. *Influenza-like illness in the United States and Mexico, 24 April 2009*. (Online) 2009. Available: http://www.who.int/csr/don/2009_04_24/en/index.html (Accessed 1 September 2009).

9. Lowen AC, Mubareka S, Steel J, Palese P. Influenza virus transmission is dependent on relative humidity and temperature. *Public Library of Science Pathogens* 2007; **3:** 1470-1476. (Online) 2009. Available: http://www.plospathogens.org/article/info:doi/10.1371/journal.ppat.0030151 (Accessed 1 September 2009).

10. Centers for Disease Control and Prevention. *Swine-origin influenza a (h1n1) virus infections in a school, New York City*. (Online) 2009. Available: http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5817a6.htm (Accessed 1 September 2009).

11. Chowell G, Bertozzi SM, Colchero MA, Lopez-Gatell H, Alpuche-Aranda C, Hernandez M et al. Severe respiratory disease concurrent with the circulation of h1n1 influenza. *New England Journal of Medicine*. (Online) 2009. Available: http://content.nejm.org/cgi/reprint/NEJMoa0904023v1.pdf (Accessed 1 September 2009).

12. Perez-Padilla M, Rosa-Zamboni D, Ponce de Leon S, Hernandez M, Quiñones-Falconi F, Bautista E et al. Pneumonia and respiratory failure from swine-origin influenza A (H1N1) in Mexico. *New England Journal of Medicine* 2009; **361:** 680-689. Available: http://content.nejm.org/cgi/content/full/NEJMoa0904252 (Accessed 1 September 2009).

13. Hiroshi Nishiura H, Wilson N, Baker MG. Estimating the reproduction number of the novel influenza A virus (H1N1) in a Southern Hemisphere setting: preliminary estimate in New Zealand. *The New Zealand Medical Journal* 2009; **122**. Available: http://www.nzma.org.nz/journal/122-1299/3722/ (accessed 1 September 2009).

14. WHO. *Pandemic (H1N1) 2009 briefing note 4: preliminary information important for understanding the evolving situation*. (Online) 2009. Available: http://www.who.int/csr/disease/swineflu/notes/h1n1_situation_20090724/en/print.html (Accessed 1 September 2009).

15. Jamieson DJ, Honein MA, Rasmussen SA et al. H1N1 2009 influenza virus infection during pregnancy in the USA. (Online) 2009. *The Lancet* 2009; **374(9688):** 451-458. Available: http://www.thelancet.com/journals/lancet/article/PIIS0140-6736(09)61304-0/fulltext (Accessed 1 September 2009).

16. Centers for Disease Control and Prevention. *Intensive-care patients with severe novel influenza a (h1n1) virus infection - Michigan*. (Online) 2009. Available: http://www.cdc.gov/mmwr/preview/mmwrhtml/mm58d0710a1.htm (Accessed 1 September 2009).

17. NSW Government, Department of Health. *Media Release from the Minister for Health, John Della Bosca, 17 June 2009*. (Online) 2009. Available: http://www.emergency.health.nsw.gov.au/swineflu/news/2009/20090617_00.html (Accessed 1 September 2009).

18. Miller MA, Viboud C, Balinska M, Simonsen L. The signature features of influenza pandemics, implications for policy. (Online) 2009. *New England Journal of Medicine* 2009; **360:** 2592-2598. Available: http://content.nejm.org/cgi/content/full/360/25/2595 (Accessed 1 September 2009).

19. Eastwood K, Durrheim D, Francis JL, d'Espaignet T, Duncan S, Islam F et al. Knowledge about pandemic influenza and compliance with containment measures among Australians. *Bulletin of the World Health Organisation* 2009; 87. (Online) 2009. Available: http://www.who.int/bulletin/volumes/87/8/08-060772/en/index.html (Accessed 1 September 2009).

20. Bullock L. WHO identifies viruses resistant to Oseltamivir. *Elsevier Global Medical News* 2009. (Online) 2009. Available: http://www.thelancet.com/H1Nv1-flu/egmn/0c03a65d (Accessed 1 September 2009).

21. Australian Government Department of Health and Ageing. *Australian influenza surveillance 2009*. (Online) 2009. Available: http://www.healthemergency.gov.au/internet/healthemergency/publishing.nsf/Content/ozflucurrent.htm (Accessed 1 September 2009).

22. Curson P, McCraken K. An Australian perspective of the 1918-1919 influenza Pandemic. *NSW Public Health Bulletin* 2006; **17:** 103-107. Available: http://www.publish.csiro.au/?act=view_file&file_id=NB06025.pdf (Accessed 1 September 2009).

23. Australian Bureau of Statistics. Australia's Population. Available: http://www.abs.gov.au/AUSSTATS/abs@.nsf/Web+Pages/Population+Clock?opendocument?utm_id=LN (Accessed 1 September 2009).

24. NSW Health. *Response to human swine influenza: Protect Phase* (Online) 2009. Available: http://www.emergency.health.nsw.gov.au/swineflu/resources/pdf/protect_phase.pdf (Accessed 1 September 2009).

25. Australian Institute of Health and Welfare. *Medical labour force 2004*, National Health Labour Force Series no 38; cat. no. HWL 39. Canberra: AIHW, 2006. (Online) 2009. Available: http://www.aihw.gov.au/publications/hwl/mlf04/mlf04.pdf (Accessed 1 September 2009).

26. University of Queensland. *UQ generates first Australian swine flu vaccine*. 2009. (Online) 2009. Available: http://www.uq.edu.au/news/index.html?article=18698 (Accessed 1 September 2009).

CHAPTER 4: LEARNING FROM OUTBREAKS

Preamble

Background

Outbreaks and clusters of disease enable response plans to be tested and provide further understanding of the public health aspects of the disease. In rural and regional areas there are a number of settings that pose a higher risk for disease transmission, particularly for respiratory disease, including boarding schools. Boarding schools provide educational opportunities for many students who may have limited access to schools in rural and remote Australia. The schools house students in dormitory type accommodation; as a result there is close household level of contact with many students. Respiratory diseases can easily be transmitted in this setting.

Public health measures to control outbreaks of respiratory disease rely on the early detection of the outbreak. Notification of an outbreak by astute clinicians or through electronic alert systems can result in timely application of control measures.

Studies presented

The epidemiological investigation into a cluster of twenty-five community-acquired pneumonia (CAP) in previously well adolescents attending a boarding school in rural New South Wales, is described in the first paper in this chapter. The outbreak in 2006 provided an excellent opportunity to test the newly set up Public Health Real-time Emergency Department Surveillance System (PHREDSS). The second paper reports on the investigation into PHREDSS. It found that using the current thresholds, PHREDSS would have trigged a signal for pneumonia syndrome in children aged 5-16 years four days earlier than the notification by the clinicians involved.

Impacts

The studies led to the Hunter New England Public Health Unit now routinely providing boarding schools in the study area with regular seasonal information about communicable diseases. This information includes influenza vaccination and respiratory hygiene messages for staff and students.

Publications arising from this chapter

4.1 Surveillance and control of a respiratory outbreak in a high risk rural setting

Cashman P, Massey P, Durrheim D, Islam F, Merritt T, Eastwood K. Pneumonia cluster in a boarding school--implications for influenza control. *Communicable Diseases Intelligence* 2007; **31(3):** 296-298.

My estimated contribution was 35%.

4.2 Working with Emergency Department data to identify outbreaks earlier.

Hope K, Durrheim DN, Muscatello D, Merritt T, Zheng W, Massey P, Cashman P, Eastwood K. Identifying pneumonia outbreaks of public health importance: can emergency department data assist in earlier identification? *Australian and New Zealand Journal of Public Health* 2008; **32(4):** 361-363.

My estimated contribution was 15%.

23. National Committee on Clinical Laboratory Standards. Performance standards for antimicrobial disk susceptibility testing. Fourteenth informational supplement. NCCLS document M100-514. Wayne, Pa: National Committee on Clinical Laboratory Standards; 2004.

24. Turnidge J, Lawson P, Munro R, Benn R. A national survey of antimicrobial resistance in *Staphylococcus aureus* in Australian teaching hospitals. *Med J Aust* 1989;150:65–72.

25. Collignon P, Gosbell I, Vickery A, Nimmo G, Stylianopoulos T, Gottlieb T. Community-acquired methicillin-resistant *Staphylococcus aureus* in Australia. Australian Group on Antimicrobial Resistance. *Lancet* 1998;352:146–147.

26. Riley TV, Pearman JW, Rouse IL. Changing epidemiology of methicillin-resistant *Staphylococcus aureus* in Western Australia. *Med J Aust* 1995;163:412–414.

27. Nimmo GR, Coombs GW, Pearson JC, O'Brien FG, Christiansen KJ, Turnidge JD, et al. Methicillin-resistant *Staphylococcus aureus* in the Australian community: an evolving epidemic. *Med J Aust* 2006;184:384–388.

28. Klevens RM, Edwards JR, Tenover FC, McDonald LC, Horan T, Gaynes R. Changes in the epidemiology of methicillin-resistant *Staphylococcus aureus* in intensive care units in US hospitals, 1992–2003. *Clin Infect Dis* 2006;42:389–391.

29. Collignon PJ, Bell JM, MacInnes SJ, Gilbert GL, Toohey M. A national collaborative study of resistance to antimicrobial agents in *Haemophilus influenzae* in Australian hospitals. The Australian Group for Antimicrobial Resistance (AGAR). *J Antimicrob Chemother* 1992;30:153–163.

30. Turnidge JD, Bell JM, Collignon PJ. Rapidly emerging antimicrobial resistances in *Streptococcus pneumoniae* in Australia. Pneumococcal Study Group. *Med J Aust* 1999;170:152–155.

31. Ellis MW, Hospenthal DR, Dooley DP, Gray PJ, Murray CK. Natural history of community-acquired methicillin-resistant *Staphylococcus aureus* colonization and infection in soldiers. *Clin Infect Dis* 2004;39:971–979.

32. EARSS interactive database. RIVM, 2005. Available from: http://www.rivm.nl/earss/database/ Accessed on 9 February 2007.

33. Cosgrove SE. The relationship between antimicrobial resistance and patient outcomes: mortality, length of hospital stay, and health care costs. *Clin Infect Dis* 2006;42 Suppl 2:S82–S89.

34. Herwaldt LA. Control of methicillin-resistant *Staphylococcus aureus* in the hospital setting. *Am J Med* 1999;106(5A):11S–8S; discussion 48S–52S. Review.

35. Doebbeling BN. The epidemiology of methicillin-resistant *Staphylococcus aureus* colonisation and infection. *J Chemother* 1995;7 Suppl 3:99–103. Review.

Pneumonia cluster in a boarding school – implications for influenza control

Patrick Cashman, Peter Massey, David Durrheim, Fakhrul Islam, Tony Merritt, Keith Eastwood

Abstract

Streptococcus pneumoniae is a common cause of community acquired pneumonia (CAP). Influenza infection increases susceptibility to *S. pneumoniae* infection in adults but this link is less well described in children. We report on an outbreak of CAP affecting 25 previously well adolescents in a New South Wales boarding school. *S. pneumoniae* 1 was confirmed in two cases. During this period, the school also experienced an influenza outbreak with an influenza-like illness attack rate peaking at 27% in Year 8 students. A planned school closure may have contributed to controlling the outbreak. Boarding schools are vulnerable to outbreaks of respiratory illness and strategies for limiting this risk are required. *Commun Dis Intell* 2007;31:296–298.

Keywords: *Streptococcus pneumoniae*, influenza, boarding school, school closure

Introduction

Streptococcus pneumoniae is the most common cause of community acquired pneumonia (CAP).[1] Institutionalisation is a risk factor for pneumococcal clusters but these have generally been described in the elderly.[2] Serotype 1 has been associated with severe pneumonia in otherwise healthy children, has a propensity for invasive disease and has caused outbreaks in institutions.[3] This serotype remains highly susceptible to antibiotic therapy.[4]

Influenza infection frequently precedes pneumococcal pneumonia in adults but this relationship is less well documented in children.[3] Influenza virus may increase susceptibility to invasive pneumococcal disease through destroying the physical respiratory barrier, increasing virus adherence, decreasing mucociliary activity and disrupting immune system responses.[5]

Influenza and invasive pneumococcal disease are notifiable by pathology laboratories in New South Wales under the *NSW Public Health Act 1991*.[6]

We report on a cluster of 25 cases of CAP in previously well adolescents attending a boarding school in rural New South Wales and discuss implications for influenza surveillance and control.

Cluster report

In August 2006, Hunter New England Population Health was notified by a paediatrician at a rural referral hospital of the admission of five male students with pneumonia from a secondary boarding school. Three were boarders and two were day students. All had presented with fever, lethargy, chest pain and cough, and had a typical lobar pneumonia on chest X-ray. They responded rapidly to intravenous penicillin. A broad range of zoonotic infections were considered and excluded. *Streptococcus pneumoniae* was identified from one of the student's blood cultures. None of the students reported any recent overseas travel.

Enquiries to local general practitioners and the school sick bay identified a recent large increase in respiratory presentations amongst students from this school. Ongoing surveillance identified a further 20 students with lobar pneumonia. Thus a total of 25 of 600 students at the school were diagnosed with pneumonia, two of whom had *Streptococcus pneumoniae* serotype 1 isolated from blood cultures. Fifteen of these children required hospital admission, eight students were diagnosed clinically by general practitioners and two were treated as outpatients by the hospital emergency department. All hospitalised cases responded rapidly to intravenous penicillin with a median hospital stay of three days.

The pneumonia cases in previously healthy adolescents occurred in an environment of widespread influenza infection. The surveillance identified large numbers of students at the school who were presenting to the school sick bay with upper respiratory tract infection (URTI) and influenza-like illness (ILI). Influenza A H3N2 was isolated from respiratory specimens collected from two hospitalised students with pneumonia and from three students presenting to the sick bay at school with ILI. Two unimmunised hospital staff caring for student inpatients with pneumonia were also subsequently diagnosed with influenza.

Public health responses included implementing a 'testing and treatment algorithm' at the Emergency Department for CAP presentations and involving the local public pathology provider in ensuring prioritisation of investigations related to the outbreak with appropriate referral to reference laboratories. Increased respiratory hygiene measures were implemented throughout the school with students actively encouraged to cover coughs and sneezes with tissues and then dispose of tissues in the garbage after use. Handwashing after coughing, sneezing or nose-blowing was also promoted by the school nurses and staff. Information about the outbreak was distributed to parents in the school newsletter with advice to keep students with symptoms at home. The school nurses facilitated the separation of students with symptoms to their homes.

Structured interviews with students with pneumonia and their parents were conducted to attempt to identify specific common exposures by place, time, recreational or school activity and boarding status. No specific shared risk factor was found other than being a student at the school. Boarding status was not a risk factor as the proportion of boarding and day students with pneumonia was similar to those proportions in the whole school student population. However in the earlier part of the outbreak, more cases of pneumonia were noted amongst boarding students. Students with pneumonia were resident in both school dormitories.

School year-specific attack rates were calculated by examining presentations for URTI and ILI to the school sick bay and general practice, and presentations of pneumonia to general practice and hospitals (Figure, Table). Fifty per cent of all students at the school presented with some form of respiratory symptom. ILI presentations at the school sick bay were highest amongst Year 8 students (27%) but affected all school years.

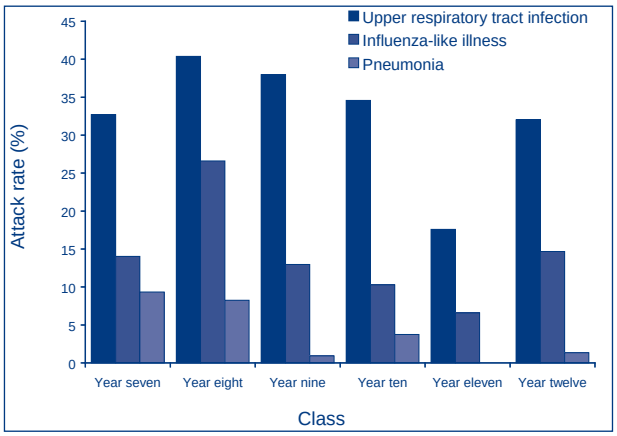
Discussion

Following the introduction of improved respiratory hygiene measures at the school and a pre-scheduled four day school closure, respiratory illness presentations to the sick bay decreased appreciably and returned to pre-outbreak levels within seven days of the school closure. This may indicate the success of social distancing in responding to respiratory outbreaks in institutions or may represent exhaustion of the influenza at-risk population.

Clusters of pneumonia in institutions amongst people of any age should alert clinicians to possible coinfection with influenza virus and *S. pneumoniae* and prompt appropriate laboratory investigations and notification to public health authorities.

Although influenza vaccination should primarily be targeted to traditionally high risk individuals, consideration should also be given to offering it in high-risk environments, including boarding schools.[7] The occurrence of influenza infection in hospital staff who cared for the children in this outbreak,

Attack rates for upper respiratory tract infection, influenza-like illness and pneumonia, August 2006, by year level for all students at the boarding school



	Year seven %	Year eight %	Year nine %	Year ten %
URTI	32.7	40.4	38.0	34.6
ILI	14.0	26.6	13.0	10.3
Pneumonia	9.3	8.3	0.9	3.7

All categories are exclusive.

adds weight to the current emphasis on protecting health staff and their patients with annual influenza immunisation.

Boarding schools, in common with other institutions where people live in close proximity, are vulnerable to outbreaks of respiratory illness. Strategies for limiting this risk are required and may include education on respiratory hygiene, guidelines for limiting overcrowding, consideration of annual influenza vaccination and guidelines for early detection and response to respiratory outbreaks.[8]

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References

1. Johnson PD, Irving LB, Turnidge JD. Community-acquired pneumonia. *Med J Aust* 2002;176:341–347.
2. Wubbel L, Muniz L, Ahmed A, Trujillo M, Carubelli C, McCoig C, et al. Etiology and treatment of community-acquired pneumonia in ambulatory children. *Pediatr Infect Dis J* 1999;18:98–104.
3. O'Brien KL, Walters MI, Sellman J, Quinlisk P, Regnery H, Schwartz B, et al. Severe pneumococcal pneumonia in previously healthy children: the role of preceding influenza infection. *Clin Infect Dis* 2000;30:784–789.
4. Hausdorff WP, Feikin DR, Klugman KP. Epidemiological differences among pneumococcal serotypes [Review]. *Lancet Infect Dis* 2005;5:83–93.
5. McCullers JA. Insights into the interaction between influenza virus and pneumococcus [Review]. *Clin Microbiol Rev* 2006;19:571–582.
6. NSW Public Health Act 1991, NSW Health. Available from: http://www.health.nsw.gov.au/policies/pd/2006/PD2006_014.html Accessed 2 March 2006.
7. National Health and Medical Research Council. *Australian Immunisation Handbook*, 8th edition. Canberra: Australian Government Publishing Service, 2003.
8. NSW Health, Controlling influenza outbreaks in aged care facilities, 2004. Available from: http://www.health.nsw.gov.au/living/flucontrol_cdfs.html

Hope K, Durrheim DN, Muscatello D, Merritt T, Zheng W, Massey P, Cashman P, Eastwood K. Identifying pneumonia outbreaks of public health importance: can emergency department data assist in earlier identification? *Australian and New Zealand Journal of Public Health* 2008; **32(4):** 361-363.

CHAPTER 5: ABORIGINAL AND TORRES STRAIT ISLANDER STATUS AND RISK OF INVASIVE BACTERIAL DISEASES

Preamble

Background

Invasive Meningococcal Disease (IMD) and Invasive Pneumococcal Disease (IPD) are serious but uncommon bacterial infections. There are little published data describing the risk of IMD among Aboriginal and Torres Strait Islander peoples. Despite the introduction of publicly funded vaccination programs in Australia, the IPD burden continues to disproportionately affect younger Aboriginal and Torres Strait Islander people. A number of the risk factors for these invasive diseases are more prevalent in Aboriginal and Torres Strait Islander people in Australia, such as poverty, overcrowding and tobacco use in the household, while higher mortality rates have been linked to limited access to health care services. Surveillance data in some jurisdictions in Australia do not routinely record or report on Aboriginal or Torres Strait Islander status of all people with these invasive diseases.

Studies presented

Aboriginal and Torres Strait islander status of IMD and IPD were collected for all notified patients from Hunter New England. IMD and IPD are notifiable diseases under the current NSW Public Health Act. Over the period of study the standard surveillance methods used did not alter across the state. The data were analysed and reported to provide, for the first time, a complete understanding of the rates of these invasive diseases in a regional area of New South Wales.

Impacts

The advocacy from these reports has resulted in increased quality of surveillance data in New South Wales and has provided useful intelligence for prioritising health issues by the Aboriginal Health Partnership in this regional area.

In the first study, the Aboriginal and Torres Strait Islander status of all cases of IMD in the study area were collected. Significantly higher rates of IMD were found in this group. These results led to the recording of Aboriginal and Torres Strait islander status in all cases of IMD across NSW and the inclusion of NSW data in national reports.

In the second study, the potential for improving the recording of Aboriginal and Torres Strait islander status in IPD through enhanced surveillance was explored. We found that using routine hospital admission data improved the recording of the status. The reasons why hospital admission data is more complete than notification data is likely due to the requirements of NSW Health policy and specific programs across the state to improve inpatient data quality. The policy and program work has not yet been applied to notification data. This study led to the first complete description of Aboriginal and Torres Strait Islander status of people with IPD for an area within the state of NSW.

Publications arising from this chapter:

5.1 Invasive Meningococcal Disease

Massey PD, Durrheim D. Aboriginal and Torres Strait Islander peoples at higher risk of invasive meningococcal disease in NSW. *New South Wales Public Health Bulletin* 2008; **19(5-6):** 100-103.

My estimated contribution was 80%.

5.2 Invasive Pneumococcal Disease

Massey PD, Todd K, Osbourn M, Taylor K, Durrheim DN. Completing Indigenous status for invasive pneumococcal disease (IPD) notifications provides a better epidemiological understanding. *Western Pacific Surveillance and Response Journal* 2011; **2**. doi: 10.5365/wpsar.2011.2.1.007

My estimated contribution was 45%.

Aboriginal and Torres Strait Islander peoples at higher risk of invasive meningococcal disease in NSW

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Abstract: *Objective*: To assess the completeness of data describing Aboriginal and Torres Strait Islander status in NSW invasive meningococcal disease notifications and determine the relative risk for invasive meningococcal disease among Aboriginal and Torres Strait Islander peoples in NSW.

Methods: Surveillance data from the NSW Notifiable Diseases Database was reviewed for 5-year periods between 1991 and 2005.

Results: Invalid and missing data on Aboriginal and Torres Strait Islander status decreased from 42% to 8% during the study period. Higher rates of disease were found in young children and significantly higher rates in Aboriginal and Torres Strait Islander children aged 0–4 years compared with their non-Aboriginal counterparts.

Conclusion: Aboriginal and Torres Strait Islander children in NSW experience higher rates of notified invasive meningococcal disease than non-Aboriginal children.

Background

Invasive Meningococcal Disease (IMD) is a serious but uncommon bacterial infection. The disease usually presents as meningitis or septicaemia, or a combination of the two presentations, with a case fatality rate of approximately 10% despite appropriate antibiotic therapy.[1] Pneumonia, arthritis and conjunctivitis may also occur. Higher rates of disease occur in children aged less than one year, children aged 1–4 years and adolescents 15–19 years of age.[1] Reported risk factors for IMD include household crowding, chronic underlying illness, active and passive smoking, some immunosuppressive illnesses and anatomical or functional asplenia.[2]

Disease rates are higher among some population groups, such as African-Americans.[3] These higher disease rates have been attributed to other risk factors such as poverty and overcrowding, while higher mortality rates have been linked to limited access to health care services.[3,4] Living conditions, such as overcrowding, can result in a higher exposure to potential carriers of *Neisseria meningitidis*.[4]

There are little published data describing the risk of IMD among Aboriginal and Torres Strait Islander peoples. A north Queensland study found a 3-fold greater risk for Aboriginal and Torres Strait Islander peoples for the period 1995 to 1999.[5] The incidence of IMD in Aboriginal and Torres Strait Islander peoples in Western Australia was six times greater than that of the non-Aboriginal population for the period 1990–1995.[6] The Australian Institute of Health and Welfare reported notification rates between 7.4 and 11.3 per 100 000 in the years 2000, 2001, 2003 and 2004 in Aboriginal and Torres Strait Islander peoples but no comparisons with non-Aboriginal Australians were provided.[7,8] To date, the Australian Institute of Health and Welfare summary of health performance indicators has not included IMD notifications from NSW as the data has not demonstrated adequate completeness for Aboriginal and Torres Strait Islander status. In 2001, the NSW Public Health Network commenced a data quality improvement project for recording Aboriginal and/or Torres Strait Islander status for selected diseases, including IMD.

The aims of the study were to assess the completeness of data describing Aboriginal and/or Torres Strait Islander status in NSW invasive meningococcal disease data contained within the NSW Notifiable Diseases Database; and to describe the relative risk for Aboriginal and Torres Strait Islander peoples being notified with IMD in NSW compared with the non-Aboriginal population.

Methods

Data on meningococcal disease is collected in NSW under the requirements of the *Public Health Act (1991)*, with all cases of meningococcal disease meeting the case definitions of the National Notifiable Diseases Surveillance System being notifiable by pathology laboratories, hospitals and doctors to public health units.[9] Case information is entered into the NSW Notifiable Diseases Database.

10.1071/NB07047

Table 1. Trends in notification of invasive meningococcal disease in Aboriginal and Torres Strait Islander people and non-Aboriginal people, and the completeness of the recording of Aboriginal and Torres Strait Islander status, NSW 1991–2005

Years	*N*	Non-Aboriginal	Aboriginal and Torres Strait Islander	Aboriginal and/or Torres Strait Islander status not recorded or invalid data	
		n	*n*	*n*	%
1991–1995	657	346	34	277	42
1996–2000	1036	720	50	266	26
2001–2005	935	806	55	74	8
Total	2628	1872	139	617	76

Source: NSW Notifiable Diseases Database.

NSW meningococcal disease notification data since the promulgation of the *Public Health Act* in 1991 were sourced from HOIST (Health Outcomes Information and Statistical Toolkit, NSW Health). Analysis was performed using Microsoft Excel 2003. Five-year study periods were defined (1991–1995, 1996–2000 and 2001–2005) with mid-term estimate population figures from the Australian Bureau of Statistics 1991, 1996 and 2001 censuses used as denominators.

The recording of Aboriginal and/or Torres Strait Islander status was assessed as complete if a valid response was recorded in the Aboriginal and/or Torres Strait Islander field in the Notifiable Diseases Database. A valid response was defined as 'yes' or 'no'.

Five-year mean notification rates were calculated for comparison purposes. The risk of being notified with meningococcal disease in the Aboriginal and Torres Strait Islander population was calculated and then compared with the risk for the non-Aboriginal population (relative risk). Age standardisation was performed using the direct method to control for the higher proportion of younger people in the Aboriginal and Torres Strait Islander population. The non-Aboriginal population in NSW was used as the standard. For ease of reference in reporting, 'Aboriginal' will be used to refer to both groups combined.

Controlling for socioeconomic status was not feasible with the notification data available. There is no routine collection of a notified individual's socioeconomic status, and the small numbers of notifications would not support an ecological analysis.

Results

During the period under study, there were 2628 notifications of invasive meningococcal disease in NSW residents. Of these notifications 139 were recorded as Aboriginal people (Table 1). In the period 1991–1995, 277/657 (42%) of notifications of IMD in NSW did not record Aboriginal status, or the data was invalid. In the most recent period, 2001–2005, 74/935 (8%) of notifications in NSW did not include valid data on Aboriginal status (Table 2).

IMD notification rates in non-Aboriginal people over the three study periods ranged from 2.11–3.17 per 100 000 population, while for Aboriginal people the rates ranged from 6.02–7.90 per 100 000 population. There was a statistically significant two- to three-fold increased risk of IMD across the three study periods for Aboriginal people in NSW (Table 2).

The highest notification rates for IMD in NSW during the period under review were seen in young children. In the period 2001–2005, non-Aboriginal children aged 0–4 years experienced an IMD rate of 12.37 per 100 000 population, while the rate was 40.99 per 100 000 population among Aboriginal children in this age group. After direct

Table 2. Notification rates and relative risk of invasive meningococcal disease for Aboriginal and Torres Strait Islander peoples compared with non-Aboriginal people in New South Wales, 1991–2005

Years	Notification rates/100 000 population		Relative risk	95% confidence intervals
	Non-Aboriginal	Aboriginal and Torres Strait Islander		
1991–1995	2.11	6.02	2.85	2.02 to 4.02
1996–2000	3.17	7.88	2.48	1.87 to 3.30
2001–2005	2.69	7.90	2.94	2.24 to 3.86

Source: NSW Notifiable Diseases Database.

Table 3. Age standardised invasive meningococcal disease notification rates for non-Aboriginal people and Aboriginal and Torres Strait Islander peoples in NSW, and the relative risk of notification in Aboriginal and Torres Strait Islander peoples, NSW, 2001–2005

Age group years	Notification rate/100 000 population		Relative risk	95% confidence intervals
	Non-Aboriginal	Aboriginal and Torres Strait Islander		
0–4	12.37	40.99	3.31	2.35 to 4.68
5–19	4.07	3.54	0.87	0.45 to 1.69
20+	1.49	2.56	1.72	0.89 to 3.33
Total	2.69	7.90	2.94	2.24 to 3.86

Source: NSW Notifiable Diseases Database.

age-standardisation for the period 2001–2005, the relative risk remained significantly higher for Aboriginal children aged 0–4 years of age (Table 3).

Discussion

The recording of Aboriginal status in NSW has improved since 1990, with invalid data decreasing from 42% to 8%. This improvement in recording of status justifies the comparison of risk among Aboriginal and non-Aboriginal people in NSW.

The risk of IMD is not homogenous across the population of NSW. Our analysis confirms that young children are at increased risk, but importantly indicates that Aboriginal status is also associated with higher rates of disease. Other countries also have demonstrated heterogenous risk among different portions of their population. In the United Kingdom, IMD incidence and mortality are socially patterned, with IMD incidence in the most deprived quintile being twice that of the most affluent quintile.[10] In New Zealand, significantly higher rates of IMD have been reported in Maori (relative risk = 2.2) and Pacific Islander people (relative risk = 3.8) when compared with the European population.[11] Aboriginal people are the most disadvantaged group in Australia.[12] Two important risk factors associated with increased risk of IMD are more common among Aboriginal people, namely having a smoker among close contacts, including maternal smoking, and sharing a bedroom.[13–15] It is not possible to explore the causal interaction of these factors from notifiable disease data. Further research into these factors could lead to the development of more informed prevention strategies.

The early recognition and diagnosis of meningococcal infection can lead to reduced risk of complications.[16] In addition to clinicians being aware of a higher risk of IMD in young children, this analysis indicates an even higher risk in young Aboriginal children.

Conclusions

The completeness of the data on Aboriginal and/or Torres Strait Islander status in notifications of invasive meningococcal disease in NSW has improved sufficiently to warrant inclusion in the Australian Institute of Health and Welfare's Performance Indicators report. This will further the understanding of meningococcal disease across Australia.

In NSW, Aboriginal children 0–4 years of age have a significantly higher risk of invasive meningococcal disease when compared with non-Aboriginal children.

References

1. Hogan D, McAnulty J. Epi*Review*: Meningococcal disease in New South Wales, 1991–2002 *N S W Public Health Bull* 2004; 15: 39–43. doi:10.1071/NB04011
2. Baltimore RS. Recent trends in meningococcal epidemiology and current vaccine recommendations. *Curr Opin Pediatr* 2006; 18: 58–63. doi:10.1097/01.mop.0000193265.78506.7f
3. Sharip A, Sorvillo F, Redelings MD, Mascola L, Wise M, Nguyen DM. Population-Based Analysis of Meningococcal Disease Mortality in the United States 1990–2002. *Pediatr Infect Dis J* 2006; 25: 191–4. doi:10.1097/01.inf.0000202065.03366.0c
4. Gardner P. Prevention of Meningococcal Disease. *N Engl J Med* 2006; 355: 1466–73. doi:10.1056/NEJMcp063561
5. Harley D, Hanna JN, Hills SL, Bates JR, Smith HV. Epidemiology of invasive meningococcal disease in north Queensland, 1995 to 1999. *Commun Dis Intell* 2002; 26: 44–50.
6. Olesch CA, Knight GJ. Invasive meningococcal infection in Western Australia. *J Paediatr Child Health* 1999; 35: 42–8. doi:10.1046/j.1440-1754.1999.t01-1-00337.x
7. Standing Committee on Aboriginal and Torres Strait Islander Health and Statistical Information Management Committee. National summary of the 2001 and 2002 jurisdictional reports against the Aboriginal and Torres Strait Islander health performance indicators. Canberra: Australian Institute of Health and Welfare; 2004. AIHW cat. No. IHW12.
8. Standing Committee on Aboriginal and Torres Strait Islander Health and Statistical Information Management Committee. National summary of the 2003 and 2004 jurisdictional reports against the Aboriginal and Torres Strait Islander health performance indicators. Canberra: Australian Institute of Health and Welfare, 2006. AIHW cat. No. IHW16. Available from: http://www.aihw.gov.au/publications/index.cfm/title/10234

9. Commonwealth of Australia. Guidelines for the early clinical and public health management of meningococcal disease in Australia. Canberra: Commonwealth Department of Health and Aged Care; 2007. Available from: http://www.health.gov.au/internet/wcms/publishing.nsf/Content/cda-pubs-other-mening-2007.htm

10. Heyderman RS, Ben-Shlomo Y, Brennan CA, Somerset M. The incidence and mortality for meningococcal disease associated with are deprivation: an ecological study of hospital episode statistics. *Arch Dis Child* 2004; 89: 1064–8. doi:10.1136/adc.2003.036004

11. Martin D, McDowell R. The epidemiology of meningococcal diseases in New Zealand in 2003. Wellington: Ministry of Health, New Zealand; 2004.

12. NSW Department of Aboriginal Affairs. Introducing Indigenous Australia. Background briefing. Sydney: NSW Department of Aboriginal Affairs; 2004. Available at www.daa.nsw.gov.au

13. Population Health Division. The health of the people of New South Wales: Report of the Chief Health Officer. Sydney: NSW Department of Health; 2008. Available at: http://www.health.nsw.gov.au/public-health/chorep/toc/choindex.htm. Accessed 28 April 2008.

14. Sorensen HT, Labouriau R, Jensen ES, Mortensen PB, Schonheyder HC. Fetal growth, maternal prenatal smoking, and risk of invasive meningococcal disease: a nationwide case-control study. *Int J Epidemiol* 2004; 33: 816–20. doi:10.1093/ije/dyh169

15. Robinson P, Taylor K, Nolan T. Risk factors for meningococcal disease in Victoria, Australia in 1997. *Epidemiol Infect* 2001; 127: 261–8.

16. Ninis N, Phillips C, Bailey L, Pollock JI, Nadel S, Britto J et al. The role of healthcare delivery in the outcome of meningococcal disease in children: case-control study of fatal and non-fatal cases. *BMJ* 2005; 330: 1475–80. doi:10.1136/bmj.330.7506.1475

Invasive pneumococcal disease in New South Wales, Australia: reporting Aboriginal and Torres Strait Islander status improves epidemiology

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The aim of this work was to determine the feasibility of improving Aboriginal and Torres Strait Islander status recording for notifiable diseases using all Invasive Pneumococcal Disease (IPD) notifications in a regional area of New South Wales, Australia.

In Australia people with IPD are nearly always admitted to hospital and their Aboriginal and Torres Strait Islander status is recorded. Aboriginal and Torres Strait Islander status was determined for IPD notifications by referring to the routine hospital admission data in a regional area of New South Wales, Australia.

There were 234 notifications in the regional area of Hunter New England during the period 2007–2009. Initially, 168 (72%) notifications had Aboriginal and Torres Strait Islander status recorded. After referring to the routine hospital admission data, the recorded status increased to 232 (99%). Updating the surveillance data required less than five minutes per notification.

Referring to routine hospital admission data proved a useful and time-efficient surveillance strategy to increase the proportion of notifications with Aboriginal and Torres Strait Islander status. These data can then be used to better understand the current epidemiology of IPD. Aboriginal and Torres Strait Islander children aged 0–4 years have a two- to threefold higher rate of invasive pneumococcal disease than non-Aboriginal children, thus high levels of timely pneumococcal immunization coverage remain important for young Aboriginal and Torres Strait Islander children.

Invasive Pneumococcal Disease, caused by *Streptococcus pneumoniae,* can result in pneumonia, meningitis, sinusitis and otitis media. Less frequently this gram-positive encapsulated coccus causes endocarditis, septic arthritis and peritonitis.[1,2] For the purpose of notification, a case of IPD is defined as: "the isolation from or the detection by nucleic acid test of *S. pneumoniae* in blood, cerebrospinal fluid or other sterile site."[3] IPD has been notifiable by laboratories in New South Wales (NSW), Australia, since December 2000 under the NSW Public Health Act 2010. Case information is entered into the NSW Notifiable Conditions Information Management System by Public Health Units. Collection of enhanced surveillance data in NSW includes Aboriginal and Torres Strait Islander status for notified cases 0–5 years of age and 50 years and older. In Australia people with IPD are nearly always admitted to hospital and their Aboriginal and Torres Strait Islander status is recorded.

Enhanced surveillance for notifications of IPD also includes risk factors and vaccination history. The enhanced surveillance commenced in NSW during 2002 following the introduction of a publicly funded 7-valent conjugate vaccine for Aboriginal and Torres Strait Islander children and a publicly funded 23-valent vaccine for Aboriginal and Torres Strait Islander adults 50 years and over in 1999. Aboriginal and Torres Strait Islander people aged 15 years and older with a chronic condition are also eligible for the publicly funded 23-valent vaccine.

The risk factors associated for IPD include prematurity (less than 37 weeks gestation), congenital or chromosomal abnormality, anatomical or functional asplenia, immunocompromised status, chronic illness, childcare attendee, previous episode of IPD, and other (for example tobacco use).[3] Several of these risk factors are more prevalent in Aboriginal and Torres Strait Islander people.[4] Data on Aboriginal and Torres Strait Islander

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status, vaccination history and risk factors are collected during enhanced surveillance of the disease.

A recent study found that, despite the introduction of a publicly funded vaccination programme in Australia, the IPD burden continues to disproportionately affect Aboriginal and Torres Strait Islander people, including young adults.[3,5] The Australian Aboriginal and Torres Strait Islander Health*Info*Net reported in 2009 that in selected states/territories the incidence of IPD among Aboriginal and Torres Strait Islander people aged 25–49 years was 11.2 times higher (50.9 per 100 000) than that among non-Aboriginal people (4.5 per 100 000).[5] The high rates of IPD notifications among Aboriginal and Torres Strait Islander people in Australia are also reflected in hospitalization rates for pneumococcal septicaemia and meningitis.[6]

Enhanced surveillance (including Aboriginal and Torres Strait Islander status) for IPD in all ages is collected and reported for notifications in Northern Territory, most of Queensland, Tasmania, South Australia, Victoria and Western Australia.[3] NSW notification data do not currently routinely include Aboriginal and Torres Strait Islander status for people aged 5–49 years of age, thus it is not known what the burden of the disease is in Aboriginal and Torres Strait Islander people in NSW in that age group.

METHOD

Aboriginal and Torres Strait Islander status was determined for IPD notifications during the period 2007–2009 in the regional area of Hunter New England (HNE) in northern NSW by referring to their routine hospital admission data. Routine hospital admission data in Australia includes demographics, presentation and discharge dates, discharge diagnosis codes and outcome data. Public health clinicians in this regional area have access to the Clinical Applications Portal database which is an electronic demographic and clinical information system within the Health Service. Notified IPD cases were checked against the admission data for the relevant admission using name, date of birth, country of birth, language spoken at home and date of admission. The Aboriginal and Torres Strait Islander status from routine hospital admission data were updated into the notifiable conditions database. The public health time and resources required to conduct this data checking were also recorded.

IPD notification data for the period 2007–2009 for the regional area were sourced from the Health Outcomes Information and Statistical Toolkit, NSW Department of Health. Analysis was performed using Microsoft Excel 2003, with notification rates calculated using mid-term estimate population figures from the Australian Bureau of Statistics 2006 Census and 2009 estimates as denominators.

The recording of Aboriginal and/or Torres Strait Islander status in the notifiable conditions database was assessed as complete if a valid response ("yes" or "no") was recorded in the Aboriginal and/or Torres Strait Islander field.

Three-year mean IPD notification rates were then determined for Aboriginal and Torres Strait Islander people and the non-Aboriginal population to allow calculation of a relative risk of IPD notification. Direct age-standardization was used to control for the relatively younger Aboriginal and Torres Strait Islander population, using the non-Aboriginal population in HNE as the standard.

This project was deemed a quality improvement exercise by the Hunter New England Human Research Ethics Committee and so did not need ethics approval. One member of the team, an Aboriginal person, was responsible for ensuring the data did not identify individual communities or people and that the interpretation of the results was consistent with community values.

RESULTS

For the period 1 January 2007 to 31 December 2009 there were a total of 234 IPD notifications in this regional area of NSW. Initially 168 (72%) notifications had Aboriginal and Torres Strait Islander status recorded in the notifiable conditions database. After referring to the routine hospital admission data, the status recorded increased to 232 (99%).

Referring to the accessible routine hospital admission data for the 66 notifications in the 5–49 years age group required two hours of work for a Surveillance Officer. Prospective data checking during 2009–2010 confirmed that it takes less than five minutes to check and update the notification when there is easy access and approvals in place for data checking.

Of the 234 notifications of IPD in residents of this regional area, 12 were recorded as Aboriginal people, and there were no patients who identified as Torres Strait Islanders in their hospital admission (**Table 1**). All of the

Table 1. **Number of IPD notifications in the regional area of New South Wales, by Aboriginal and Torres Strait Islander status, 2007–2009**

Age Group	Aboriginal and Torres Strait Islander	(%)	Non-Indigenous	Unknown	Unknown prior to data checking	Total
0–4 years	5	19%	22	0	0	27
5–49 years	3	5%	62	1	65	66
50+ years	4	2%	136	1	1	141
Total	**12**	**5%**	**220**	**2**	**66**	**234**

notifications in the 5–49 years age group had Aboriginal and Torres Strait Islander status recorded as "unknown" before the data checking was conducted.

The crude notification rate for IPD in non-Aboriginal people over the study period was 8.9 per 100 000 population, while for Aboriginal and Torres Strait Islander people the rate was 12.2 per 100 000 population, though not significantly different (**Table 2**).

After direct age-standardization, the relative risk (RR) was significantly higher for Aboriginal people aged 0–4 years of age (RR 2.68, 1.02–7.09 95%CI). The rates of disease in the age groups 5–49 years and 50 years and older were not different (**Table 2**).

Aboriginal and Torres Strait Islander children aged 0–4 years of age had a statistically significant higher relative risk of being notified with IPD. Other age groups did not have a significantly higher relative risk.

DISCUSSION

Surveillance of vaccine-preventable diseases is important to allow targeted vaccine strategies where necessary and to inform evaluations of existing vaccination programmes. Accessing Aboriginal and Torres Strait Islander status by referring to routine hospital admission data for the 66 IPD cases in the 5–49 year age group and updating the notification data required only two hours in total to complete. Time constraints at a public health unit level are a limiting factor for completeness of data, but where there is easy and approved access for data checking this should be undertaken. As a result this regional area of NSW can now report Aboriginal status for nearly all notified IPD cases from the period 2007–2009. This information will be updated annually and allows the Hunter New England Aboriginal Health Partnership to plan and evaluate services to Aboriginal communities.

The method used to collect Aboriginal and Torres Strait Islander status for admissions with IPD could also be used with other notifiable conditions that result in hospital admission such as invasive meningococcal disease. The surveillance method could be applied in other jurisdictions and settings where electronic access to hospital admission data for public health units is available and approved. Not only will this provide a more complete epidemiological profile but the surveillance can also improve the public health response and enable more culturally appropriate actions to be taken.

Table 2. **IPD notification rates in residents of the regional area of New South Wales, standardized by age group and Aboriginal and Torres Strait Islander status with relative risk of IPD in Aboriginal and Torres Strait Islander populations, 2007–2009**

Population by age group	Notifications	Population	Notification rate/ 100 000 population	RR	95% Confidence Interval
Non-indigenous					
0–4 years	22	148 344	14.83		
5–49 years	62	1 431 947	4.33		
50+ years	136	898 607	15.13		
Total	**220**	**2 478 898**	**8.87**		
Aboriginal and Torres Strait Islander					
0–4 years	5	12 559	39.81	2.68	1.02 to 7.09
5–49 years	3	74 080	4.05	0.94	0.29 to 2.98
50+ years	4	11 968	33.42	2.21	0.82 to 5.97
Total	**12**	**98 607**	**12.17**	**1.37**	**0.77 to 2.45**

The notification rate in non-Aboriginal people in the regional area, 8.9 per 100 000 population, is similar to the rate reported for all NSW residents, 8.3 per 100 000 population in 2006.[3] The reported rate using the complete data for notified IPD in Aboriginal and Torres Strait Islander populations in this regional area of NSW was 12.2 per 100 000 population, which was lower than that reported for Australia (28.0 per 100 000 population in 2006).

Although the rate of IPD in the 5–49 years age group was similar in Aboriginal and Torres Strait Islander and non-Aboriginal in the study populations, monitoring these data over time will enable a better understanding of the importance of this disease in the community.[3]

Several limitations to this study mean that the results need to be treated with caution. Relatively few notifications were received during the study period resulting in wide confidence intervals, although the increased risk in children under 5 years was statistically significant. A further limitation may be that even though it is policy of NSW Health that all people admitted to hospital are asked about their Aboriginal and Torres Strait Islander status,[7] it is possible that a small number of Aboriginal and Torres Strait Islander people with IPD may not have been identified in the routine hospital admission data. Levels of Aboriginal and Torres Strait Islander identification in NSW have improved with current identification at 88%.[8] Hospital identification levels at 88% may not be sufficiently high for the results to fully represent the population. It is also recognized that notifications of IPD can be an underestimate of the burden of disease in a population.

Controlling for socioeconomic status is not feasible with the notification data available in NSW as there is no routine collection of a notified individual's socioeconomic status. The small numbers of notifications involved also do not support an ecological analysis.

CONCLUSIONS

Referring to routine hospital admission data is a useful and time-efficient surveillance strategy to increase the proportion of IPD notifications with Aboriginal and Torres Strait Islander status. This surveillance method may also be useful in other important notifiable diseases where people are admitted to hospital.

Including Aboriginal and Torres Strait Islander status in the surveillance of IPD is important to enable the detection of changes in the epidemiology of the disease and to inform strategies for further reducing the impact of this serious illness.

Aboriginal and Torres Strait Islander children aged 0–4 years have a two- to threefold higher rate of invasive pneumococcal disease than non-Aboriginal children and thus high levels of timely pneumococcal immunization coverage remain important for young Aboriginal and Torres Strait Islander children.

Conflict of interest

None declared.

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References:

1. Musher DM. Strepococcus pneumoniae. In: Mandell GL, Bennett JE, Dolin R, editors. *Mandell, Douglas, and Bennett's Principles and Practice of Infectious Diseases, 7th edition*. Philadelphia: Churchill Livingstone Elsevier; 2009.p.2623–2642.
2. Heymann DL, editor. *Control of Communicable Diseases Manual - 19th Edition*. Washington DC, American Public Health Association, 2008.
3. Roche PW et al. Enhanced Invasive Pneumococcal Disease Surveillance Working Group; Pneumococcal Working Party of the Communicable Diseases Network Australia. Invasive pneumococcal disease in Australia, 2006. *Communicable Diseases Intelligence*, 2008, 32:18–30. pmid:18522302
4. *The Health and Welfare of Australia's Aboriginal and Torres Strait Islander Peoples 2008*. Australia, Bureau of Statistics and Institute of Health and Welfare, 2008 (http://www.aihw.gov.au/publications/index.cfm/title/10583, accessed 7 June 2011).
5. Thomson N et al. *Overview of Australian Indigenous health status, December 2009*. Australian Indigenous HealthInfoNet, 2009 (http://www.healthinfonet.ecu.edu.au/health-facts/overviews, accessed 7 June 2011).
6. Menzies R et al. Vaccine preventable diseases and vaccination coverage in Aboriginal and Torres Strait Islander people, Australia 2003 to 2006. *Communicable Diseases Intelligence*, 2008, 32 Suppl;S2–67. pmid:18711998
7. *Policy Directive PD. 2005_547 Aboriginal and Torres Strait Islander Origin - Recording of Information of Patients and Clients.* New South Wales, Department of Health: Aboriginal Health, 2005 (http://www.health.nsw.gov.au/policies/pd/2005/pdf/PD2005_547.pdf, accessed 7 June 2011).
8. *Health Services Series no. 35: Indigenous identification in hospital separations data—quality report*. Canberra, Australian Institute of Health and Welfare, 2010 (http://www.health.act.gov.au/c/health?a=sendfile&ft=p&fid=-1827097553&sid=, accessed 7 June 2011).

CHAPTER 6: TUBERCULOSIS AND COUNTRY OF BIRTH

Preamble

Background

In many low incidence tuberculosis settings, such as New South Wales (NSW), Australia, higher rates of tuberculosis are reported in the high-incidence country-of-birth migrant population groups than people born locally or in countries with low tuberculosis incidence. Newly arrived migrants to Australia are increasingly being resettled into rural areas of Australia and may bring with them different levels of risk of TB. [1]

Tuberculosis incidence rates that take into account the different origin of sub-populations in local areas enable health services to strategically target tuberculosis control measures, including ensuring ethnic and language appropriate services. [2]

Searches of PubMed and Google Scholar did not reveal any publications in low incidence and developed settings that considered country of birth adjusted local area TB rates.

Study presented

This study uses existing epidemiological data and reconstructs the rates of tuberculosis to reflect the state and local area population mix. The general rates of tuberculosis in rural areas are lower than in urban areas of NSW. However, this can be deceptive at the local level since small enclaves of people from high TB incidence countries can be missed if regional figures are used. The hypothesis was that the rates in rural areas reflect demographic characteristics, particularly country of origin characteristics, and that local populations with high TB incidence would be found. Our study confirmed this and showed that interpreting TB data by taking account of country of birth is required. TB rates are commonly reported as overseas born and Australian born. Rates of TB in the overseas born population include people not from high incidence settings, such as the United Kingdom. The novel approach allows the grouping of populations by TB incidence in their country of birth and analysing at the local level.

The results show that the TB rate in people born in a high incidence country in NSW during the study period was 61.2/100,000 population, which fits within the definition of high-

incidence according to the World Health Organization. A number of local areas were found to have higher than expected rates of TB taking into account the local demography.
It is important to note and to assure the community, that for public health reasons, it is NSW Health Policy to not disclose a person's TB status to immigration authorities. In addition patients of the service are not charged for health services related to their TB irrespective of their Medicare status. [3]

Impacts

This novel approach has not previously been applied in Australia and its potential benefit has been embraced by State TB authorities who participated in understanding the analysis and preparing the manuscript. The analysis will be used to target TB programme resources and will be repeated every two years in NSW to determine higher than expected rates in local areas.

Publications arising from this chapter:

6.1 Tuberculosis and country of birth

Massey PD, Durrheim DN, Stephens N, Christensen A. Using country of birth to better understand local TB epidemiology in a low incidence setting. *International Journal Tuberculosis and Lung Disease*, submitted.

My estimated contribution was 80%.

Reference:

1. Luck GW, Black R, Race D. Demographic Change in Rural Australia: Future Opportunities and Challenges, in Demographic Change in Australia's Rural Landscapes, Landscape series; Volume12: 375-384; Springer, Netherlands, 2010.
2. de Vries G, van Hest NA, Baars HW, Sebek MM, Richardus JH. Factors associated with the high tuberculosis case rate in an urban area. International Journal of Tuberculosis and Lung Disease. 2010; **14**:859-865.
3. NSW Health. Tuberculosis - Principles for Management of people with Tuberculosis in NSW. Policy Directive PD2008_019.

Using country of birth to better understand local TB epidemiology in a low incidence setting

Submitted manuscript

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Using country of birth to better understand local TB epidemiology in a low incidence setting

SUMMARY (200/200 words)

SETTING

Low tuberculosis (TB) incidence area. New South Wales (NSW), Australia

OBJECTIVE

To identify local areas with higher rates of TB, controlling for high-incidence country-of-birth, to enable targeted public health interventions.

DESIGN

Descriptive epidemiology using TB notification data for the three year period 2006-2008. Population and notification data were grouped into people from a high-incidence country-of-birth and the rest.

RESULTS

During the study period there were 1401 notified TB cases in the state of NSW. Of these TB cases 76.5% were born in a high-incidence country. The annualised TB rate for the high-incidence country-of-birth group was 61.2/100,000 population and for the remainder of the population was 1.8/100,000.

Of the 152 local areas in NSW, nine had higher and four had lower TB rates in the high-incidence country-of-birth population when compared with the high-incidence country-of-birth population for the rest of NSW. Of the local areas with higher TB rates, four areas had higher TB rates in both people with a high-incidence country of birth and people not born in a high-incidence country.

CONCLUSION

In many low incidence settings, such as New South Wales, Australia, higher rates of TB are reported in the high-incidence country-of-birth migrant population groups than people born locally or in countries with low TB incidence. TB incidence rates that take into account the different origin of sub-populations in local areas, enables health services to strategically target TB control measures.

Using country of birth to better understand local TB epidemiology in a low incidence setting

INTRODUCTION

In many low incidence countries such as Australia, Canada, New Zealand and the United Kingdom, higher rates of tuberculosis (TB) are reported in recent migrants to the country. [1-4] For example the increasing TB rate in the United Kingdom has been considered a result of increased notifications in migrants from countries with a high incidence of TB.[5] In these settings the incidence of TB continues to decline in people born in the low incidence country, resulting in a higher proportion of foreign-born cases.[6,7]

The TB incidence in the country of birth is the most important population level predictor of TB rates among migrants in Australia and Canada.[8,9] Among migrants born in high-incidence countries, the numbers of TB notifications is highest within the first few years of arrival to a low incidence country, and then decreases substantially in subsequent years.[1,7] In contrast, very few people migrating from lower-incidence countries to Australia and New Zealand are notified with TB within 1 year of arrival.[7,10]

Reports from an urban area in the United Kingdom suggest that services that do not take account of ethnic mix may result in delayed diagnosis and poor clinical outcomes.[11,12] Developing an understanding of the rates of TB in a local area, enables health services to target TB control measures in low incidence settings.[12,13] Measures such as active case finding and low threshold diagnostic services to facilitate earlier diagnosis have been suggested to use in the targeted areas.[13]

Epidemiological reports of TB in low incidence countries such as Australia[1,14], Canada[2] and New Zealand[3] do not routinely report TB rates for local areas or take into account the countries of birth in the local area. Age standardisation is routinely performed on TB rates but this may only partly correct for the risk in the migrant population.

The aim of this study was to identify local areas in an Australian state that have higher rates of TB than expected given the local areas' country of birth profiles, to enable further focused epidemiological studies, including if necessary molecular studies, and to determine the need for local area TB prevention and early diagnostic strategies.

STUDY POPULATION AND METHOD

The study population is the people of the state of New South Wales (NSW), Australia, for the period 2006-2008.

Population data was sourced from the Australian Bureau of Statistics (ABS) 2006 Census, by local government area. Country of birth data is only available at local government area level for Census years and there are no published estimates for intervening years. Thus the most recent Census (2006) population data was used and multiplied by three to provide the denominator population groups for the three-year study period.

Data on TB is collected in NSW under the requirements of the *Public Health Act (2010)*, with all cases of tuberculosis meeting the case definitions of the National Notifiable Diseases Surveillance System.[15] Case and population data were sourced through the Health Outcomes Information Statistical Toolkit (HOIST). HOIST is a SAS-based 'data warehouse' operated by the Centre for Epidemiology and Research of the NSW Department of Health.

Country of birth data is collected on each notified TB case. For the purposes of this analysis TB cases were defined into two groups: people born in a high TB incidence country and people not born in a high TB incidence country. The population for the state and each local area were also grouped using the same definition.

We used the World Health Organisation definition of high-incidence, being a country with TB incidence (all forms) being greater than or equal to 60 per 100,000 population per year.[16]

Using the three-year study period, 2006-2008, annualised TB rates for each high incidence country of birth population and the population not born in a high incidence country, were calculated by local area and for the state as a whole. A three-year period was used to take account of variations in the annual TB incidence data and the small number of cases in each year.

Annualised crude notifications rates were calculated for each population group at the state level. The rates were compared using a single tailed Fishers Exact Test with exact p-values.

A relative risk of having notified TB was calculated for the high incidence country of birth population and the remaining population, for the local areas. The risk was calculated by comparing the local area TB rate, for high incidence country of birth population and the remaining population, to the TB rates in the corresponding population groups for the state (excluding the local area population). Using Microsoft Excel, relative risks with 95% confidence intervals were calculated for the high incidence country of birth population and for the remaining population in each area. Local areas were classified as significantly higher than NSW if their relative risk was higher than 1.0 and with 95% confidence intervals excluding 1.0. Local areas were classified as significantly lower than NSW if their relative risk was lower than 1.0 and with 95% confidence intervals excluding 1.0.

The relationship between age-distribution and TB incidence in local areas was explored, using the Pearson's correlation co-efficient and 95% confidence intervals.

The Index of Relative Socioeconomic Disadvantage (IRSD) for local areas of the state was sourced from the ABS Socio-Economic Indexes for Areas through HOIST. The IRSD contains indicators of disadvantage such as low income, high unemployment and low levels of education.[17] A high IRSD score implies less disadvantage for a particular local area, allowing comparisons to be made.[18]

The relationship between the IRSD index and TB incidence in local areas was explored using the Pearson's correlation co-efficient.

Analysis was performed using Microsoft Excel® 2010 and SPSS® (Grad Pack 15.0 for Windows).

The study was deemed a quality improvement project by the Hunter New England Health Human Ethics Review Committee.

RESULTS

The estimated population for NSW was 6,814,971 in 2006. During the study period 2006-2008 there were 1401 notified cases of TB in NSW of which 76.5% (n=1071) were born in a high-incidence country. The annualised crude rate of all TB in NSW during the study period was 6.85 / 100,000 population. For NSW 8.6% (n=583,186) of the population reported being born in a high-incidence country. The annualised TB rate in people born in a high incidence country for all of NSW was 61.2 / 100,000 population, which was significantly higher than the 1.8 / 100,000 population annualised TB rate for the remainder of the population.

(Table 1)

There were 152 local areas in NSW during the study period. The three-year annualised rates of notified TB for the high-incidence country of birth population ranged from 0 to 294.99 per 100,000 population.

Nine metropolitan local areas had significantly higher rates of TB in the people born in a high incidence country, compared to the people born in a high incidence country for the rest of NSW (range 77.8 – 115 per 100,000 population). Four metropolitan local areas had significantly lower rates of TB in the people born in a high incidence country of birth population, compared to the same group for the rest of NSW (range 6.6 – 37.1 per 100,000 population). Eight metropolitan and one regional area had significantly higher rates of TB in people not born in a high TB incidence country, compared to the same group for the rest of NSW (range 3.1 – 8.6 per 100,000 population).

(Figure 1)

There was a strong correlation between the age distribution of TB cases in local areas with higher rates of TB in the high incidence country of birth populations, and with the age distribution of TB cases in the same population group in other local areas (r=0.89, 95%CI 0.73, 0.96). Local areas were ranked by IRSD and correlation explored. There was no correlation between the IRSD and TB rates for high incidence country of birth populations in local areas (r=0.11).

DISCUSSION

New South Wales, Australia, has a low annual incidence of TB, but there are local areas and population groups with higher rates of TB. In line with other studies[1,8,10] this study demonstrates that TB in NSW predominately occurs in people born in high incidence countries who have migrated to Australia.

There were many local areas in NSW where the crude rates of TB were found to be higher or lower than the NSW rate, but by adjusting for the country of birth within the local population, the rates of TB were better understood. The age distribution of the high incidence country of birth population was similar in the areas with higher rates compared to the other areas. TB is often associated with increasing age in developed settings. The analysis indicated that the age distribution was not a significant factor in explaining the higher rates of TB in some of the local areas.

Adjusting TB rates for country of birth, to identify local areas with higher than expected rates of TB, enables closer consideration of TB awareness and access to TB services. It is in these local areas that health services should target specific TB control measures such as early diagnosis and completion of treatment.[4,12,13] Being alert to the possibility of TB disease is an important step towards its control.[19]. Targeted work with medical services, other community based health workers and community groups that serve recent migrants from high TB incidence countries is indicated.[13] Providing accessible education for the population groups and support that addresses access, language and cultural issues is vital within this targeted work.[4]

The importance of addressing access, language and cultural issues locally has previously been highlighted through focus group discussions with a migrant group in a low incidence country.[20] Fear of being deported emerged as barrier to sharing complete health information with health workers. The routine contact tracing and follow-up of infected cases was considered a source of concern since it was feared that health care workers could share the information with immigration authorities. TB and other health services in the identified local areas need to be acutely aware of these issues as services are planned and delivered.

Health and immigration policies can impact on TB control because measures, such as contact tracing, assume new meanings for migrants.[20] Targeting TB strategies carries risks of re-stigmatising population groups especially recently arrived migrants and might create more barriers to TB control.[21] To reduce these risks, understanding of the local epidemiological data about TB needs to be based on crucial factors such as living conditions, life chances and access to affordable and appropriate health care.

Four local areas in NSW had higher than expected TB rates in people born in a high-incidence country and also those not born in a high-incidence country. This may or may not indicate that local TB transmission is occurring. Further detailed epidemiological investigation, including molecular studies, is warranted in these areas.

This study has a number of weaknesses that need to be considered when interpreting the results. Denominators used to calculate the rates are from 2006 Census data; they may not represent the actual number of people with specific country of birth in the remaining years of the study. As the numbers of people born in some countries who reside in NSW are small, a change in their number could have a large effect on country specific TB rates. Thus it was decided to group high incidence and low incidence countries into only two population groups to reduce the effect of possible changes in small numbers from specific countries or regions. While country of birth in the census (denominator) is self-reported, surveillance (numerator) data are more likely to contain health professional reported country of birth and thus sources of information differ. The estimates of rates are biased by the fact that temporary visitors are included among the cases but are not necessarily enumerated

within the base population. A further weakness is the use of the 2006 Census data to represent the whole study period 2006-2008. Some changes in the mix of the population at local areas may have occurred during the study period and these changes cannot be measured.

CONCLUSION

In many low TB incidence settings, such as the state of New South Wales Australia, higher rates of TB are reported in the high-incidence country of birth migrant population groups. Understanding TB incidence, taking into account the different mix of populations by incidence in country of origin in local areas, enables health services to strategically target TB control measures.

RECOMMENDATIONS

1. In addition to the current methods for reviewing TB epidemiology, analysis of local TB rates adjusted for country of birth should be conducted regularly in low incidence countries with a migrant population.
2. Further detailed epidemiological investigation, including molecular studies, should be conducted in the four local areas with higher than expected TB rates in both population groups.
3. Targeted local area TB prevention and early diagnosis strategies should be explored in the local areas with higher than expected TB rates.

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REFERENCES

1. Barry C, Konstantinos A; National Tuberculosis Advisory Committee. Tuberculosis notifications in Australia, 2007. Commun Dis Intell. 2009; 33(3):304-315.
2. Ellis E, Gallant V, Scholten D, Dawson K, Phypers M. Tuberculosis in Canada 2009 – Pre-release. Public Health Agency of Canada, Ottawa. 2010 http://www.phac-aspc.gc.ca/tbpc-latb/pubs/tbcan08pre/index-eng.php (Accessed 21 Feb 2011)
3. Lopez L, Sexton K, Heffernan H. Tuberculosis in New Zealand Annual Report 2009. Institute of Environmental Science and Research Limited. Auckland. 2010. http://www.surv.esr.cri.nz/surveillance/AnnualTBReports.php (Accessed 21 Feb 2011)
4. Anderson SR, Maguire H, Carless J. Tuberculosis in London: a decade and a half of no decline. Thorax 2007; 62:162–167.
5. Gilbert RL, Antoine D, French CE, Abubakar I, Watson JM, Jones JA. The impact of immigration on tuberculosis rates in the United Kingdom compared with other European countries. Int J Tuberc Lung Dis. 2009; 13(5):645-651.
6. Maher D, Raviglione M. Global epidemiology of tuberculosis. Clin Chest Med 2005 26: 167–182.
7. Das D, Baker M, Venugopal K, McAllister S. Why the tuberculosis incidence rate is not falling in New Zealand. N Z Med J. 2006; 119(1243):U2248.
8. Watkins RE, Plant AJ. Predicting tuberculosis among migrant groups. Epidemiol. Infect. 2002; 129:623–628.
9. Watkins RE, Plant AJ, Gushulak BD. Tuberculosis rates among migrants in Australia and Canada. Int J Tuberc Lung Dis. 2002; 6(7):641-644.
10. Marks GB, Bai J, Stewart GJ, Simpson SE, Sullivan EA. Effectiveness of postmigration screening in controlling tuberculosis among refugees: a historical cohort study, 1984-1998. Am J Public Health. 2001;91(11):1797-9.
11. Melzer M, Storring RA, Bagg LR. Tuberculosis in an area bordering east London: significant local variations when compared to national data. Infect. 2000; 28(2):103-105.

12. Beckhurst C, Evans S, MacFarlane AF, Packe GE. Factors influencing the distribution of tuberculosis cases in an inner London borough. Commun Dis Public Health. 2000; 3(1):28-31.
13. de Vries G, van Hest NA, Baars HW, Sebek MM, Richardus JH. Factors associated with the high tuberculosis case rate in an urban area. Int J Tuberc Lung Dis 2010; 14(7):859-865.
14. Roberts-Witteveen AR, Christensen A, McAnulty JM. EpiReview: tuberculosis in NSW, 2008. N S W Public Health Bull. 2010; 21(7-8):174-182.
15. Department of Health and Ageing. National Notifiable Diseases Surveillance (NNDSS) http://www.health.gov.au/internet/main/publishing.nsf/Content/cda-surveil-nndss-nndssintro.htm (Accessed 21 Feb 2011)
16. World Health Organisation. Tuberculosis Control in the Western Pacific Region, 2009. http://apps.who.int/globalatlas/dataQuery/default.asp Accessed 21 Feb 2011.
17. Population Health Division. The health of the people of New South Wales - Report of the Chief Health Officer. Sydney: NSW Department of Health. Available at: www.health.nsw.gov.au/publichealth/chorep/ Accessed (21 Feb 2011).
18. Adhikari P. Socio-economic indexes for areas: Introduction, use and Future directions. ABS Catalogue no. 1351.0.55.015. Canberra: ABS, 2006.
19. Carr H. Tuberculosis control in people from countries with a high incidence of tuberculosis. In: Harrison A, Calder L, eds. Guidelines for tuberculosis control in New Zealand 2003. Wellington, New Zealand: Ministry of Health, 2002. http://www.moh.govt.nz/moh.nsf/.
20. Kulane A, Ahlberg BM, Berggren I. "It is more than the issue of taking tablets": the interplay between migration policies and TB control in Sweden. Health Policy. 2010; 97(1):26-31.
21. Littleton J, Park J, Thornley C, Anderson A, Lawrence J. Migrants and tuberculosis: analysing epidemiological data with ethnography. Aust N Z J Public Health. 2008; 32(2):142-149.

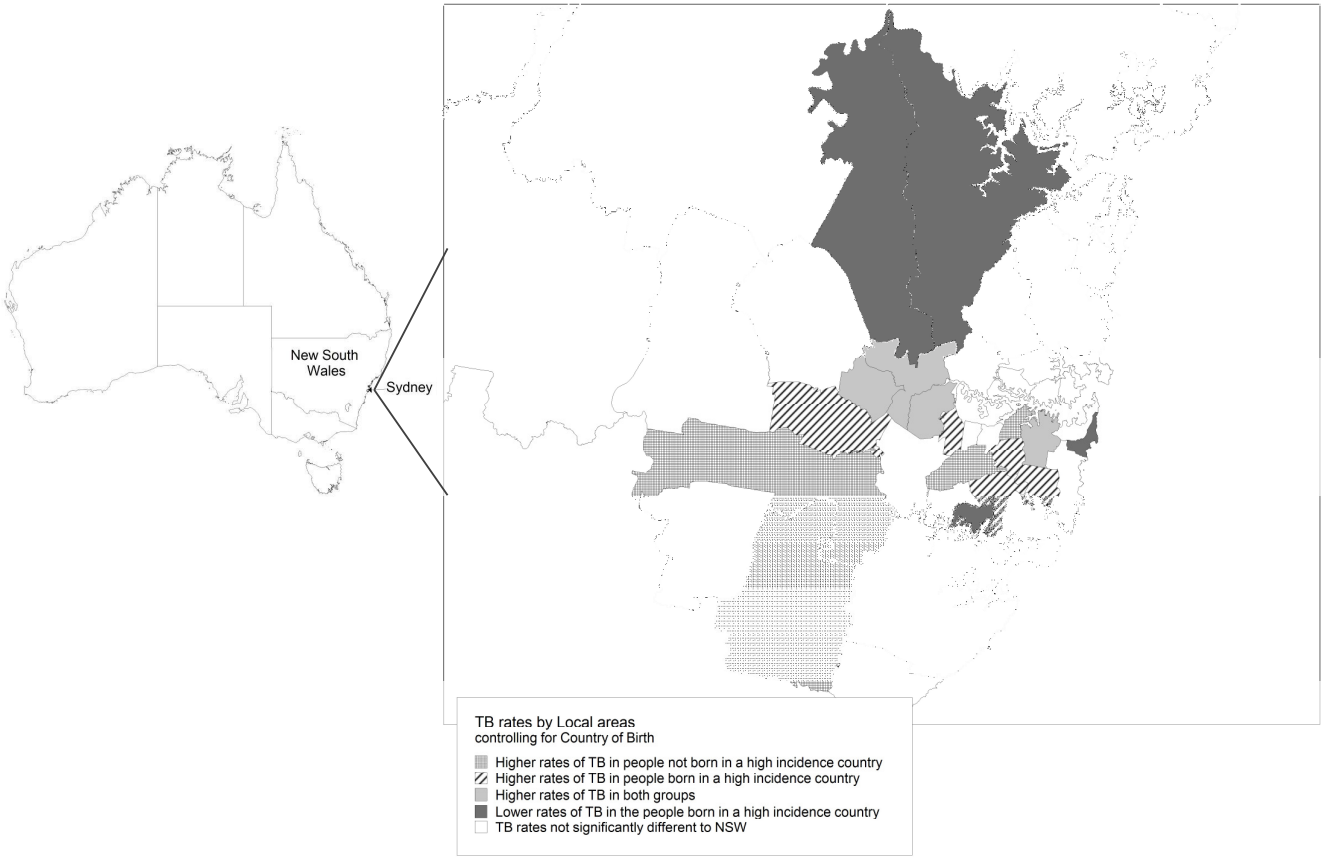
Table1: Annualised crude rates of TB for NSW, by high incidence country of birth, 2006-2008

	Notified TB cases 2006-2008	Total Population, 2006-2008*	Annualised crude notification rate of TB	p-value
NSW residents born in a high incidence country	1071	1749558	61.2	<0.0001
All other NSW residents	330	18695355	1.8	
Total (3 yrs)	1401	20,444,913	6.85**	

*Total population summed for the three study years

**Crude rate using 2006 population data for each of the three-year period

Figure 1: Map of local areas in metropolitan Sydney, NSW, with significantly higher or lower rates of Tuberculosis in the high incidence country of birth population group, 2006-2008.



CHAPTER 7: BRUCELLOSIS – AN EMERGING THREAT IN A REGIONAL AREA

Preamble

Background

Human infection with *Brucella suis* (swine brucellosis) usually follows occupational or recreational exposure to infected animals. Worldwide many cases of human infection follow contact with infected feral pigs. In Australia *B. suis* has only previously been described in Queensland. There is a growing market for the export of "wild boar" and a considerable number of Australians are involved in feral pig hunting. There are 1155 licensed game meat harvesting field facilities in NSW and an unknown number of unlicensed feral pig hunters. Between December 2006 and December 2009, five men from New South Wales (NSW), Australia, were diagnosed with brucellosis following regular recreational or occupational feral pig hunting in north-west NSW near the border with Queensland. In recent years, there has been a growing Australian market for exporting "wild boar" meat to Europe. Accredited hunters kill feral pigs with rifle or knife, gut and dress them and then transport the fresh carcasses to "Chillers".

Presented studies

This first paper in this chapter reports on the findings from the human and animal health epidemiological investigations that followed the notification of five human brucellosis cases in north-western NSW. The second paper reports on the results of an investigation into the brucellosis prevention strategies that would be acceptable to the people at greatest risk. Semi-structured interviews explored hunters' experiences and views on how to prevent brucellosis (Appendix 2 – Interview questions).

Impacts

The strategies for the prevention of brucellosis that emerged from this study are to be trialled in conjunction with a public health unit in Queensland where brucellosis is more common.

The results of the studies have been used to raise awareness amongst clinicians of the existence of *Brucella suis* in New South Wales. General Practitioner clinical updates in

north-west New South Wales have included information on the diagnosis and management of brucellosis in humans.

Based on the findings a communication strategy is being planned to share the prevention strategies with feral pig hunters.

Publications arising from this chapter:

7.1 Feral pig hunting a risk factor for Brucellosis

Massey PD, Walker B, Durrheim D. Feral pig hunting: a risk factor for human brucellosis in north-west NSW? Irwin M, *New South Wales Public Health Bulletin* 2010; **20(12):** 192–194.

My estimated contribution was 45%.

7.2 Preventing brucellosis

Massey PD, Polkinghorne BG, Durrheim DN, Lower T, Speare R. Blood, guts and knife cuts: reducing the risk of swine brucellosis in feral pig hunters in north-west New South Wales, Australia. *Rural and Remote Health*, submitted and revised manuscript.

My estimated contribution was 50%.

Feral pig hunting: a risk factor for human brucellosis in north-west NSW?

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Abstract: A multi-agency investigation followed the notification of four locally acquired human brucellosis cases in north-west NSW. Feral pig hunting within a geographically discrete region was identified as the likely exposure with *Brucella suis* the suspected cause. To test whether feral pigs in the region were infected with *Brucella*, serological testing was performed on trapped feral pigs and testicular abscesses from condemned carcasses bound for export were cultured. Although no *Brucella* species were identified in the feral pigs tested in NSW, *Leptospira* species were. Strengthening of human surveillance and ongoing collaboration between animal and human health agencies is required to confirm that *Brucella suis* causes brucellosis in humans and feral pigs in north-west NSW.

Feral pigs are known reservoirs for brucellosis in Queensland and overseas.[1–3] In 1990, Hone estimated that there could be 13.5 million feral pigs (with 95% confidence intervals of 3.5–23.5 million) inhabiting about 38% of Australia.[4] There is increasing human contact with feral pigs in Australia, as meat from hunted feral pigs is exported to Europe for human consumption.[5]

Of the species of *Brucella* bacteria that commonly cause human disease only *B. suis* is locally acquired in Australia, with feral pigs being the confirmed reservoir in Queensland but not NSW. *B. melitensis* does not occur in Australia and the country was declared free from *B. abortus* in 1989 following the National Brucellosis and Tuberculosis Eradication Campaign.[6]

Although rare in Australia, brucellosis is the most common zoonosis worldwide and is an illness that can be acquired through travel.[7,8] Unfortunately, serological tests by which most human diagnoses are made cannot distinguish between *Brucella* species and therefore it is difficult to determine the relative contribution of locally acquired *B. suis* and overseas acquired species.

This article reports the findings of the human and animal health investigation that followed the notification of four human brucellosis cases and which aimed to identify *B. suis* in feral pigs in rural north-west NSW.

Public health investigation and findings

Between December 2006 and September 2009, four men who met the clinical and laboratory case definition for brucellosis were notified to Hunter New England Population Health. All described regular recreational or occupational feral pig hunting prior to the onset of their symptoms. They reported hunting close to Moree, which is located approximately 120 km from the Queensland border, with one also hunting around the Queensland border. All described butchering carcasses without using personal protective equipment. None of their hunting companions reported similar illness and none reported overseas travel or consumption of unpasteurised dairy products from countries in which *Brucella* is endemic in the 3 months prior to the onset of their illness.

All cases were diagnosed by serology which was conducted using the standard agglutination test (SAT). Only one case had blood cultured, more than 5 months after the onset of his illness, and *Brucella* was not detected. Therefore, the *Brucella* species causing the case's illness was not confirmed. All cases were symptomatic at presentation and their symptoms included fever, sweats, abdominal pain, vomiting and loin and back pain. They were treated with doxycycline and rifampicin for the recommended period and recovered. Table 1 summarises the demographic, clinical, laboratory and hunting location details of the four cases.

Animal health investigation and findings

Blood sampling of trapped feral pigs in the region where human cases had occurred was arranged through the

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Table 1. Characteristics of four men from NSW diagnosed with brucellosis between 2006 and 2009

Case no.	Age (years)	Year of diagnosis	SAT titre on diagnosis[A]	Blood culture	Time from symptom onset to diagnosis (weeks)	Hunting area
1	64	2009	1280	Not performed	7	Moree area
2	29	2008	320	Not performed	3	Moree to Queensland border
3	41	2008	320	*Brucella* not detected	26	Moree area
4	31	2006	1280	Not performed	5	Moree area

[A]A four-fold rise in titre in paired sera indicates brucellosis, whereas a single titre equal to or greater than 160 suggests active infection or repeated exposure to *Brucella* species.

NSW Department of Industry and Investment (I & I NSW) with the cooperation of the North West Livestock Health and Pest Authority. Samples from over 200 pigs on 31 separate trapping occasions from different locations were submitted for serology. None of these samples were positive for *Brucella* serology, whereas 20 were positive for *Leptospira*, 17 for *Leptospira interrogans* serovar pomona and three for *Leptospira borgpetersenii* serovar tarassovi; both these serovars are pathogenic to humans.

In a separate investigation, Australian Quarantine Inspection Service (AQIS) officers arranged for the culture of testicular abscesses that had resulted in feral pig carcasses bound for export being condemned. Testicular abscesses in the absence of injury are a good indicator of brucellosis in feral pigs. While several testicular samples sourced from feral pigs from southern Queensland identified *B. suis*, those sourced from northern NSW did not. However, it is not unusual for old abscesses caused by brucellosis to have no viable bacteria.

Discussion

Human brucellosis and leptospirosis are notifiable by pathology laboratories under the NSW *Public Health Act 1991*. Human brucellosis surveillance needs to differentiate local from overseas acquired cases, as local acquisition has implications for Australia's animal health.[9] If locally acquired *B. abortus* or *B. melitensis* were detected, this would affect Australia's brucellosis-free status. If locally acquired *B. suis* is identified, I & I NSW should be notified so that the source, presumably feral pigs, can be investigated and targeted for eradication, reducing the risk to humans.

Animal surveillance for *B. abortus* is ongoing and is reported in Animal Health Australia's National Animal Health Information System. Despite extensive testing, *B. abortus* has not been detected in recent years.[10]

While *B. suis* was not identified in the four men or the feral pigs tested in NSW, pigs are able to cross the border from Queensland where the disease is known to occur and could have been the source of infection. The presence of potentially zoonotic *Leptospira* infection in feral pigs from north-west NSW was confirmed by this investigation. Therefore, this collaboration between human and animal health agencies allowed for an improved understanding of the epizoology of local feral pigs and the potential risk to humans, and identified a novel surveillance mechanism (sampling condemned export carcasses) for monitoring the health of feral pigs in a defined catchment area.

Conclusion

Although human brucellosis and leptospirosis are rare, feral pig hunting is likely to be a risk factor for locally acquired disease in north-west NSW. We propose that the surveillance of human brucellosis be strengthened by: investigating and reporting for cases, the likely place of disease acquisition (Australian state/s or overseas) and participation in feral pig hunting activities (for locally acquired cases); and by encouraging speciation of *Brucella* through blood culture. In addition, an ongoing collaboration with animal health colleagues is required to confirm *B. suis* infection in NSW feral pigs and subsequent transmission to feral pig hunters.

Acknowledgments

This work was conducted during a rural placement of the NSW Public Health Officer Training Program. The authors would like to thank Bill Hetherington and the veterinarians and rangers of the North West Livestock Health and Pest Authority for conducting the trapping and sampling of feral pigs; David Cox from the Australian Quarantine Inspection Service for arranging culture of testicular abscesses from feral pig carcasses; the Elizabeth Macarthur Agricultural Institute for performing the animal pathology testing; and David Dickeson from the Centre for Infectious Diseases and Microbiological Laboratory Services, ICPMR, for his advice on the serology of brucellosis and leptospirosis.

References

1. Robson JM, Harrison MW, Wood RN, Tilse MH, McKay AB, Brodribb TR. Brucellosis: re-emergence and changing epidemiology in Queensland. *Med J Aust* 1993; 159(3): 153–8.

2. Centers for Disease Control and Prevention (CDC). Brucella suis infection associated with feral swine hunting – three states, 2007–2008. *MMWR Morb Mortal Wkly Rep* 2009; 58(22): 618–21.

3. Vicente J, Leon-Vizcaino L, Gortazar C, Jose Cubero M, Gonzalez M, Martin-Atance P. Antibodies to selected viral and bacterial pathogens in European wild boars from southcentral Spain. *J Wildl Dis* 2002; 38(3): 649–52.

4. Hone (1990a) cited in Choquenot D, Mcllroy J and Korn T. Managing Vertebrate Pests: Feral Pigs. Canberra: Australian Government Publishing Service; 1996.

5. Tinsdell (1982) cited in Choquenot D, McIllroy J and Korn T. Managing Vertebrate Pests: Feral Pigs. Canberra: Australian Government Publishing Service; 1996.

6. Gilbert GL. Brucellosis: continuing risk. *Med J Aust* 1993; 159(3): 147–8.

7. Pappas G, Papadimitriou P, Akritidis N, Christou L, Tsianos EV. The new global map of human brucellosis. *Lancet Infect Dis* 2006; 6(2): 91–9. doi:10.1016/S1473-3099(06)70382-6

8. Memish Z, Balkhy H. Brucellosis and international travel. *J Travel Med* 2004; 11(1): 49–55.

9. NSW Health. Brucellosis: Response Protocol for NSW Public Health Units. Notifiable Diseases Manual. North Sydney: NSW Health; September 2004. Available from: http://www.health.nsw.gov.au/factsheets/guideline/brucellosis.html (Cited 7 September 2009.)

10. Animal Health Australia. National Animal Health Information System. Brucellosis testing: Results of tests for bovine brucellosis in cattle (by Australian state or territory). Available from: http://www.animalhealthaustralia.com.au/nahis/public.php?page=out_showtable&outputid=29 (Cited 10 September 2009.)

Journal of Rural and Remote Health **Revised manuscript**
Project Report

Title: Blood, guts and knife cuts: Reducing the risk of swine brucellosis in feral pig hunters in north-west New South Wales, Australia

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Abstract (500 words) 457/500

Introduction

Humans who have close contact with livestock, wild or feral animals can risk acquiring zoonotic infections such as brucellosis, Q fever, and leptospirosis. Human infection with *Brucella. suis* (swine brucellosis) usually follows occupational or recreational exposure to infected animals. Worldwide many cases of human infection follow contact with infected feral pigs. In Australia there is a growing market for the export of “wild boar” and a considerable number of people are involved in feral pig hunting. However, feral pig hunters are often hard to reach with health strategies.

According to Australian authorities the most important means of preventing disease in humans includes covering cuts; wearing gloves; washing hands; and avoiding blood when coming into contact with feral pigs. There has not been an evaluation of the acceptability of these recommended risk reduction strategies in the settings where feral pig hunting and evisceration occurs.

Methods

Semi-structured interviews and small focus groups were conducted with feral pig hunters in north-west New South Wales to explore their hunting experiences and views on the brucellosis prevention strategies. Interview and focus group notes were thematically analysed.

Results

There was a range of experiences of feral pig hunting, from a very professional approach to a purely recreational approach.

The main domains that emerged from participants’ experiences during their most recent feral pig hunting activity and their reflections on current swine brucellosis risk reduction strategies were:

- You've gotta be tough to be a feral pig hunter;
- Most of the suggested strategies won’t work as they are;
- Reducing risk in the scrub;

- How to let pig hunters know.

The recreational nature and prevailing macho perspective of participants demand a pragmatic approach to risk reduction if it is going to prove acceptable to feral pig hunters. The ‘You’ve gotta be tough to be a feral pig hunter’ context of the activity and the reality that many feral pig hunters participate with little preparation and a “just keep going” approach, may counteract currently recommended risk reduction strategies.

The alternate strategies that emerged from the interviews need to be tested in the real activity, especially evisceration in the scrub. But the following ideas were grounded in the participants’ experiences:

- Take more time and watch your hands when making cuts
- Have good lighting
- Take care when cutting near a sow’s uterus
- Use latex gloves to cover cuts on hands

Conclusions

Swine brucellosis is a zoonosis of concern for feral pig hunters in many parts of Australia including north-west NSW. Many of the current strategies to reduce the risk of brucellosis did not appear appropriate or acceptable to feral pig hunters interviewed. More acceptable strategies when eviscerating such as taking more time, watching hands when cutting, ensuring good lighting, being careful in the vicinity of the uterus and using a latex glove to cover cuts and abrasions on hands need to be field tested. Further development of the food safety regulations is required to also support zoonosis risk reduction strategies.

Key Words

Brucellosis; Hunting; Zoonoses

Introduction

Humans who have close contact with livestock, wild or feral animals can risk acquiring zoonotic infections such as brucellosis, Q fever, and leptospirosis. Brucellosis is a zoonotic infection caused by small, Gram negative aerobic coccobacilli from the *Brucella* genus [1]. Four *Brucella* species are associated with moderate to significant human pathogenicity, specifically *B. melitensis* which is found primarily in goats, *B. suis* in pigs, *B. abortus* in cattle and *B. canis* in dogs. Humans have also very infrequently been infected with *Brucella* species from marine mammals [2]. Globally *B. melitensis* more frequently affects humans than the other species and is the most virulent, pathogenic and invasive species, followed by *B. suis*, *B. abortus* and *B. canis* [1]. *B. abortus* has been eradicated from Australia and *B. melitensis* and *B. canis* are not found in Australia [3].

Brucellosis symptoms in humans are nonspecific, including undulating fever, sweats, malaise, anorexia, headache and back pain. The onset can be insidious or acute, generally beginning 2-4 weeks, but up to 6 months, after exposure [4]. Depression and chronic infection can occur [5] with delays in diagnosis increasing the risk of complications [6].

Human infection with *B. suis* (swine brucellosis) follows occupational or recreational exposure to infected animals, inhalation of infectious aerosols, laboratory exposure, or consumption of inadequately cooked contaminated meat [5]. Worldwide many cases of human infection follow contact with infected feral pigs or “wild boars” [7].

Approximately 20–30% of feral pigs are *Brucella*-positive by serology in Italy, the USA and Croatia [7]. *B. suis* infection in feral pigs is characterised by infertility and abortion in sows, deaths of piglets and orchitis in boars. Genital secretions are the most important source of infection. Infected feral pigs rarely show macroscopic post-mortem lesions and thus may be overlooked during evisceration and meat inspection [8].

Brucellosis in Australia is mainly an occupational disease of farm workers, veterinarians, hunters and abattoir workers with exposure to infected animals or their tissues [3]. The national incidence is 0.2/100,000 population with 80% of cases occurring in Queensland. The majority of cases are male and aged between 15 and 49 years [3].

In recent years, there has been a growing Australian market for exporting "wild boar" meat to Europe. Accredited hunters kill feral pigs with rifle or knife, gut and dress them and then transport the fresh carcasses to "Chillers". Pig dogs play an integral role in feral pig hunting in Australia. Dogs have been reported to be infected with *B. suis* internationally [9], but their contribution to *B. suis* transmission in feral pigs and humans in Australia is currently unknown.

A recent retrospective review conducted in Queensland, Australia, of 32 patients with swine brucellosis contracted between 1996 and 2009 found that feral pig hunting explained 30 of the cases (94%), none of which used protective equipment during hunting [6].

Between December 2006 and December 2009, five men from New South Wales (NSW), Australia, were diagnosed with brucellosis following regular recreational or occupational feral pig hunting in north-west NSW near the border with Queensland [10, 11]. All cases had butchered feral pig carcasses without using personal protective equipment. None reported any other risk factors for contraction of brucellosis [10]. Blood samples from 200 trapped feral pigs in the region where the human cases occurred were negative for *Brucella* serology, but 20 were positive for *Leptospira spp*. [10]

It is reported that the most important means of preventing disease in humans is to take precautions when coming into contact with animals including [12] [13]. Box 1

There has not been an evaluation of the acceptability of the recommended risk reduction strategies in the settings where feral pig hunting and dressing

occurs. Feral pig hunters are likely hard to reach with health promotion strategies.

The NSW food regulatory authority provides detailed information about the techniques to be used to harvest “wild boar” meat to make it safe for human consumption [14].

Aims

This project aimed to:

- explore the appropriateness of current swine brucellosis risk reduction strategies for feral pig hunters;
- identify strategies that are acceptable and appropriate for feral pig hunters; and
- investigate the most appropriate methods of disseminating health related information to reach professional and recreational feral pig hunters.

Methods

This work was conducted applying a grounded theory approach, developing an explanatory theory of basic social processes within the environments in which they occur. [15]. Grounded theory can give voices to those who are otherwise rarely heard, such as the participants in this research. [16] Theoretical sampling was used for recruiting participants so that different experiences and dimensions were explored. Sampling started with health service and community contacts then, using a snowballing method [18], each participant was asked to recommend the study to people they knew who hunted feral pigs.

Semi-structured interviews and small focus groups were conducted with participants to explore their experiences with hunting and their views on the brucellosis prevention strategies. Interview questions asked about their most recent feral pig hunting activity. The participants were specifically asked how the recommended risk reduction strategies could have been applied during that most recent hunt. Respondents were also asked about appropriate

dissemination methods for health messages to feral pig hunters. Each in depth interview and focus group was conducted by two researchers (PM, BP). Extensive interview notes taken by both researchers were then combined into a single collated data set.

Interview and focus group notes were thematically analysed. Emerging themes from the early interviews were explored in subsequent interviews. [15] Researchers (PM, BP) separately coded the data. An open coding system was used, where codes were noted freely across all notes. The coding system was refined iteratively as the notes were re-analysed. Coding was then compared between researchers, deconstructed and reconstructed. Once the coding system was finalised, all notes were re-coded. Relationships between codes/categories were then assessed across the notes. This was done by selecting codes or topics that were emerging as significant for the research and looking for coded text that could explain or contribute to the phenomenon. [19] Illustrative quotes were then drawn from the notes. Recruitment and interviews continued until data saturation occurred.

Study rigour was guaranteed by having two researchers independently conduct the data analysis and then discuss emergent themes with the remaining authors, enhancing the ‘‘reflexivity’’ of the analysis and confirming coding scheme. All research activities were thoroughly documented to permit a critical appraisal of methods. The role of prior assumptions and experience was acknowledged and, when possible, eliminated. [20][21]

Ethical approval to conduct this research was provided by the Hunter New England Human Research Ethics Committee (10/11/17/5.02).

Results

Over the study period, December 2010 – March 2011, five feral pig hunters participated in semi-structured interviews. Additionally, two focus groups of two and three hunters were conducted. Participants were all males from north-

west NSW aged between 22 and 41 years. Four were from large towns and with no known social links. The remaining participants were from farming areas and a small village. The two focus groups consisted of people who hunted together. Most participants had occupations other than hunting, such as farm work, driving, service industry or public service.
There was a range of hunting experiences from a very professional hunting approach to purely recreational approach that included some poaching, which in this context involves hunting while trespassing on private property. Most participants hunted pigs for sport and recreation. Five of the participants described that in addition to the enjoyment provided, selling carcasses provided enough income to cover their alcohol purchases.

The main domains that emerged from participants' experiences during their most recent feral pig hunting activity and reflecting on current swine brucellosis risk reduction strategies were:

- You've gotta be tough to be a feral pig hunter
- Most of the suggested strategies won't work
- Reducing risk in the scrub
- How to let pig hunters know

You've gotta be tough to be a feral pig hunter

Participants spoke about feral pig hunting as a tough activity but also as good fun. "I go with a group of mates, we are more about the fun and sport," was a common sentiment amongst participants.

Participants explained that most hunting involves chasing pigs through the scrub with dogs and knives. The dogs catch and hold the pig until the hunter slaughters the pig with a knife thrust to the heart or lungs. The pig is then dragged back to the truck where it is lifted up onto a hook and eviscerated. Being a tough person who can drag and lift pig carcasses; and is willing to get injured and covered in blood during the chase and the gutting, emerged as expected hunter traits.

You get covered in blood, particularly if you go through the shoulder, blood bubbles and sprays out of the lungs and you get sprayed up the arms, even on the lips and face.

You get covered in it...and ya stink.

You always get cuts. Barbwire or sticks, I've had a few nicks from the knife.

This toughness is also expressed through the actions taken following an injury. Four of the participants spoke about ignoring injuries while continuing their hunting activity.

I've got a little scar on my finger from a pig's tusk, it just turned and split me a bit – not much of a drama. At the time we were 25 kms from town at 2.30 in the morning. I just checked it, it wasn't too deep and rinsed it off and kept going.

Get plenty of nicks. Give it a wipe or do some swearing. If it's bad, you give it a wash. Most people just keep going which probably doesn't help.

Participants also spoke about the peer-pressure to exhibit toughness. One participant spoke about the perceived reaction of his mates to him wearing gloves and said "I think a lot of people don't wear gloves, they think 'Ah ya pussy'."

Most of the suggested strategies won't work

Participants reported that covering cuts does not work as the dressings do not hold in the wet and rough conditions. Wearing gloves was not a common practice amongst the participants. Reasons for not wearing gloves included peer pressure and "you can feel a lot better without them."

Washing hands was acceptable but the focus was getting rid of the smell of the pigs, rather than perceived health and safety benefits. As one participant said “if you are in the scrub and just killed a pig you do it as soon as you can, if there’s a dam about you rinse off.” Some hunters wash their hands frequently but still struggle to wash as often as advised by the food regulatory authority. Others commented that if one was busy, cleanliness may be neglected, “you might get 20 (pigs) in a mob. Sometimes you’ll go a few hours without washing your hands!” Using a disinfectant was uncommon.

One of the Queensland Health and World Health Organization brucellosis prevention strategies is avoiding exposure to blood. Implementing this strategy was considered impossible by participants. Participants said “Definitely hard!” and “you can’t, they’re not going to lift themselves” referring to the direct handling of carcasses required.

Washing down work areas was considered by many respondents to be “a good idea but not something the boys would do.”

Burning or burying remains was not considered practicable. As one participant said, “can’t see guys doing this, you should see some of the ground I hunt in, it’d take an hour to dig a hole.” The remains are left on the ground. Another participant said “Nah, never do it. The crows and foxes would starve!”

Reducing risk in the scrub

Participants were aware that there was a risk of infection from diseased animals but thought this could be judged by the animal’s condition. “Unless they’re fat and healthy, don’t take ‘em.” Personal risk assessment appeared related to knowledge of a hunter with infection, “Until it (an illness) happens to them or someone they know, they just turn a blind eye to it”.

Strategies to reduce risk in the scrub emerged from the interviews. Taking more time and watching hands when making cuts was the clearest theme that

emerged from the interviews, “just a matter of slowing down and taking care”, “can’t rush in and go slit, slit, slit” and “I’ve seen heaps of fellas get cut ‘cause they’re in too much of a hurry.” Particularly hunters need to “always look for your f***** hands, you don’t wanna cut them."

Ensuring good lighting into the carcass, such as headlamps or adjustable extension arms for the spotlights on the back of the truck were recommended. A participant explained “a few wear headlamps, a few are old fashioned and still muck around with torches.”

Taking care in the vicinity of a sow’s uterus when gutting a pig was also considered a worthwhile strategy for reducing risk. One participant described how he is “careful to keep the womb intact and take it 10 metres away from the Ute. I don’t give it to the dogs.” Another said that “If you’re not careful you can split it (the uterus).”

Using surgical type gloves to cover cuts was suggested by some participants as they considered these gloves more effective than recommended dressings. One man said “If I get a bad cut, I glove it with a latex glove and tape it and then just try not to use that hand.”

How to let pig hunters know

Several different methods of information delivery were suggested by respondents. Trade magazines, websites and information at the Chiller were methods recommended by all participants for communicating with hunters. In relation to pig hunting magazines, one participant said “nearly all of the boys I know read that stuff. If not buying it you’d at least flick through it at the newsagent.” Websites and hunting blog sites were also popular. As one person said “I know heaps of people who read that (website)”

Regarding messaging at the Chiller, the advice was to have “just a short message, you don’t want a lot of text.” In addition, it was advised not to lecture hunters “A lot of these pig hunters they’re pretty non-helpful blokes; if you try

to tell them something they won't listen, but if you make it like you're providing information they will."

Many participants described animosity towards the food regulatory authority. As one participant said, "Everyone's that dirty with Safe Foods we'd take one look (at safety info) and throw it over the shoulder. People are over 'em."

Limitations

This study was conducted in the north-west area of the state of NSW and with a relatively small number of participants. Data saturation occurred during the interview process, the issues identified by the semi-structured interview were also found in the focus groups, and the participants were from three different locations. But this study may not be representative of Australian feral pig hunters.

Discussion

The infectious disease and injury risk of feral pig hunting in Australia and internationally are well established. Swine brucellosis in humans in the USA is predominantly associated with exposure to infected feral pigs [4]. Two cases were reported in 2004, in hunting partners from a hunt club who had killed and dressed feral pigs in South Carolina [22]. Also three cases of swine brucellosis were detected in feral pig hunters after hunting and butchering pigs in Florida. No personal protective equipment was worn during these procedures, and no other risk factors for brucellosis were identified [4]. Also in Florida between 1963 and 1975, eight hunters contracted swine brucellosis attributed to contacts with feral pigs. [23].

The environment and nature of feral pig hunting: rough terrain, frequently nocturnal, weapon use, close proximity to wild animals and butchering process, challenge traditional risk reduction strategies. The recreational nature and prevailing macho nature of participants demand a pragmatic approach to risk reduction if it is going to prove acceptable to feral pig hunters. The "You've gotta be tough to be a feral pig hunter" context of the activity and the reality that many feral pig hunters participate with little preparation and a

"just keep going" approach, may counteract currently recommended risk reduction strategies. These findings reflect those of previous research into the culture of farm safety in Australia [24].

The alternate strategies that emerged from the interviews need to be tested in the real world, especially evisceration in the scrub. But the following ideas were grounded in the participants' experiences:

- Take more time and watch your hands when making cuts
- Have good lighting
- Take care when cutting near a sow's uterus
- Use latex gloves to cover cuts on hands

Taking more care during butchering may well be challenging. Not only is there self-driven need for speed when faced with a "big mob" of pigs, but current food authority regulations place time constraints on the gutting and delivery to the 'Chiller' to ensure that pig meat remains fresh. These regulations may be inadvertently increasing hunters' health risks. Achieving a better balance needs to be considered by both the authorities and hunters.

Feral pig hunters appear to weigh up their risk of illness depending on whether they "know someone" with the illness. The use of authorised stories of people who have had brucellosis in pig hunting magazines and websites may be a useful method for increasing awareness and the reality of brucellosis for hunters.

Conclusion

Swine brucellosis is a zoonosis of concern for feral pig hunters in many parts of Australia including north-west NSW. Many of the current strategies to reduce the risk of brucellosis did not appear appropriate or acceptable to the feral pig hunters interviewed. More acceptable strategies when eviscerating such as taking more time, watching hands, ensuring good lighting, being careful in the vicinity of the uterus and using a latex glove to cover cuts on

hands need to be tested in the field. Further development of the food safety regulations is required to also support zoonosis risk reduction strategies.

Acknowledgements

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A translation of Australian slang appearing in the text:

- “pig dog” – A large cross-bred dog trained to hunt pigs.
- “Chiller” – A large commercial refrigerator used for transferring and storing feral pig carcasses prior to exportation.
- “ya pussy” – You weak and feeble individual.
- “muck around” – Waste time
- “Ute” – Short for “utility vehicle”, a light vehicle with a cabin and an open top rear cargo tray. Known in the USA as a “pick-up truck”.
- “Everyone’s that dirty…” – Everyone is very annoyed
- “big mob” – A large group
- “heaps of fellas” – Many men
- “the scrub” – Any remote or rural area with many low trees or bushes
- “dam” – A hole dug in the ground by a property owner to hold water for agricultural use.

Box 1: Summary of the recommended precautions to prevent swine brucellosis in humans when coming into contact with animals [12][13]

- Covering all cuts or abrasions with waterproof dressings.
- Wearing gloves, overalls and eye protection when slaughtering animals or handling carcases, with disinfection of protective equipment by heat treatment, fumigation by formaldehyde, or soaking in disinfectant.
- Thorough washing of hands and arms in soapy water after handling animals or carcasses and using a disinfectant hand rinse.
- Taking particular care when handling or disposing of birth products.
- Washing off all urine, faeces, blood and other body fluids and thoroughly cleaning all working areas.

References

1. Bossi P, Tegnell A, Baka A, Van Loock F, Hendriks J, Werner A, et al. Bichat guidelines for the clinical management of brucellosis and bioterrorism-related brucellosis. *Euro Surveillance*. 2004; **9(12)**: E15-E16.
2. Van Bressem MF, Raga JA, Di Guardo G, Jepson PD, Duignan PJ, Siebert U, et al. Emerging infectious diseases in cetaceans worldwide and the possible role of environmental stressors. *Diseases of Aquatic Organisms*. 2009; **86(2)**: 143-157.
3. Newman L, Stirzaker S, Knuckey D, Robinson K, Hood J, Knope K, et al. Australia's notifiable disease status, 2008: annual report of the National Notifiable Diseases Surveillance System. *Communicable Diseases Intelligence*. 2010; **34(3)**: 157-224.
4. *Brucella suis* infection associated with feral swine hunting - three states, 2007-2008. *MMWR - Morbidity & Mortality Weekly Report*. 2009, **58(22)**: 618-621.
5. Young E. *Brucella* species. In: G Mandell, J Bennett, R Dolin (Eds). *Mandell, Douglas, and Bennett's principles and practice of infectious diseases*. 7th ed. Philadelphia: Churchill Livingstone Elsevier, 2009; 2623-2642.
6. Eales K, Norton R, Ketheesan N. Brucellosis in northern Australia. *American Journal of Tropical Medicine and Hygiene*. 2010; **83(4)**: 876-878.
7. Meng X, Lindsay D, Sriranganathan N. Wild boars as sources for infectious diseases in livestock and humans. *Philosophical Transactions of the Royal Society of London B: Biological Sciences*. 2009; **364(1530)**: 2697-2707.
8. Al Dahouk S, Nöckler K, Tomaso H, Splettstoesser W, Jungersen G, Riber U, et al. Seroprevalence of brucellosis, tularemia, and yersiniosis in wild boars (*Sus scrofa*) from north-eastern Germany. *Journal of Veterinary Medicine Series B-Infectious Diseases and Veterinary Public Health*. 2005; **52(10)**: 444-455.
9. Lucero NE, Ayala SM, Escobar GI, Jacob, NR. *Brucella* isolated in humans and animals in Latin America from 1968 to 2006. *Epidemiology and Infection*. 2008; **136(4)**: 496-503.
10. Irwin M, Massey P, Walker B, Durrheim D. Feral pig hunting: a risk factor for human brucellosis in north-west NSW? *New South Wales Public Health Bulletin*. 2009; **20(11-12)**: 192-194.
11. New South Wales Department of Health, Communicable Diseases Branch. Communicable Diseases Report, NSW, November and December 2009. *New South Wales Public Health Bulletin*. 2010; **21(1-2)**: 43-47.

12. Queensland Government. *Brucellosis*. Queensland Health Fact Sheet. Brisbane, QLD: 2010. Available from: http://access.health.qld.gov.au/hid/InfectionsandParasites/BacterialInfections/brucellosis_fs.asp (accessed 29 April 2011).
13. World Health Organization. *Brucellosis in humans and animals*. Geneva: 2006. Available from: http://www.who.int/csr/resources/publications/Brucellosis.pdf (accessed 29 April 2011).
14. New South Wales Food Authority. *Wild Game Meat Field Harvester Food Safety Program*. Sydney, NSW: 2010. Available from: http://www.foodauthority.nsw.gov.au/_Documents/industry_pdf/Wild_Game_Meat_Field_Harvester_FSP.pdf (accessed 29 April 2011).
15. Glaser B, Strauss A. The Discovery of Grounded Theory: Strategies for Qualitative Research. New York: Adline de Gruyter, 1967.
16. Sofaer S. Qualitative methods: what are they and why use them? Health Services Research. 1999; **34(5)**: 1101–1118.
17. Starks H, Brown Trinidad S. Choose Your Method: A Comparison of Phenomenology, Discourse Analysis, and Grounded Theory. *Qualitative Health Research.* 2007; **17**: 1372-1380.
18. Chaim N. Sampling Knowledge: The Hermeneutics of Snowball Sampling In Qualitative Research. International Journal of Social Research Methodology. 2008 **11(4)**: 327-344.
19. Coffey A, Atkinson P. Making sense of qualitative data. Thousand Oaks, CA: Sage, 1996.
20. Strauss A, Corbin J. (1998). Basics of qualitative research: Grounded theory procedures and technique. Newbury Park, CA: Sage, 1998.
21. Lee T. Using qualitative methods in organizational research. Thousand Oaks, CA: Sage, 1999.
22. Starnes C, Talwani R, Horvath J, Duffus W, Bryan C. Brucellosis in two hunt club members in South Carolina. Journal of the South Carolina Medical Association. 2004; **100(4)**:113-115.
23. Bigler W, Hoff G, Hemmert W, Tomas J, Janowski H. Trends of brucellosis in Florida. An epidemiologic review. *American Journal of Epidemiology*. 1977; **105(3)**: 245-251.
24. Durey A, Lower T. The Culture of Safety on Australian Farms. *Rural Society*. 2004; **14(1)**: 57-69.

CHAPTER 8: REMAINING QUERIES IN QUERY FEVER

Preamble

Background

More than 400 cases of Query fever (Q fever) were reported in Australia during 2007 and in New South Wales, Australia's most populous state, during 2007 the crude rate of notification was 3.15 per 100,000 population (n = 215). These cases occurred despite an effective vaccine being available.

Recent data suggest that the ongoing burden is being borne by rural people who live and work in close contact with farm animals. Human infection commonly occurs through inhaling contaminated aerosols or dust, such as when people work and live around livestock.

The National Q Fever Management Program (NQFMP) was implemented in Queensland, South Australia, Victoria, and Western Australia in 2001, and the Australian Capital Territory (ACT), New South Wales (NSW) and Tasmania during 2002. The first phase of the NQFMP targeted abattoir workers, other contractors working in abattoirs and sheep shearers. The second phase expanded the target population to sheep, dairy and beef cattle farmers, their employees and family members working on farms. The program was completed in NSW in June 2004, and other states up to 2006. [1]

There is a need for a Q fever immunisation program in Australia that ensures that non-abattoir workers, who remain at risk from this serious disease, can access the protection offered by the available vaccine.

Presented studies

The first paper in this chapter calls for more action to control Q fever; the second paper investigates the changing epidemiology of Q fever; and the third reviews current screening practices for the cardiac defects that increase the risk of Q fever endocarditis in people admitted with Q fever to a regional hospital. The survey tool developed to investigate exposure risks in the third study is in Appendix 3.

Impacts

The studies have led to the risk of Q fever for livestock workers becoming the focus of general practitioner education events in the northwest of the state. In addition the findings

were discussed at two community meetings in northwest NSW where local action is now taking place to increase Q fever immunisation coverage of livestock workers.

Publications arising from this chapter:

8.1 Q fever vaccination – unfinished business

Massey PD, Durrheim DN, Way A. Q-fever vaccination- unfinished business in Australia. *Vaccine* 2009; **27(29):** 3801.

My estimated contribution was 50%.

8.2 Q fever risk exposure surveillance

Massey PD, Irwin M, Durrheim DN. Enhanced Q fever risk exposure surveillance may permit better informed vaccination policy. *Communicable Diseases Intelligence* 2009; **33(1):** 41-45.

My estimated contribution was 50%.

8.3 Prevention of Q fever endocarditis

Hess IM, Massey PD, Durrheim DN, O'Connor S, Graves SR. Preventing Q fever endocarditis: a review of cardiac assessment in hospitalised Q fever patients. *Rural and Remote Health*, accepted.

My estimated contribution was 40%.

References:

1. Gidding HF, Wallace C, Lawrence GL, McIntyre PB. Australia's national Q fever vaccination program. Vaccine. 2009; 27: 2037-2041.

Dear Editor

We celebrate with Gidding et al. [1] the achievements of the short-lived national Q fever vaccination program in Australia. The data presented suggest a significant impact on Q fever in certain at-risk populations at the time of the program, particularly abattoir workers. Similar benefits may accrue in other countries with a Q fever burden, if a national program was conducted. However, Australia's Q fever immunisation challenge is not yet completed.

More than 400 cases of Q fever were reported in Australia for 2006 [2] and in New South Wales, Australia's most populous state, during 2007 the crude rate of notification was 3.15 per 100,000 population (n = 215) [3]. These cases occurred despite an effective vaccine being available [4]. The national Q fever vaccination program in Australia was a short-term intervention and public health history clearly demonstrates that intensive time limited interventions that are not accompanied by system change are unlikely to be sustainable [5].

There has been a shift in the epidemiology of Q fever notifications in NSW [6]. Recent data suggest that the ongoing burden is being borne by rural people who live and work in close contact with farm animals. Human infection commonly occurs through inhaling contaminated aerosols or dust [1], such as when people work and live around livestock.

It is clear that while advocating international application of Q fever vaccination in at-risk populations, there is a need for a sustainable systematic program in Australia that ensures that non-abattoir workers who remain at risk from this serious disease can access the protection offered by the available vaccine.

References

[1] Gidding HF, Wallace C, Lawrence G, McIntyre PB. Australia's national Q fever vaccination program. Vaccine 2009;27:2037–41.

[2] Begg K, Roche P, Owen R, Liu C, Kaczmarek M, Stirzaker S, et al. Australia's notifiable diseases status, 2006: annual report of the National Notifiable Diseases Surveillance System. Comm Dis Intell 2008;32(2):139–207.

[3] Communicable Diseases Branch, NSW Department of Health. Year in review: communicable disease surveillance, NSW, 2007. NSW Pub Health Bull 2008; 19(5–6):85–95.

[4] Chiu C,DurrheimDN. A review of the efficacy of human Qfever vaccine registered in Australia. NSWPublic Health Bull 2007;18:133–6.

[5] Swerissen H, Crisp BR. The sustainability of health promotion interventions for different levels of social organization. Health Prom Int 2004;19(1):123–30.

[6] Massey PD, Irwin M, Durrheim DN. Enhanced Q fever risk exposure surveillance may permit better informed vaccination policy. Comm Dis Intel;33(1):42-6.

Enhanced Q fever risk exposure surveillance may permit better informed vaccination policy

Peter D Massey, Melissa Irwin, David N Durrheim

Abstract

The association between farming risks and Q fever is not well documented in Australia. In a review of New South Wales notifications, data were analysed using 3-year study periods from 1993 to 2007 to investigate possible trends and explore reported risk exposures. A retrospective case series was also conducted using acute Q fever cases notified during 2007 from a rural area of New South Wales. Occupation was recorded for less than 50% of Q fever notifications in New South Wales during the study period. A significant decline in the proportion of notifications occurred in the occupational group reported as 'Abattoir/Meat' worker and a significant increase occurred in the 'Farmer/Livestock' category. The case series found that in the month prior to illness onset 78% (42/54) reported direct contact with animals. In the month prior to becoming ill with Q fever 71% (31/51) of employed cases had contact with newly introduced livestock in their workplace. As a result of their Q fever illness 93% of cases required time off work or school, with a median of 21 days. At the time of the structured interviews 63% had not fully recovered. The epidemiology of Q fever disease in New South Wales has changed and amongst notified cases the relative importance of non-abattoir contact with livestock, wildlife or feral animals appears to be increasing. The surveillance field 'Occupation' no longer alone adequately describes risk exposure for many of the people notified with Q fever and a new field that better describes risk exposures is required. This may allow more finely tuned vaccination policy. *Commun Dis Intell* 2009;33:42–46.

Keywords: Q fever, surveillance, rural, exposure, risk, occupation

Introduction

Q fever is an acute febrile illness caused by the intracellular gram-negative bacteria *Coxiella burnetii*[1] and is the most common zoonotic disease in Australia.[2] Transmission usually occurs because of direct or indirect contact with infected animals, their tissues or products.[3] There are several clinical syndromes of Q fever including a self-limited febrile illness, pneumonia, endocarditis, hepatitis and osteomyelitis.[4] The case-fatality rate among untreated cases may be as high as 2.4% but is usually less than 1%.[5]

Since the 1930s Q fever has been strongly associated with Australian abattoirs.[6,7] In a review of Q fever notifications in New South Wales, for the period 1991–2000, where data on occupation were recorded, 51% of the cases were recorded as abattoir or meat workers, and agriculture related occupations represented 29% of the cases.[7] Queensland and Victoria have reported abattoir worker as the occupation in 40%–45% of notifications.[8]

The association between farming and Q fever is less well documented. In south-west Queensland the majority of recent notifications have been associated with an occupation of farming.[9] In north-western New South Wales a Q fever cluster was described in a shearing team.[10] During a Q fever vaccination program on the north coast of New South Wales, over 27% of cattle workers had laboratory evidence of pre-existing immunity to Q fever.[11]

There is an effective, safe vaccine against Q fever[12] and vaccination of people at risk of Q fever is the main disease prevention strategy available in Australia.[13] Abattoir- and other meat industry workers were the main focus of the National Q Fever Management Program conducted in Australia from 2001–2004.[14] Since the end of the National Q Fever Management Program, cases of Q fever continue to be reported despite the availability of an effective vaccine. In New South Wales annual notified cases have increased from 143 in 2005 to 175 in 2006 and 215 cases in 2007.[15]

In New South Wales Q fever is a Category 3 scheduled medical condition under the provisions of the *NSW Public Health Act 1991* and is notifiable to public health units. In accordance with NSW Department of Health (NSW Health) policy, Q fever is followed up by public health units for the purpose of monitoring the epidemiology to inform the development of better prevention strategies.[16]

The aim of this investigation was to describe the changing epidemiology of Q fever in New South Wales and to survey notified individuals in the Hunter New England region, a rural area of New South Wales, to better understand current risk exposures.

Methods

New South Wales Q fever notifications recorded in the NSW Notifiable Diseases Database (NDD)

were sourced from NSW Health's HOIST (Health Outcomes Information and Statistical Toolkit). Data were analysed for New South Wales and the Hunter New England region.

Initially, New South Wales notifications were analysed using five 3-year study periods from 1993–2007 to investigate possible trends and explore reported exposures. The occupation recorded for each notification of Q fever was grouped for analysis into 'Abattoir/Meat' work and a small range of other occupational categories. Data were also described by gender, Indigenous status, Area Health Service of residence and hospitalisation. Analysis was conducted using SPSS® Graduate Pack 15.0 for Windows® (version 15, SPSS Inc, Chicago, Ill, USA). Chi square for trend analysis was conducted on gender and occupation variables over the study periods using Epi Info (version 6, Centers for Disease Control and Prevention, Atlanta, Georgia).

A retrospective case series was also conducted using acute Q fever cases from the 2007 notifications of Q fever from a rural area of New South Wales (Hunter New England), to gain a better understanding of Q fever risk exposures. This group was selected because of recent increased notifications in the area. Routine follow-up of notified cases had already occurred, however additional information on occupation, the nature of potential Q fever risk exposures and morbidity were obtained using a structured telephone survey of those that met the case definition for acute Q fever. Acute Q fever was defined according to the NSW Response Protocol for Public Health Units as: definitive laboratory evidence for acute Q fever; or laboratory suggestive evidence and a compatible clinical history.[16] Analysis for the retrospective case series was conducted using SAS V9.1 and Microsoft Office Excel, 2003. Ethics approval was not required.

Results

For the period 1993–2007 there were 3,447 notifications of Q fever in New South Wales residents with the highest number of notifications occurring in the period 1993–1995 (Figure 1). Most Q fever notifications (90%; n=3123) occurred in the working age group, 15–64 years, and less than 3% (n=81) were in children aged under 15 years (Figure 2).

Over the whole study period more than 80% (2,764 of 3,446) of notifications were males but an increasing proportion of females were notified with Q fever; 12.8% in 1993–1995 to 28.4% in 2005–2007 ($P<0.0001$). Across New South Wales, the large majority (94.9%) of notifications occurred in residents of rural Area Health Services. Only 43% (1,494 of 3,446) of notifications over the study period had

Figure 1. Notifications of Q fever, New South Wales, 1993 to 2007, by 3-year groupings

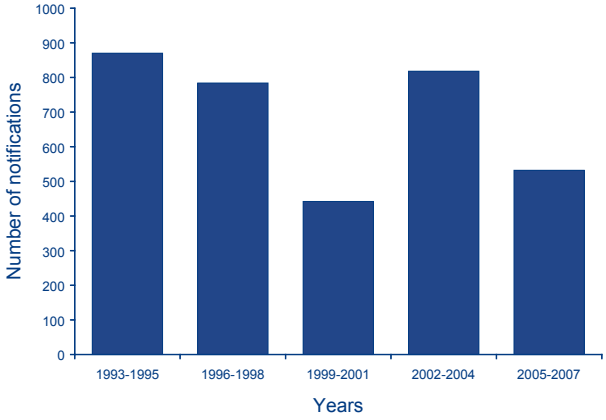
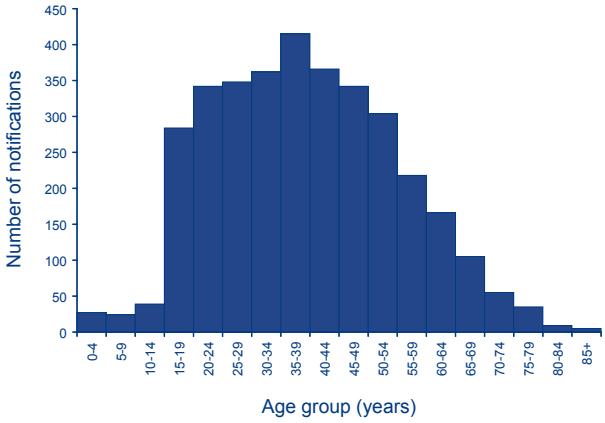


Figure 2. Age distribution of Q fever notifications, New South Wales, 1993 to 2007

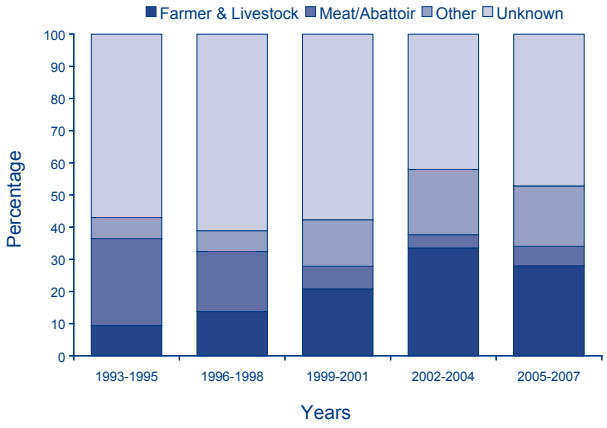


valid data for the hospitalisation variable. Among notifications with valid data, 24% (358/1494) were reported to have been hospitalised.

Occupation was recorded for less than 50% of Q fever notifications in New South Wales. The highest reported occupation groups were 'Farmer/Livestock' (16.1%) and 'Abattoir/Meat' (13.9%). A significant decline in the proportion of notifications in the occupational group 'Abattoir/Meat' worker ($P<0.0001$) occurred over the study periods (Figure 3). The proportion in the 'Farmer/Livestock' occupational group increased over the study period ($P<0.0001$).

For the period 1 January 2007 to 31 December 2007 there were 75 notifications of Q fever in people resident in the Hunter New England area. On serological and clinical review, 61 were found to have acute Q fever and 12 (20%) of these were female. Structured interviews were completed with 54 of the 61 notifications (89%).

Figure 3. Notifications of Q fever, New South Wales, 1993 to 2007, by occupation group

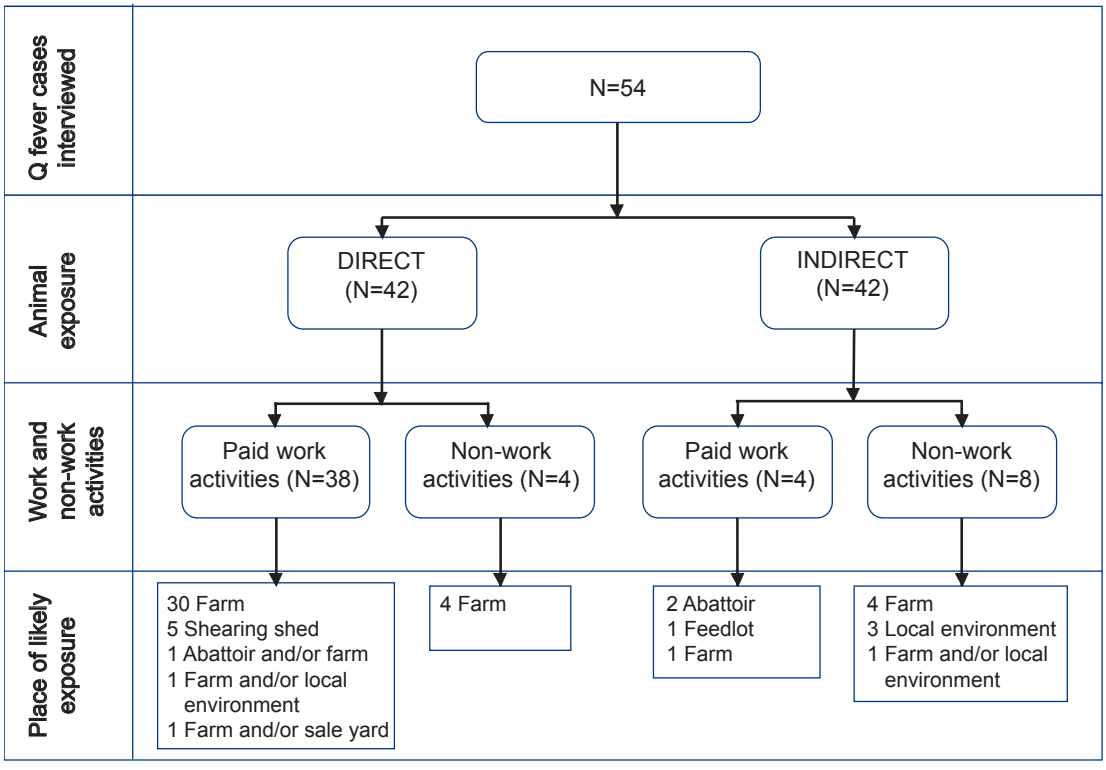


Of those surveyed 42 (78%) described themselves as living on a farm, or in a semi-rural area or village. Most worked (94%; n=51) in the month prior to illness onset with 18 occupations reported. Abattoir work was uncommon (6%; 3), while the occupations of farmer, farm manager and farm worker predominated (70%; 36). In the month prior to becoming ill with Q fever, 31 (61%) of those working had contact with newly introduced livestock as part of their work.

In the month prior to illness onset, 42 (78%) of the cases surveyed reported direct contact with animals, their tissues or products with 38 (90%) of these occurring during work activities. The remaining 12 (22%) reported indirect contact with dusts that were contaminated by animals tissues, products or excreta, with 4 (33%) occurring during work activities. Direct exposure to cattle was reported by 81% of respondents, exposure to sheep reported by 38% and kangaroos or wallabies exposure reported by 26%. The most common place where exposure to animals occurred was on a farm (Figure 4) although many respondents reported exposure to multiple animal species in different settings. Of those who worked with animals 31% of activities described involved contact with animal blood or body fluids, 32% involved assisting animals with parturition and 46% participated in activities that involved general handling of animals.

As a result of their Q fever illness 50/54 (93%) people had time off work or school, with a median of 21 days off work or school and a range of 2–296 days. Twenty-nine respondents were hospitalised for a median of 6 days and a range of 1–42 days. At the time of the structured interviews (conducted 28 to 93 weeks after illness onset) 34 (63%) people reported they had not fully recovered. Table 1 describes the most frequent ongoing issues reported by respondents. Of those reporting full recovery, the median time to full recovery was 12 weeks with a range of 1–35 weeks.

Figure 4. Description of likely Q fever exposures among interviewed Hunter New England residents notified with acute Q fever in 2007



None of the respondents reported being vaccinated against Q fever. Thirty-eight (70%) people reported that they knew about the vaccine before their illness and the most common reasons provided for not being immunised were: believing that they were not at risk or problems with access (Table 2).

Table 1. Ongoing health conditions in people notified with acute Q fever in the Hunter New England area, 2007

Issue	n*	%*
Fatigue	32	94
Athralgia or myalgia	20	59
Fevers and sweats	9	26
Endocarditis	1	3
Total with ongoing issues	34	100

* Number and per cent is greater than the total as certain respondents reported more than 1 ongoing issue.

Table 2. Reasons provided for not being vaccinated against Q fever in people notified with Q fever from Hunter New England in 2007

Issue	n	%
Thought not at risk	14	37
Access problems	9	24
Not got around to it	5	13
Told not at risk	2	5
Child	2	5
Not provided by employer	2	5
Other	4	11
Total aware of Q fever vaccine	38	100

Discussion

This study of people notified with Q fever confirms that it is a serious illness that commonly produces considerable morbidity, emphasising the importance of prevention. The high proportion of people with ongoing health issues many weeks after illness onset has not previously been reported in Australia. The comparison of hospitalisation rates from routinely collected surveillance data and data gathered during the retrospective survey highlights the underestimation in routinely collected notification data. This would be important to consider when conducting an economic evaluation of Q fever vaccination strategies.

Cases of Q fever continue to be reported in New South Wales despite the availability of an effective vaccine. The National Q Fever Management Program which operated from 2001–2004 provided free vaccine to some groups at risk. The large reduction in the number of notifications amongst people reporting work in an abattoir is likely to reflect a good outcome from this program, but many people in rural New South Wales who are potentially exposed to Q fever remain susceptible to this disease.

The epidemiology of Q fever disease in New South Wales has changed and amongst notified cases the relative importance of non-abattoir contact with livestock, wildlife or feral animals appears to be increasing. A fifth of notified rural residents described participating in activities that exposed them directly or indirectly to animals, their tissues and products in a non-work setting. The surveillance field 'Occupation' no longer alone adequately describes risk exposure for many of the people notified with Q fever and a new field that describes risk exposures is required. This would allow a more finely tuned focus of future vaccination policy.

Considering awareness of Q fever vaccination was reasonable at 70% (38/54), the barriers to immunisation described in this case series need to be confirmed in a larger sample of people and actions taken to address the underlying reasons for non vaccine uptake. Given the marked step in the age distribution of notified Q fever cases it would be valuable to confirm whether there is an opportunity of targeting Q fever vaccination to rural children, and confirm vaccine safety and efficacy in this group.

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References

1. Maurin M, Raoult D. Q fever. *Clin Microbiol Rev* 1999;12:518–553.
2. Owen R, Roche PW, Hope K, Yohannes K, Roberts A, Liu C, et al. Australia's notifiable diseases status, 2005: Annual report of the National Notifiable Diseases Surveillance System. *Commun Dis Intell* 2007;31:1–70.
3. CSL. Q fever: your questions answered, 1999. CSL Limited, Parkville, Victoria.
4. Mandell GL, Bennett JE, Dolin R, eds. *Principles and Practice of Infectious Diseases,* 4th edn. Churchill Livingstone Inc, 1995. 1727–1735.
5. Heymann DL, ed. *Control of Communicable Diseases Manual,* 18th Edn. American Public Health Association, 2004. 434–438.
6. Derrick EH. 'Q' fever. A new fever entity: Clinical features, diagnosis and laboratory investigation. *Med J Aust* 1937:11:281–299.
7. Lin M, Delpech V, McAnulty J, Campbell-Lloyd S. Notifications of Q fever in New South Wales, 1991–2000: EpiReview. *N S W Public Health Bull* 2001;12:172–175.
8. Bell M, Patel M, Sheridan J. Q fever vaccination in Queensland abattoirs. *Commun Dis Intell* 1997;21:29–31.
9. Boland PJ, Parker NR. Q fever in south west Queensland. *Med J Aust* 1999;171:446.
10. Massey P, Taylor K. Q fever cluster in a shearing team, *N S W Public Health Bull* 2004;15:220–227.
11. Hutson B, Deaker R, Newland J. Vaccination of cattle workers at risk of Q fever on the north coast of New South Wales. *Aust Fam Physician* 2000;29:708–709.
12. Chiu C, Durrheim DN. A review of the efficacy of human Q fever vaccine registered in Australia. *N S W Public Health Bull* 2007;18:133–136.
13. Parker NR, Barralet JH, Bell MA. Q fever. *Lancet* 2006;367:679–688.
14. Palmer C, McCall B, Jarvinen K, Krause M, Heel K. 'The dust hasn't settled yet': the National Q Fever Management Program, missed opportunities for vaccination and community exposures. *Aust N Z J Public Health* 2007;31:330–332.
15. Communicable Diseases Branch, NSW Department of Health. Year in review, communicable diseases surveillance, NSW, 2007. *NSW Public Health Bulletin* 2008;19:85–95.
16. NSW Department of Health. *Q fever: Response Protocol for NSW Public Health Units 2004*. Available from: http://www.health.nsw.gov.au/factsheets/guideline/qfever.html Accessed 2 December 2008.

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Preventing Q fever endocarditis: a review of cardiac assessment in hospitalised Q fever patients

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ABSTRACT

Introduction

Acute Q fever is an important zoonotic disease in some parts of rural Australia. Q fever can lead to chronic disease such as endocarditis, this complication occurring more commonly in patients with underlying heart valve pathology or an impaired immune system. Untreated Q fever endocarditis has a high mortality rate, but even with appropriate therapy, 10% of patients will die. Cardiac assessment can identify patients at risk. The aim of this review is to examine recorded cardiac assessment of hospitalised Q fever patients within the regional area of Hunter New England (HNE), New South Wales (NSW).

Methods

Medical records of patients with Q fever admitted to hospitals in HNE during 2005-2009 were identified through the NSW Notifiable Diseases Database and the NSW Inpatient Statistics Collection. A standardised medical record review tool was used to undertake the review.

Results

Eighty-nine records were reviewed. Over 50% of patients were admitted to a district hospital, run by local general practitioners. Cardiac assessment was not routinely documented with 91% having no record of a cardiac history being taken. Approximately 25% had no record of a cardiac physical examination and only six cases had a record of a complete cardiac examination.

Conclusion

Q fever remains an important disease in some parts of rural Australia. Q fever endocarditis is a serious sequel to acute Q fever and underlying heart valve pathology. Due to its indolent progression and poor outcome when diagnosis is delayed, a thorough cardiac assessment of all patients with suspected or confirmed Q fever is important.

The level of documentation of cardiac assessment for Q fever patients is of concern as it may indicate cardiac assessments were not performed. General practitioners, especially in rural and regional areas, are encouraged to conduct cardiac assessments for all patients with acute Q fever to identify patients at risk of developing Q fever endocarditis.

KEYWORDS:

Endocarditis, Medical Records, Physical Examination, Q fever, Rural Health

Introduction

Q fever is a notifiable zoonotic disease caused by *Coxiella burnetii* infection [1-5]. It is commonly found in rural areas in people with close contact with livestock such as cattle, sheep and goats. Abattoir workers, farm workers and veterinarians are most at risk of infection [1-4]. More than half of human infections are asymptomatic and most other infections result in a mild self-limiting febrile illness that occurs 2-3 weeks after inhaling Coxiella containing aerosols [1]. However, acute disease can be severe with atypical pneumonia or hepatitis [1-4]. The diagnosis is usually made through serology 2-3 weeks after the onset of disease and tetracycline treatment remains effective. Nevertheless, Q fever can have a major impact on people's lives [6, 7]. A recent study found that 93% of Q fever cases required time off work or school with a median of 21 days, and reported a high proportion (63%) with ongoing health issues many weeks after illness onset [7]. Post Q fever fatigue syndrome (QFS) is a well-recognised sequel sometimes lasting for many years [8, 9]. A safe and effective vaccine has been available in Australia since 1989 [10, 11]. People having the vaccine are required to undergo pre-vaccination testing in order to prevent hypersensitivity reactions due to previous exposure to Q fever [12].

In Australia, Q fever remains the most commonly reported zoonotic disease with 450 cases in 2007 [13]. The incidence of the disease is likely to be higher due to cases that remain undiagnosed and the passive disease surveillance system for Q fever relying on laboratory investigation by clinicians and notification to public health officials. There is no active case finding program for Q fever. Over 85% of Q fever notifications are from residents in Queensland and New South Wales (NSW) [13]. In 2008 there were a total of 164 cases in NSW with the majority residing in rural northern NSW [14]. Of all cases in NSW, 42 (26%) were from the regional area of Hunter New England (HNE) in North East NSW. Of these, 15 (36%) were hospitalised. A recent serological survey of 2,438 serum samples conducted in HNE area health service found a seroprevalence for Q fever phase II antibodies between 6% and 12% [15]. The highest seroprevalence was found in patients from rural areas.

The regional area of HNE has a population of approximately 840,000 and covers a geographical area of over 130,000 square km. It includes two tertiary referral hospitals both located in Newcastle, four rural referral hospitals and a number of district and community hospitals (clinical services are usually provided by local general practitioners).

Acute Q fever progresses to chronic Q fever in 5-30% of patients [3, 15, 16], the most serious form being culture-negative endocarditis accounting for 60-73% of chronic Q fever cases [1, 2, 17]. Although endocarditis commonly develops within 3-6 months of the acute attack [18], it may only become apparent after 5-20 years [3, 19]. Q fever endocarditis occurs almost exclusively in patients with pre-existing cardiac valve defects, prosthetic heart valves or an impaired immune system [1, 2, 20]. Pre-existing valve defects most commonly involve insufficiencies of the mitral and/or aortic valve; however patients with prosthesis seem at greater risk of developing endocarditis [20]. In some cases with Q fever endocarditis, pre-existing valvulopathy has been minor such as bicuspid aortic valve, mitral valve prolapse and trivial mitral valve insufficiency [21]. The risk of endocarditis in patients with

valvular disease has been estimated at 39% [20]. Almost three-quarters are male with a mean age of 60 years [18, 20, 22]. Diagnosis is usually made by applying the modified Duke criteria, a set of indicators used to diagnose infective endocarditis [23, 24]. The original criteria have been modified to include a single positive blood culture or positive serology result for chronic Q fever. As an alternative to serology and blood cultures, diagnosis can be made by real-time quantitative Polymerase Chain Reaction (qPCR) on the patient's blood [25]. If Q fever endocarditis is untreated, most patients will die, but even with appropriate therapy mortality rate remains at 10% [1, 2]. Thus early diagnosis and prompt antibiotic treatment is important [1]. However, the mean diagnostic delay for Q fever endocarditis has been recorded as six months [22].

To prevent Q fever endocarditis some Q fever experts recommend identifying patients at risk through screening for a clinical history of valvulopathy [20], or a systematic echocardiography for all acute Q fever patients [21, 26].

We conducted a medical record audit to describe recorded cardiac assessment practices in patients hospitalised with diagnosed or suspected acute Q fever (hospitalised with an acute Q fever related illness) in the regional area of HNE during 2005-2009.

Methods

All residents of HNE area health service admitted to a HNE hospital from 2005-2009 with an acute Q fever diagnosis were identified through:

1. The NSW Notifiable Disease Database (NDD): Q fever cases recorded as hospitalised were included while those recorded as not hospitalised were excluded. Q fever cases recorded as 'unknown hospitalisation' were matched with the NSW Inpatient Statistics Collection in the data warehouse HOIST (Health Outcomes Statistical Toolkit) [27] and included if they were hospitalised within six months of definitive laboratory diagnosis.
2. The NSW Inpatient Statistics Collection: All hospitalised patients with a Q fever ICD-10 diagnosis (A78) were matched with NDD to ensure data completeness. Non-matches were checked with pathology providers to confirm Q fever diagnosis.

Where multiple hospital admissions had occurred within six months of definitive diagnosis, only the admission during which Q fever was first diagnosed or tested for or the first admission with a Q fever related illness after diagnosis was considered. Emergency Department only admissions and cases where Q fever was not suspected or tested for during the entire hospital admission were excluded.

A standardised medical record review tool was used to collect patient demographics and details on hospital admission, cardiac history and cardiac examination (by IH or PM). Cardiac examination was defined as a complete examination if the patient had a record of heart and chest auscultation, jugular venous pressure assessment, presence of hepato- and/or splenomegaly and peripheral oedema.

When there was no record of a cardiac assessment or when there were statements such as ‘nil else’ it was assumed the assessment was not performed. Cardiac echocardiography was not reviewed due to unavailability of this diagnostic test in most district hospitals in the regional area of HNE. Descriptive analysis was performed using *MS Excel* (Microsoft 2007; Redmond, Washington, U.S.A.]. Records of patients admitted to district hospitals (clinical services usually provided by local general practitioners) were compared with patients admitted to a rural referral hospital and tertiary referral hospital. Due to small cell counts (<5) Fisher’s exact test (two tailed) was performed using an online calculator [28].

The HNE area Human Research Ethics Committee classified this research project as a quality improvement project.

Results

Eighty-nine hospitalised Q fever cases were included in our study (see *figure 1*). Seventy-eight cases were identified through the Notifiable Diseases Database (6 excluded) and 83 through the NSW Inpatient Statistics Collection (31 already identified through Notifiable Diseases Database). The additional 52 potential cases from the NSW Inpatient Statistics Collection had their laboratory diagnosis reviewed and 17 were confirmed hospitalised Q fever patients.

Insert figure 1.

The characteristics of hospitalised Q fever patients are described in *table 1*. Over 50% of patients (48) were admitted to a district hospital while a third (29) was admitted to a rural referral hospital. Most patients (67, 75%) were diagnosed with Q fever after discharge following receipt of positive follow up serology. Twenty patients (22%) received the Q fever diagnosis whilst in hospital and two patients (2%) were known to have Q fever at admission to hospital.

Insert table 1.

The majority (79, 91%) of medical records of patients who were suspected of having Q fever (Q fever diagnosis made during or after hospital admission) had no record of a cardiac history being taken (*table 2*). Of all hospitalised Q fever cases, only two patients (2%) had a record of being asked about previous rheumatic fever and no patients had any record of previous cardiac valve disease or surgery. Of the patients who were known or suspected to have Q fever, the majority of cases had a record of heart auscultation (66%) and chest auscultation (76%). However, only six cases (7%) had a record of a complete cardiac examination.

Insert table 2.

When type of hospital was explored there were no significant differences in documentation of cardiac history and cardiac examination amongst cases admitted to a rural referral hospital and those patients admitted to a tertiary referral hospital. These were grouped and compared to cases admitted to a district hospital (clinical services usually provided by local general practitioners) (*table 3*). The proportion of patients with documentation of cardiac history or cardiac examination was significantly lower in patients admitted to a district hospital. Only one patient's record admitted to a district hospital indicated that a cardiac history was taken and all 20 patients with no documentation of a cardiac examination were admitted to a district hospital.

Insert table 3.

Discussion

The cardiac assessment of hospitalised patients, from the regional area of HNE between 2005-2009, with suspected or known Q fever was not routinely documented in medical records. Only nine patients' records indicated documentation of a cardiac history and no patient had a recorded history of exploring cardiac valve disease or surgery. Further, almost a quarter of suspected Q fever patients had no record of a cardiac physical examination and only six patients had a documented complete cardiac physical examination. No patient had a medical record indicating complete cardiac history and physical examination. Patients admitted to district hospitals (clinical services usually provided by local general practitioners) had significantly less documentation of a cardiac history and cardiac physical examination.

Assuming a conservative estimate of chronic Q fever developing in 5% of patients with acute infection [16] and endocarditis accounting for 60% of chronic Q fever patients [1,2], between two to three patients of all the acute Q fever cases (89) we reviewed could potentially develop Q fever endocarditis. We expected that a known Q fever diagnosis would prompt the treating doctor to conduct and document a thorough cardiac assessment to identify patients requiring further follow up and treatment, however this was not found. No patient in our study received a full cardiac assessment and no patient was identified as being at risk. Nevertheless, the medical record review identified three patients with endocarditis.

This study has several limitations. Medical record review may not accurately reflect the history taking and clinical examination of the admitting practitioner. Previous studies indicate that medical records are not necessarily parallel to the quality of care received [29]. However, the low level of documentation is of concern as it may reflect the level of cardiac assessment being conducted.

Only hospital medical records were reviewed and it is possible that the admitting doctor in rural towns may have seen the patient in private practice immediately prior to admission and maintained private practice medical records. This might explain the significantly lower level of documentation of patients admitted to district hospitals. Further, it is possible that a thorough cardiac assessment was conducted in a follow-up appointment either by the treating general practitioner or as in an outpatient clinic of a larger rural or tertiary referral hospital. Future research could explore the management of diagnosed Q fever patients followed up by general practitioners as well as in outpatient clinics to determine whether cardiac assessment may be conducted at a later stage.

A further weakness was that only HNE area hospital medical records were reviewed and thus the results may not be generalisable to other sites in Australia.

Efforts to encourage cardiac assessment in patients with an acute Q fever diagnosis have been made in NSW since the results of this study became available. Pathology North Hunter, which provides pathology services to the majority of HNE, has added a reminder about the importance of cardiac assessment with positive Q fever serology results (S Graves (co-author), pers. Comm., 28 October 2010). NSW Health has included cardiac assessment in the 'how is it treated' section of the recently

updated factsheet on Q fever [30]. Other efforts could include: the development of clinical guidelines for Q fever for general practitioners and physicians; education of general practitioners and physicians, specifically aimed at the rural workforce through regular professional development seminars; and education and information provided to patients diagnosed with Q fever.

Conclusions

Q fever remains an important disease in some parts of rural Australia. Q fever endocarditis is a serious sequel to acute Q fever and underlying heart valve pathology. Due to its indolent progression and poor outcome when diagnosis is delayed, a thorough cardiac assessment of all patients with suspected or confirmed Q fever is important.

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CONFLICT OF INTEREST

None declared.

REFERENCES

1. Maurin M, Raoult D. Q Fever. *Clinical Microbiology Reviews* 1999; 12(4): 518-553.
2. Parker NR, Barralet JH, Bell AM. Q fever. *The Lancet* 2006; 367(9511): 679-688.
3. Marmion BP. A guide to Q fever and Q fever vaccination. Victoria: CSL Biotherapies, 2009.
4. Massung R. Q Fever. In: DL Heymann, editor. Control of Communicable Diseases Manual. 19th ed. Washington: American Public Health Association, 2008; 494-498.
5. Garner MG, Longbottom HM, Cannon RM, Plant AJ. A review of Q fever in Australia 1991-1994. *Australian and New Zealand Journal of Public Health* 1997; 21(7): 722-730.
6. Hatchette TF, Hayes M, Merry H, Schlech WF, Marrie TJ. The effect of C.burnetii infection on the quality of life of patients following an outbreak of Q fever. *Epidemiology and Infection* 2003; 130(3): 491-495.
7. Massey PD, Irwin M, Durrheim DN. Enhanced Q fever risk exposure surveillance may permit better informed vaccination policy. *Communicable Disease Intelligence* 2009; 33(1): 41-45.
8. Marmion BP, Shannon M, Maddocks I, Storm P, Penttila I. Protracted debility and fatigue after acute Q fever. *The Lancet* 1996; 347(9006): 977-978.
9. Ayres JG, Smith EG, Flint N. Protracted fatigue and debility after acute Q fever. *The Lancet* 1996; 347(9006): 978-979.
10. Ormsbee RA, Marmion BP. Prevention of Coxiella burnetii infection: vaccines and guidelines for those at risk. In: Marrie TJ, editor. Q fever: the disease. Volume 1. Boca Raton, Florida: CRC Press, 1990; 225-248.
11. Chiu CK, Durrheim DN. A review of the efficacy of human Q fever vaccine registered in Australia. *NSW Public Health Bulletin* 2007; 18(7-8): 133-136.
12. The Australian Immunisation Handbook. National Health and Medical Research Council. 9th ed. Canberra: Australian Government Publishing Service; 2008.
13. NNDSS Annual Report Writing Group. Australia's notifiable disease status, 2007: Annual Report of the National Notifiable Disease Surveillance System. *Communicable Disease Intelligence* 2009; 33(2): 89-154.
14. Communicable Diseases Branch, NSW Department of Health. Year in review: communicable disease surveillance, NSW, 2008. *NSW Public Health Bulletin* 2009; 20(9-10): 141-151.
15. Islam A, Ferguson J, Givney R, Graves S. Seroprevalence to *Coxiella burnetii* among residents of the Hunter New England region of New South Wales, Australia. *American Journal of Tropical Medicine and Hygiene* 2011; 84(2): 318-320.
16. Fournier PE, Marrie TJ, Raoult D. Diagnosis of Q fever. *Journal of Clinical Microbiology* 1998; 36(7): 1823-1834.
17. Raoult D, Tissot-Dupont H, Foucault C, Gouvernet J, Fournier PE, Bernit E, et al. Q Fever 1985-1998: Clinical and epidemiologic features of 1,383 infections. *Medicine* 2000; 79(2): 109-123.
18. Landais C, Fenollar F, Thuny F, Raoult D. From acute Q fever to endocarditis: serological follow-up strategy. *Clinical Infectious Diseases* 2007; 44: 1337-1340.

19. Wilson HG, Neilson GH, Galea EG, Stafford G, O'Brien MF. Q fever endocarditis in Queensland. *Circulation* 1976; 53(4): 680-684.
20. Fenollar F, Fournier PE, Carrieri P, Habib G, Messana T, Raoult D. Risk factors and prevention of Q fever endocarditis. *Clinical Infectious Diseases* 2001; 33(3): 312-316.
21. Fenollar F, Thuny F, Xeridat B, Lepidi H, Raoult D. Endocarditis after acute Q fever in patients with previously undiagnosed valvulopathies. *Clinical Infectious Diseases* 2006: 42: 818-821.
22. Houpikian P, Habib G, Mesana T, Raoult D. Changing clinical presentation of Q fever endocarditis. *Clinical Infectious Diseases* 2002; 34(5): e28-34.
23. Fournier PE, Casalta JP, Habib G, Messana T, Raoult D. Modification of the diagnostic criteria proposed by the Duke Endocarditis Service to permit improved diagnosis of Q fever endocarditis. *American Journal of Medicine* 1996; 100(6): 629-633.
24. Li JS, Sexton DJ, Mick N, Nettles R, Fowler VG, Ryan T, et al. Proposed modifications to the Duke criteria for the diagnosis of infective endocarditis. Clinical Infectious Diseases 2000; 30(4): 633-638.
25. Stenos J, Graves S, Lockhart M. Coxiella burnetii. In: Schuller M, Sloots TP, James GS, Halliday CL, Carter IWJ, editors. PCR for clinical microbiology. An Australian and international perspective. Springer Science + Business Media B.V., 2010; 145-148.
26. Raoult D, Marrie TJ, Mege JL. Natural history and pathophysiology of Q fever. *Lancet Infectious Diseases* 2005; 5(4): 219-226.
27. Health Outcomes Information Statistical Toolkit (HOIST) database collection warehouse: *NSW Inpatient Statistics Collection*. Centre for Epidemiology and Research, NSW Department of Health. [Accessed 22 April 2010]
28. GraphPad Software. Fisher's exact test. Available online at: http://www.graphpad.com/quickcalcs/CatMenu.cfm [accessed 17 September 2010].
29. Luck J, Peabody JW, Dresselhaus TR, Lee M, Glassman P. How well does chart abstraction measure quality? A prospective comparison of standardised patients with the medical record. *American Journal of Medicine* 2000; 108(8): 642-649.
30. NSW Department of Health. Q fever factsheet. Available online at: http://www.health.nsw.gov.au/factsheets/infectious/qfever.html [updated 11 March 2011; accessed 19 September 2011]

TABLES

Table 1: Characteristics of hospitalised Q fever patients (HNE, 2005-2009)

Characteristics	**n=89 n[%]**
Age (years)	
Median age (range)	46 (14-74 years)
Sex	
Male	76 (85)
Female	13 (15)
Aboriginal or Torres Strait Islander background	
Yes	3 (3)
No	83 (93)
Unknown	3 (3)
Type of hospital	
District hospital	48 (54)
Rural referral hospital	29 (33)
Tertiary referral hospital	12 (13)
Admission (days)	
Median length of stay (range)	4 (1-61 days)
Diagnosis of Q fever	
Prior to hospital admission	2 (2)
During hospital admission	20 (22)
After hospital admission	67 (75)

Table 2: Medical record review of hospitalised Q fever patients (HNE, 2005-2009)

Medical Record Review	**Known Q fever cases (n=2) n (%)**	**Suspected Q fever cases (n=87) n (%)**
Cardiac history		
Recorded	1 (50)	8 (9)
Not recorded	1 (50)	79 (91)
Cardiac history questions recorded		
Ischaemic heart disease	1 (50)	6 (7)
Rheumatic fever/rheumatic heart disease	-	2 (2)
Other heart conditions (Atrial fibrillation, arrhythmia)	-	1 (1)
Cardiac valve disease/surgery	-	-
Cardiac examination		
Recorded	2 (100)	67 (77)
Not recorded	-	20 (23)
Cardiac examination recorded		
Heart auscultation	2 (100)	57 (66)
Chest auscultation (lungs)	2 (100)	66 (76)
Jugular venous pressure	1 (50)	24 (28)
Hepato- and/or splenomegaly	-	42 (48)
Peripheral oedema	2 (100)	19 (22)
All of the above (complete examination)	-	6 (7)

Table 3: Comparison of Q fever cases admitted to a district hospital versus cases admitted to a rural or tertiary referral hospital

Medical Record Review	**District hospital (n=48) n (%)**	**Rural or tertiary referral hospital (n=41) n (%)**	**P-value***
Cardiac history			
Recorded	1 (2)	8 (20)	0.01
Not recorded	47 (98)	33 (80)	
Cardiac history questions recorded			
Ischaemic heart disease	1 (2)	6 (15)	
Rheumatic fever/rheumatic heart disease	-	2 (5)	
Other heart conditions (Atrial fibrillation, arrhythmia)	-	1 (2)	
Cardiac valve disease/surgery	-	-	
Cardiac examination			
Recorded	28 (58)	41 (100)	<0.0001
Not recorded	20 (42)	-	
Cardiac examination recorded			
Heart auscultation	21 (44)	38 (93)	
Chest auscultation (lungs)	27 (56)	41 (100)	
Jugular venous pressure	1 (2)	24 (59)	
Hepato- and/or splenomegaly	14 (29)	28 (68)	
Peripheral oedema	1 (2)	20 (49)	
All of the above (complete examination	-	6 (15)	
Diagnosis of Q fever			
Prior to hospital admission	1 (2)	1 (2)	ns
During or after hospital admission	47 (98)	40 (98)	

* P-value was calculated using the two-sided Fisher's exact test as at least one cell value <5

CHAPTER 9: MALARIA PREVENTION FOR TRAVELLERS FROM RURAL AUSTRALIA

Preamble

Background

People from rural, Australia travel for many reasons to areas where malaria is endemic. When patients seek travel health advice with their General Practitioner more than three-quarters of patients are not referred to a travel health specialist or clinic. [1] Along with many other skills, General Practitioners need a good understanding of travel medicine and reliable resources.

Appropriately assessing the risk of malaria in an individual traveller can be a complex consultation for health care providers, especially for practitioners working outside of the specialised travel medicine clinic. [2] There are a number of specific travel medicine references and software applications available, however they are expensive and therefore often not practical for the rural General Practitioner. Extensive time spent practising travel medicine is usually required to gradually accumulate specific knowledge of the epidemiology of malaria. [2] Difficulties in accessing specialist travel health advice in rural areas, or General Practitioners relying on resources that do not align with specialist advice, may result in increased risk of acquiring malaria in travellers from these areas.

In Australia, the mosquito *Anopheles farauti sensu lato* is considered the most important vector of malaria.[3] It is principally found in areas north of 19° latitude in Queensland and north of 15° latitude in the Northern Territory. *Anopheles* mosquito vectors have not been reported in the study area. Using mathematical modelling, the risk of a malaria outbreak occurring in NSW was assessed and is thought to be very low, especially in rural areas where there is a relatively low density of people. Malaria is not a major health risk in NSW although the possibility of transmission cannot be ruled out completely. [3]

Studies presented

This chapter describes an investigation into a cluster of malaria cases in a group of travellers from regional NSW. The aims of the public health investigation were to determine awareness of travellers of the risk of developing malaria in Papua New Guinea, and to analyse risk factors for malaria focusing on operational issues of malaria prevention for travellers from a

rural area. An assessment of the travel health resource used to support General Practitioners in this cluster was also compared to the current specialist travel health advice.

Impacts

The outcomes of the work have been used to advocate for changes in the Australian Medicines Database 'MIMS' on the duration of post-exposure doxycycline malaria chemoprophylaxis. The information in this resource, which is used by health care providers including in this study, was not consistent with specialist travel medicine advice and may result in increased risk of malaria.

Publications arising from this chapter:

9.1 Malaria prevention

Massey P, Durrheim DN, Speare R. Inadequate chemoprophylaxis and the risk of malaria. *Australian Family Physician* 2007; **36(12):** 1058-1060.

My estimated contribution was 70%.

References

1. Thava Seelan S, Leggat PA. Referral of travellers from Australia by general practitioners for travel health advice. *Travel Medicine and Infectious Diseases*. 2003;1: 185-188.
2. Batchelor T, Gherardin T. Prevention of malaria in travellers. *Australian Family Physician*. 2007; 36:316-20.
3. Ewald BD, Webb CE, Durrheim DN, Russell RC. Is there a risk of malaria transmission in NSW?. *New South Wales Public Health Bulletin* 2008; 19: 127–131.

RESEARCH

Inadequate chemoprophylaxis and the risk of malaria

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BACKGROUND
Malaria is an important disease for Australian travellers, particularly to Papua New Guinea. Travellers often seek health advice from their general practitioner before travel or if they develop illness after travel.

METHOD
A retrospective cohort investigation into malaria risk in a group of adult Australians that trekked the Kokoda trail in Papua New Guinea.

RESULTS
Six of 38 group members were diagnosed with malaria on return from Papua New Guinea. None of the 12 individuals who took chemoprophylaxis for the recommended period post-travel developed malaria compared to 4/24 travellers who terminated prophylaxis prematurely or 2/2 who took no chemoprophylaxis.

DISCUSSION
Chemoprophylaxis is effective if taken for the full recommended period following travel to a malaria endemic area; 4 weeks for doxycycline and mefloquine, and 7 days for atovaquone+proguanil. Malaria is a likely cause of illness in recently returned travellers from Papua New Guinea who develop a febrile illness.

Malaria is the most important parasitic disease affecting people living in and travelling to malaria endemic areas.[1] Due to large scale global travel some people infected with malaria may develop symptoms in countries where malaria is not endemic. The risk of malaria for travellers varies substantially depending on the area visited, intensity of transmission, season and exposure factors, including type of accommodation and itinerary.[2]

Malaria in humans is caused by four parasite species: *Plasmodium falciparum*, *P. vivax, P. ovale* and *P. malariae.* Transmission is through the bite of an infected female Anopheles mosquito. The incubation period varies from 7–30 days but chemoprophylaxis can prevent malaria or delay the onset of illness by weeks or months. Delays characterise *P. vivax* and *P. ovale* infections that produce dormant liver stage parasites. The diagnosis of malaria depends on the demonstration of parasites on a blood smear or a positive blood antigen test. Commonly the clinical picture includes: fever, chills, sweats, headaches, nausea and vomiting, and malaise. Serious complications may accompany *P. falciparum* infections, particularly cerebral malaria, severe anaemia and multi-organ failure. Malaria can be a fatal disease. However, illness and death from malaria can be prevented.[3]

In Australia there were 799 notifications of malaria in 2004–2005 and none were reported as locally acquired.[4] Papua New Guinea (PNG) is often implicated as the source of infection among Australian travellers who are diagnosed with malaria after overseas travel.[5] The contribution of PNG to imported malaria in Australia has ranged from 18–74% depending on the year studied and region of study.[5–7] Malaria is endemic in areas below 1800 m altitude in PNG, but can also occur in the highlands.[8] All four malaria species are present in PNG with the potentially life threatening *P. falciparum* being present throughout the malaria affected area at levels rarely found outside sub-Saharan Africa.[9] The major malaria vectors *Anopheles farauti*, *A. koliensis* and *A. punctulatus* are found in coastal, low lying and highland areas of PNG. These species have different biting activity, but peak activity is between sunset and dawn.[10]

Unfortunately no effective vaccine against malaria is currently commercially available.[11] Travellers to malaria endemic areas are advised to use effective personal protection measures (PPM) and chemoprophylaxis. The predominant site of action of many antimalarial chemoprophylactic drugs is the blood stage rather than the liver stage of the plasmodium parasite. These antimalarials must be taken for 4 weeks after the last possible exposure to malaria infection to enable action against blood stage

parasites as they emerge from the liver.[1,12]

Personal protection measures include bed nets and other materials impregnated with insecticides, window and door screens, knockdown insecticides indoors, covering exposed areas with light coloured clothing and shoes and socks, regularly applying an insect repellent that contains N-diethyl-meta-toluamide, using mosquito repellent coils and vapourising mats, and avoiding exposure during peak biting times.[13] Where PPM is combined with appropriate chemoprophylaxis, the risk of malaria infection can be reduced.[14] Australian travellers rely on their general practitioner, or on a GP specialising in travel medicine, for advice on malaria prevention measures and for prescribing malaria prophylaxis before travelling.

We report on the malaria risk experience of a group of 38 Australians who travelled in three teams to PNG at the end of August 2006 and were involved in trekking and volunteer work. After visiting PNG, four adult residents of rural northern New South Wales were notified by an alert GP with a diagnosis of malaria to the local population health unit. The teams spent 15–17 nights in PNG, starting in Port Moresby, trekking the Kokoda trail and finishing in the coastal area near Gona. The groups participated in community work in villages along the way.

The aims of the public health investigation were to ensure that all members were aware of the risks of developing malaria postexposure, to detect and manage cases appropriately, and to analyse contributing risk factors.

Method

A retrospective cohort investigation was conducted. Contact details were obtained and all members of the travel group were included in the investigation. As this was a high priority public health investigation under the auspices of the New South Wales *Public Health Act 1991*, ethics approval for the investigation was not required.

A standard questionnaire was used to investigate signs and symptoms of malaria, itinerary, types of accommodation, nature of activities, use of PPMs, travel advice sought, type of chemoprophylaxis prescribed, doses of chemoprophylaxis taken, post-travel febrile illness and medical advice given.

The use of six recommended PPM during the high risk mosquito biting period between dusk and dawn were investigated, namely restricting outdoor activities, use of bed nets, indoor knockdown insecticide, mosquito coils, long clothing and topical repellent.

The duration of the investigation extended over 3 months after the group's return from PNG. Group members who had not experienced any illness were advised to immediately seek medical advice should they develop malaria symptoms during the subsequent 3 months and contact the population health unit. Two additional group members were subsequently diagnosed with malaria.

Diagnosis of malaria was made by demonstrating malaria parasites in specifically stained thick or thin blood films or by an immunochromatographic rapid diagnostic test (RDT) when blood films were not available. These tests were conducted by an accredited reference laboratory in Sydney, New South Wales.

Data were analysed using SPSS® for Windows® (version 13 SPSS Inc, Chicago, Ill, USA) for descriptive analysis of proportions, and Fisher's exact test or likelihood ratios were used for comparing proportions as appropriate.

Results

All 38 (100%) members of the travel group participated in the investigation, and there were no missing data. The median age of group members was 45 years with a range 18–70 years. Of seven travellers who reported developing a febrile illness on return to Australia, six (86%, $p<0.001$) were subsequently diagnosed with malaria. The onset of illness for malaria cases ranged from 1–16 weeks after return. Hospital treatment was required for five of the malaria cases.

P. vivax was identified in blood smears in 4/6 cases. One patient was positive for *P. vivax* using a RDT and included as a case. The remaining case was presumptively diagnosed and treated for malaria based on clinical grounds. This patient had partially self treated during the trip and had no other cause identified for this febrile illness. The pathology for this patient remained negative despite repeated testing.

Malaria was diagnosed in members of each team: 1/21 of team one, 2/12 of team two and 3/4 of team three (likelihood ratio =4.624, $p=0.10$). Overnight accommodation included staying briefly in a hotel, open air 'guesthouses' (*Figure 1*), tents with or without screens, or sleeping in the open. The duration in different accommodation types did not differ significantly between cases and noncases.

Figure 1. 'Guesthouse' accommodation on the track

Twenty-five (65%) group members always wore long sleeved shirts and trousers and 19 (50%) always used insect repellent during the highest risk period. No members used all six PPMs always or often (*Table 1*). Only one traveller took their own bed net. There was no significant difference in PPM use between malaria cases and noncases in this group.

All but one of the group consulted a GP before travel. Malaria infection occurred in 2/2 (100%) of the group members who did not take chemoprophylaxis and 4/36 (11%) people who did take chemoprophylaxis ($p=0.021$). Three types of chemoprophylaxis were used; doxycycline by 28 (78%), mefloquine by 6 (17%), and atovaquone+proguanil by 2 (6%). Malaria occurred in those using doxycycline (3/28) or mefloquine (1/6) but there was no statistical association with type of chemoprophylaxis used.

Five of the individuals using chemoprophylaxis (14%) missed doses and only 12 (33%) continued use for the recommended period after leaving the malarious area (4 weeks for doxycycline and mefloquine, and 7 days for atovaquone+proguanil).[15] None of the 12 individuals who took chemoprophylaxis for the recommended period developed malaria compared to 4/24 (17%) of those who terminated chemoprophylaxis prematurely, either by choice or by following the schedule prescribed by their GP (likelihood ratio=3.489, $p=0.062$).

Most (30/38) members of the travel group reported not seeing any mosquitoes during their journey through PNG.

Table 1. Reported number of PPMs always or often used, by malaria diagnosis

Number of PPMs always/ often used	Malaria	No malaria	Total
0	1	2	3
1	1	9	10
2	2	18	20
3	1	3	4
4	1	0	1
>5	0	0	0
Total	6	32	38

Discussion

Chemoprophylaxis and PPMs remain integral to malaria prevention. This investigation documented infrequent use of multiple PPMs even though travel occurred in an area known to have malaria. Pretravel consultations should emphasise the importance of combining chemoprophylaxis with multiple effective PPMs that limit mosquito exposure.[16]

The 100% attack rate among people who did not take any chemoprophylaxis is a compelling argument for taking effective chemoprophylaxis when visiting high risk malaria areas. This is particularly important in rural locations in PNG where available accommodation, as in the current case, may not provide an adequate barrier to Anopheles mosquitos feeding during peak biting periods.

For travellers returning from a malaria endemic area, including PNG, it is recommended that chemoprophylaxis be continued for the recommended period after travel to cover infection acquired up to the final day of stay. Irregular use has previously been linked with malaria infection in Australian travellers.[7] Our investigation supports the importance of counselling travellers that chemoprophylaxis should be continued for the recommended period post-travel. Each case of malaria in this investigation occurred in a group member who had taken either no chemoprophylaxis or terminated their chemoprophylaxis earlier than the recommended period.

Malaria risk varies over time, between and within countries and is dependent on a range of factors including climate, the presence of Anopheles mosquitoes, malaria parasites being able to complete their growth cycle in the mosquitoes ('extrinsic incubation period'), nature of accommodation and human behavioural factors.[3] It would be useful for GPs who provide pre-travel advice or post-travel assessment to have ongoing access to up-to-date and reliable information on malaria risk and prevention strategies.

This investigation was limited by the small number of travellers in the cohort and the delayed and self reported nature of risk and protective factors.

Malaria infection usually presents as a febrile illness. In patients with inadequate chemoprophylaxis use, disease onset may be delayed for weeks or months. Our investigation demonstrates the importance of maintaining a high index of suspicion for malaria in travellers returning from malaria endemic countries, with 6/7 travellers in this cohort that developed fever post-travel being diagnosed with clinical or confirmed malaria. Being alert for possible clusters of infection and timely notification can ensure optimal clinical and public health management.

Implication for general practice

- Malaria is the most important parasitic disease affecting people living in and travelling to malaria endemic areas.
- Pretravel consultations should emphasise meticulous use of effective chemoprophylaxis for the full recommended period after return coupled with multiple effective PPMs to reduce the risk of infection and disease.
- Malaria infection usually presents as a febrile illness. In patients with inadequate chemoprophylaxis use, disease onset may be delayed for weeks or months.

Conflict of interest: none declared.

References

1. Franco-Paredes C, Santos-Preciado JI. Problem pathogens: prevention of malaria in travellers. Lancet 2006;6:139–49.
2. Dürrheim DN, Leggat PA, Shanks GD. Malaria Prevention. In: Leggat PA, Goldsmid J, editors. Primer of travel medicine. 3rd edn revised. Brisbane: ACTM Publications, 2005; p. 25–34.
3. Centers for Disease Control and Prevention. Prevention of specific infectious diseases. In: Health Information for International Travel 2005–2006. Atlanta: US Department of Health and Human Services, Public Health Service, 2005. Available at www.cdc.gov/travel/yb/index.htm [Accessed 25 April 2007].
4. Liu C, Broom AK, Kurucz N, Whelan PI. Communicable Diseases Network Australia National Arbovirus and Malaria Advisory Committee annual report 2004–05. Commun Dis Intell 2005;29:341–57.
5. Robinson P, Jenney AW, Tachado M, et al. Imported malaria treated in Melbourne, Australia: epidemiology and clinical features in 246 patients. J Travel Med 2001;8:76–81.
6. Boreham RE, Relf WA. Imported malaria in Australia. Med J Aust 1991;155:754–7.
7. Charles DM, Hart J, Davis WA, Sullivan E, Dowse GK, Davis TM. Notifications of imported malaria in Western Australia, 1990–2001: incidence, associated factors and chemoprophylaxis. Med J Aust 2005;182:164–7.
8. Mueller I, Namuigi P, Kundi J, et al. Epidemic malaria in the highlands of Papua New Guinea. Am J Trop Med Hyg 2005;72:554–60.
9. Mueller I, Taime J, Ibam E, et al. Complex patterns of malaria epidemiology in the highlands region of Papua New Guinea. P N G Med J 2002;45:200–5.
10. Benet A, Mai A, Bockarie F, Lagog M, et al. Polymerase chain reaction diagnosis and the changing pattern of vector ecology and malaria transmission dynamics in Papua New Guinea. Am J Trop Med Hyg 2004;71:277–84.
11. Greenwood BM, Bojang K, Whitty CJM, Targett GAT. Malaria. Lancet 2005;365:1487–98.
12. Schwartz E, Parise M, Kozarsky P, Cetron M. Delayed onset of malaria: implications for chemoprophylaxis in travelers. N Engl J Med 2003;349:1510–6.
13. Juckett G. Malaria prevention in travellers. Am Fam Physician 1999;59:2523–34.
14. Lin H, Linn N, Kyaw MP, et al. The use of personal protective measures in control of malaria in a defined community. Southeast Asian J Trop Med Public Health 1997;28:254–8.
15. Therapeutic Guidelines Limited. Therapeutic guidelines: antibiotic. 13th edn. North Melbourne: 2006; p. 145–51.
16. Dürrheim DN, Leggat PA. Prophylaxis against malaria. Preventing mosquito bites is also effective. BMJ 1999;318:1139.

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CHAPTER 10: CONCLUSION, OUTCOMES AND FUTURE RESEARCH DIRECTIONS

The overall aim of this research thesis was to expand the evidence base for controlling communicable diseases in regional and rural Australia. The north-west regional area of New South Wales was the main setting for these studies. A particular focus was Aboriginal and Torres Strait Islander peoples, and people in close contact with livestock and feral animals.

Communicable diseases continue to pose a significant challenge to the public's health. Communicable diseases are still a leading cause of morbidity and mortality around the world, and those most at risk are the less advantaged [1]. Communicable diseases also impact the people of rural, regional and remote Australia. Rural and regional Australia is different from metropolitan Australia. The defining characteristic of rural is geography but rural and remote Australia are also sociologically, culturally, economically and spiritually different from metropolitan areas, as well as internally diverse [2]. Building evidence to reduce the risk and impact of communicable diseases will assist in narrowing the urban/rural health divide.

An operational research framework was used to investigate the risks and advocate for change to policy and practice. The operational research approach enables research to be focused on addressing key issues in health programs. This approach has a natural synergy with communicable disease prevention and control in rural, regional and remote Australia, where health and research resources are scarce.

The World Health Organization defines operational research as "the use of systematic research techniques for program decision-making to achieve a specific outcome." [3] This methodological approach is designed to provide policymakers and managers with evidence that can be used to improve program operations. It is distinguished from other kinds of research as it addresses specific problems within specific programs, not general health issues. Operational research addresses those problems that can be influenced within programs and utilises systematic data collection procedures, both qualitative and quantitative, to accumulate evidence to support decision-making.

A pragmatic approach to addressing program and policy deficiencies connects easily with the rural and regional nature of healthcare [2]. However, operational research per se, especially in comparatively health resource limited rural and remote Australia [4], is unethical if it does not lead to program improvements.

Main findings

PANDEMIC INFLUENZA IN RURAL AREAS

Influenza A(H1N1)pdm09 caused the first influenza pandemic of the 21st century [5]. Much of the focus of pandemic planning had been on controlling the disease in metropolitan centres, but during 2009 higher rates of laboratory confirmed disease were seen in rural, regional and remote Australia [6].

Aboriginal and Torres Strait Islander people were over-represented amongst the more severe Australian cases with approximately 20% of all hospital admissions being Aboriginal or Torres Strait Islander people even though the total population proportion is only 2% [6]. A similar proportion required intensive care treatment [7]. The research of this thesis has demonstrated that in New South Wales, Aboriginal and Torres Strait Islander people were four times more likely to be admitted to hospital with A(H1N1)pdm09 influenza than non-Aboriginal people.

Through a consultation project with Aboriginal communities as part of this research, risks were identified to limiting the negative impact of pandemic influenza; and a number of potential solutions emerged from focus group discussions. Communication was identified as the main area requiring solutions. The local resource people, or “go-to” people, in an Aboriginal community are people who are heard and trusted. It is especially these people who need to receive information about pandemic influenza. The communication must demonstrate respect for culture and be presented simply and clearly. In addition improving access to health services was raised as a key issue.

Other disease prevention strategies that emerged from this study were that infection control messages needing to be aligned with the reality of life in many Aboriginal communities.

Sneezing into the crook of the arm is possible if people cannot afford tissues for the whole family. The importance of people attending family and cultural gatherings needed recognition and modifying case isolation policies should reflect this. Standing back at funerals with the support of Elders and talking outside with visitors to the home were seen as acceptable strategies. Of particular importance for health services and Government, was that Aboriginal people need to have a say in how support is provided in future responses.

Influenza pandemics are a serious threat to the health and social functioning of Aboriginal communities. Measures to reduce the risk of influenza in communities must be developed with the communities to maximise their acceptance. The process of engagement and ongoing respectful negotiations with communities is critical to developing culturally appropriate pandemic mitigation and management strategies.

Working within a Participatory Action Research methodology, and overseen by the Hunter New England Aboriginal Health Partnership, the process of engagement and negotiation with Aboriginal communities yielded pandemic influenza control strategies that were based in community understanding. These strategies would make a good starting point for dialogue between public health service and Aboriginal and Torres Strait Islander communities. This partnership would allow further development of strategies to mitigate pandemic influenza in culturally appropriate and respectful ways.

Planning and preparing for pandemic influenza enables a regional area to develop or modify strategies to meet the needs of the local population. The findings of the operational research in this thesis have demonstrated that there are opportunities to streamline mass vaccination operations to increase clinic capacity in a regional area. This modification to policy and practice would result in reduced client throughput time, enhanced involvement of external agencies, and modified clinic roles.

Clinical nurse consultants, nurse educators and nurse managers working within a health authority were found to be an appropriate public health surge workforce during health emergencies if provided with appropriate training and support. This finding is important for rural areas with limited baseline public health capacity.

An analysis of the 2009 influenza pandemic response showed that there were parts of the state, especially regional areas where the pandemic was not as pronounced. There may

have been benefits in extending pandemic containment measures in these less affected areas and in communities where large numbers of vulnerable people, such as Aboriginal and Torres Strait Islander peoples, live. This study found that containment is worthwhile in limiting the spread of disease in specific situations, but is unlikely to change the course of a pandemic unless it can be sustained until a large proportion of the population is vaccinated.

LEARNING FROM OUTBREAKS

Outbreaks of disease provide opportunities for public health practitioners to review response protocols and systems. In addition, outbreaks are a useful indicator of how effective a surveillance system is. Boarding schools, in common with other institutions where people live in close proximity, are vulnerable to outbreaks of respiratory illness.

The review of a respiratory outbreak at a boarding school in this thesis found that increased sensitivity to outbreaks and enhanced prevention strategies need to be adopted by schools and clinicians providing care to boarders. Clusters of pneumonia in students of a boarding school should alert clinicians to possible co-infection with influenza virus and *Streptococcus pneumoniae*. This alert should then prompt the appropriate laboratory investigations and notification to public health authorities. In addition, strategies to increase the sensitivity of a surveillance system, including signal generation by age-group rather than the whole population, may allow earlier notification of an outbreak and thus an earlier response.

The study found that strategies for limiting the risk of respiratory illness in boarding schools are required. These strategies should include education on respiratory hygiene, guidelines for limiting overcrowding, consideration of annual influenza vaccination and guidelines for early detection and response to respiratory outbreaks.

ABORIGINAL AND TORRES STRAIT ISLANDER STATUS OF PEOPLE WITH INVASIVE NOTIFIABLE DISEASES

Immunisation against Meningococcal C is a very effective prevention strategy, but the vaccine does not protect against the more common B serotype. According to data reported by the Australian Childhood Immunisation register the Meningococcal C vaccination coverage for 0-4 year olds, in the study area, over the study period, was 94%. [8]

The early recognition and diagnosis of invasive meningococcal disease (IMD) can lead to reduced risk of complications. In addition to clinicians being aware of a higher risk of IMD in young children, this research indicates an even higher risk in young Aboriginal children. The study revealed that in New South Wales, Aboriginal and Torres Strait Islander children 0–4 years of age have a significantly higher risk (Relative risk 3.31; 2.35 to 4.68 95% CI) of IMD when compared with non-Aboriginal children.

Referring to routine hospital admission data proved a useful and time efficient surveillance strategy to increase the proportion of invasive pneumococcal disease (IPD) notifications with Aboriginal and Torres Strait Islander status recorded. Aboriginal and Torres Strait Islander children aged 0-4 years were found to have a two-to three-fold higher rate of IPD than non-Indigenous children and thus high levels of timely pneumococcal immunisation coverage remain important for young Aboriginal and Torres Strait Islander children.

TUBERCULOSIS AND COUNTRY OF BIRTH

This novel method used to review notified cases of tuberculosis (TB) in NSW provided some useful epidemiological insights into TB. During the study period, 2006-2008, there were 1401 notified TB cases in the state of NSW. Of the TB cases 76.5% were born in a high-incidence country. The annualised TB rate for the high-incidence country-of-birth group was 61.2/100,000 population and 1.8/100,000 population annualised TB rate for the remainder of the population.

Of the 152 local areas in NSW, nine had higher and four had lower TB rates in the high-incidence country-of-birth population than the high-incidence country-of-birth population for the rest of NSW. Of the local areas with higher TB rates, four areas had higher TB rates in people with a high-incidence country of birth and those not born in a high-incidence country. The regional area of Hunter New England had rates of TB that were as expected given the country of birth mix of the population.

This study found that understanding TB incidence, taking into account the different mix of populations by incidence in country of origin in local areas, would enable health services to strategically target more detailed epidemiological investigations and TB control measures to areas with greater likelihood of TB.

BRUCELLOSIS

Although locally acquired brucellosis was not believed to occur in NSW prior to this thesis, the studies included in this thesis found that feral pig hunting is likely to be a risk factor for locally acquired *Brucella suis* infection in northwest NSW. The study into appropriate prevention strategies revealed that many of the current strategies to reduce the risk of brucellosis in Queensland did not appear appropriate or acceptable to feral pig hunters.

Alternate strategies emerged from the interviews with the feral pig hunters. The strategies were grounded in the participants' experiences and included: taking more time and watching their hands when making cuts; having good lighting; taking extra care when cutting near a sow's uterus; and using latex gloves to cover cuts on their hands. The strategies now need to be tested in the real activity, especially evisceration in the scrub.

Q FEVER

The analysis of the current epidemiology of Q fever in New South Wales demonstrated that amongst notified cases the relative importance of non-abattoir contact with livestock, wildlife or feral animals appears to be increasing. A fifth of notified rural residents described participating in activities that exposed them directly or indirectly to animals, their tissues and products in a non-work setting. The study found that the surveillance field 'Occupation' no longer alone adequately described risk exposure for many of the people notified with Q fever and a new field that describes risk exposures is required. This change would allow a more finely tuned focus for future vaccination policy.

Q fever endocarditis is a serious sequel to acute Q fever in people with underlying cardiac valve pathology. The medical record review found a low level of documenting cardiac assessment for hospitalised Q fever patients. This is of concern as it may indicate cardiac assessments were not performed and opportunities for preventing chronic Q fever infection missed.

MALARIA PREVENTION

In a cohort study conducted as part of this thesis it was found that six members of group of 38 were diagnosed with malaria on return from Papua New Guinea. None of the 12

individuals who took chemoprophylaxis for the recommended period post-travel developed malaria compared to 4/24 travellers who terminated prophylaxis prematurely or 2/2 who took no chemoprophylaxis.

The mosquito vector that is considered the most important for malaria transmission in Australia has not been reported in the study area. Malaria has been assessed to not be a major health risk in NSW, although the possibility of transmission cannot be ruled out completely. [9]

The study showed that chemoprophylaxis is effective if taken for the full World Health Organization recommended period following travel to a malaria endemic area; 4 weeks for doxycycline and mefloquine, and 7 days for atovaquone+proguanil. It was found that the Australian formulary advice relied upon by the prescribing general practitioners was not consistent with the current advice from the World Heath Organization.

Outcomes

A number of changes to policy and practice have already flowed from the studies in this thesis. The changes have been at local, state and inter-state levels.

The influenza pandemic of 2009 was not only a major test of public health emergency preparedness but it also brought with it opportunities to change and develop policy and practice. It has now become part of the policy and practice of the Hunter New England regional area to work closely with Aboriginal community controlled health services and Aboriginal communities in the design and implementation of influenza prevention and control strategies.

Responding directly to the findings from the studies, workshops have occurred during 2011 with “go-to” people in Aboriginal communities in the northwest of the state. These workshops discussed the family strategies and immunisation issues identified through the studies. In addition during the early part of the 2011 influenza season, the communication strategy between the public health unit and “go-to” people in Aboriginal communities was implemented. The findings from the studies have also been communicated with the Hunter New England Aboriginal Health Partnership, particularly the health service recommendations.

The findings were also shared with a national audience through a poster presentation at the Coalition for Research to Improve Aboriginal Health Aboriginal Health Research Conference in May 2011 and will be communicated at an international First Nations and Pandemics meeting scheduled for Cairns in September 2011.

Advocacy for changes to the National Plan for Human Influenza Pandemics have occurred. Further policy changes are being developed. An example is that the New South Wales Health Department has requested that the research team advise on and participate in the development of the revised State Public Health protocols on pandemic influenza and Aboriginal communities.

The Hunter New England Public Health Unit now routinely provides boarding schools in the study area with seasonal information about communicable diseases. This information includes influenza vaccination and respiratory hygiene messages for staff and students. As a result of the study on Aboriginal and Torres Strait Islander status of IMD, notification data completeness in NSW has improved to a level that the data is now being included in national reports. The Aboriginal and Torres Strait Islander field is now a required field in the dataset and data quality indicators are measured.

The method used to control for high incidence country of birth in local area TB rates has resulted in NSW Health indicating that this method will be replicated every two-three years statewide to enhance understanding of the local TB epidemiology across NSW and plan services.

The strategies for brucellosis prevention that emerged from this study are to be trialled in conjunction with a public health unit in Queensland where brucellosis is more common.

The risk of Q fever for livestock workers has been the focus of general practitioner education events in the northwest of the state. In addition the findings were discussed at two community meetings in northwest NSW where local action is now taking place to increase Q fever immunisation coverage of livestock workers.

Conclusion

The research in this thesis has identified a number of areas for improving health policy and practice. The main areas were: listening to people in the community; improving surveillance methods and epidemiological understanding; and improving public health practice.

The aim of this thesis was to add to the evidence base on the control of communicable diseases in a rural area, and specifically conduct epidemiological research for directing health policy and practice. The aim has been met, but further operational research questions have emerged. Some of the more pressing questions are now discussed.

Future research directions

Evaluation of the impact and effectiveness of policy changes is a vital step in the further development of this field of study. The studies in this thesis have highlighted areas for further consideration and investigation.

Continuing the Participatory Action Research approach with the Aboriginal communities involved will enable them to continue to have their say and direct how the study results are implemented. Exploring this implementation process is now the focus of a project grant from the National Health and Medical Research Council. Integral aspects of the research currently underway are the determination of the most appropriate and acceptable ways of supporting "go-to" people and testing the acceptability of family strategies identified through the studies. In-depth interviews with "go-to" people and culturally appropriate consideration of the issues identified during these interviews will enable deeper shared understanding. Aboriginal families have also been asked to trial the family strategies during the influenza season and will then be asked to share their experiences and views of the strategies.

The TB and country of birth study has shown that there are some local areas in NSW with higher rates of tuberculosis than expected given their local demography. It is possible that there is some local transmission of TB and delays in diagnosis occurring in these local areas. Further investigation through in-depth interviews with TB cases in areas with higher than expected rates is now indicated. Health services access and potential delays in TB diagnosis in these local areas should be explored as part of this work.

The brucellosis risk reduction strategies that emerged from the study will now be trialled in the challenging field setting of feral pig hunting. Working in collaboration with public health colleagues in Queensland, a sample of feral pig hunters in northwest NSW and southern Queensland will be asked to implement the strategies. Semi-structured interviews following this field trial will provide useful insights into the acceptability of the strategies and whether they are achievable. The strategies will then be further developed before dissemination to the game hunting community.

The changing epidemiology of Q fever demands a Q fever vaccination program that is targeted to young people prior to them having direct contact with livestock in high disease risk situations. A serosurvey and risk factor survey of a cohort of high school aged children in

a beef producing area is required to determine at what age young people are currently being infected.

Final word

The final word goes to one of the participants in the pandemic influenza studies with Aboriginal communities, and highlights the work of this thesis:

> *"Put things in place along the way. People will know and be better prepared for next time"* participant GC

References

1. Heymann DL. *Control of communicable diseases manual, 19th edition.* Washington; AHPA, 2008.
2. Wakerman J, Humphreys JS. Rural health: why it matters. *Medical Journal of Australia* 2002; **176:** 457-458.
3. World Health Organization. *Expanding capacity for operations research in reproductive health: summary report of a consultative meeting, WHO, Geneva, Switzerland, December 10–12, 2001*. WHO, Geneva, 2003.
4. Australian Institute of Health and Welfare 2010. Medical labour force 2008. Bulletin no. 82. Cat. no. AUS 131. Canberra: AIHW.
5. World Health Organization. *Influenza-like illness in the United States and Mexico, 24 April 2009*. (Online) 2009. Available: http://www.who.int/csr/don/2009_04_24/en/index.html (Accessed 1 September 2009).
6. Bishop JF, Murnane MP, Owen R. Australia's winter with the 2009 pandemic influenza A (H1N1) virus. *New England Journal of Medicine* 2009; **361(27):** 2591-2594.
7. ANZIC Influenza Investigators, Webb SA, Pettilä V, Seppelt I, Bellomo R, Bailey M, Cooper DJ, Cretikos M, Davies AR, Finfer S, Harrigan PW, Hart GK, Howe B, Iredell JR, McArthur C, Mitchell I, Morrison S, Nichol AD, Paterson DL, Peake S, Richards B, Stephens D, Turner A, Yung M. Critical care services and 2009 H1N1 influenza in Australia and New Zealand. *New England Journal of Medicine* 2009; **361:** 1925-1934.
8. Hunter New England Population Health, Health in Hunter New England HealtheResource, Hunter New England Area Health Service, 2010. Available at: http://www2.hnehealth.nsw.gov.au/HNEPH/HHNE/com/comImmun.htm - <Accessed 27.10.2011>
9. Ewald BD, Webb CE, Durrheim DN, Russell RC. Is there a risk of malaria transmission in NSW?. *New South Wales Public Health Bulletin* 2008; 19: 127–131.

APPENDICES

1. Research Protocol: Feasible containment strategies for swine influenza H1N1 in rural and remote Indigenous communities.

2. Interview questions: Brucellosis risk reduction strategies for feral pig hunters.

3. Survey tool: Nature of exposure to risk for Q fever in notified cases from HNE.

4. Survey tool: Risk factors for malaria in a group of travellers to Papua New Guinea.

5. Ethics approvals:
    a. Pandemic influenza and Aboriginal communities
        i. Hunter New England Human Research Ethics
        ii. James Cook University Human Research Ethics
        iii. Aboriginal Health and Medical Research Council of NSW
    b. Brucellosis and feral pig hunters
        i. Hunter New England Human Research Ethics

Research Protocol

Hunter New England Aboriginal Health Partnership
Mamu Health Services Ltd
Kimberley Aboriginal Medical Services Council
James Cook University, Curtin University

Feasible containment strategies for swine influenza H1N1 in rural and remote Indigenous communities

1. Background

Pandemic influenza is a large-scale, world-wide human influenza epidemic that is caused by a new influenza virus emerging that people have little or no immunity to (NSW Health). Pandemics have occurred throughout history every 10-50 years (COAG, 2006).

Recent planning for the next influenza pandemic has resulted in many local, state and national plans being developed. The National Action Plan for Human Influenza Pandemic (COAG, 2006) recognises that there will be individuals and social groups who require special consideration including Aboriginal and Torres Strait Islander Australians, but there is little evidence of this consideration being undertaken.

In the national emergency management strategy for remote Aboriginal and Torres Strait Islander communities, *Keeping Our Mob Safe* (Emergency Management Australia, 2007), it is noted that the planning and development of emergency operations in remote communities requires a holistic approach, including the participation of Aboriginal and Torres Strait Islander people at all levels. This requirement would also be relevant in non-remote Aboriginal and Torres Strait Islander communities. The needs of Aboriginal and Torres Strait Islander communities in the area of emergency management planning are identified as a priority by the report to the Council of Australian Governments, *Natural Disasters in Australia: Reforming mitigation, relief and recovery arrangements* (2002). Aboriginal and Torres Strait Islander communities have specific social, ecological and geographical issues to consider within emergency management planning.

Social, ecological and geographical factors are as important in the emergence and resurgence of infectious diseases as are molecular or microbiological factors (Maye, 2000).

During the pandemic of 1918-1919 Aboriginal and Torres Strait Islander populations were severely affected with a mortality rate approaching 50 per cent in some communities (Cleland Burton, 1928). Social, ecological and geographical factors provide an explanation of the disproportionately high mortality rates in these communities.

Epidemics are often cited as significant periods of intolerance and discrimination; as moments that lay bare societal views of Aboriginal and Torres Strait Islander, immigrant, and working-class peoples as diseases and threatening (Jones, 2005). There is a history of public health measures being shaped by social and cultural perceptions of marginalised groups as vectors of disease. Coercive public health measures have been seen as reinforcing racial stereotyping (Jones, 2005).

Quarantine is one of the public health measures to be used in the containment of pandemic influenza (COAG, 2006). But quarantine may be a double-edged sword by offering protection from disease to some and resulting in stigmatization and suffering to

others (Markel, 1997). Aboriginal communities in Australia already experience marginalization, stigmatisation, intolerance and discrimination without a pandemic.

The 1918-1919 pandemic has been described as causing terror among the inhabitants of Aboriginal stations and missions (Curson & McCracken, 2006). Some of this terror may have been due to the pandemic containment strategies applied. Similar strategies are being planned for future influenza pandemics (Commonwealth of Aust, 2006). These include:

• widespread adoption of good infection control practices in the community
• 'seek and contain' measures for new cases of infection, and the provision of antiviral medicines for people exposed to the virus or at continuous high risk of exposure
• special hospital arrangements for flu patients, 'fever clinics', or both
• possible restrictions on movement within Australia.

There is no evidence that the planned pandemic influenza containment strategies for Australia have been developed in respectful negotiation with Aboriginal and Torres Strait Islander communities. A group discussion of key stakeholders under the auspices of the Hunter New England Aboriginal Health Partnership has identified many difficult issues with the strategies. Some of these issues identified were:

- Poor access to health services will hinder early case finding;
- Suspicion in the community about Government lead programs;
- Fear about "control" measures and the current experience of dispossession and the stolen generations.
- Isolation may mean moving people hundreds of kilometres from their home and social supports;
- Containing people at home will be unlikely to be successful due to the large numbers of people living in some houses, a different understanding of what household means, the high proportion of children in the population, community and cultural requirements;
- The real understanding of who is a contact may be different in Aboriginal and Torres Strait Islander communities to what is described in the definitions;
- Contact tracing will be difficult due to the mobility of some people within Aboriginal and Torres Strait Islander communities and possible multiple names;
- Shame felt by people being contained;

Developing understanding of pandemic influenza and containment strategies within Health Services as well as within Aboriginal and Torres Strait Islander communities will enable containment strategies to be agreed on. Strategies need to be developed that will be acceptable and will work.

2. Methodology

Introduction

This proposal calls for a research process which has at its centre, the Aboriginal and Torres Strait Islander communities of the Hunter/New England region, North Queensland and the North-West Kimberley region.

For many Aboriginal and Torres Strait Islander people research has not been a positive experience (Smith 1999; Humphrey 2001). Aboriginal and Torres Strait Islander people have been the object of research since European occupation in this country. For at least

the last four decades that research effort has documented the stark differences between Aboriginal and Torres Strait Islander and non-Aboriginal and Torres Strait Islander Australians on every dimension of health and wellbeing (Oxfam Australia, 2007). Despite this vast empirical database and acknowledgment of what needs to be done to affect change, research evidence about every aspect of Aboriginal and Torres Strait Islander lives continues to be accumulated anew. Not surprisingly, Aboriginal and Torres Strait Islander people have said 'enough!' and have laid down clear guidelines for the conduct of research on Aboriginal and Torres Strait Islander issues (NHMRC 1991; 2003). These guidelines require all researchers to conduct their work according to Aboriginal and Torres Strait Islander priorities and processes, and respecting Aboriginal and Torres Strait Islander values (Anderson 1996).

Participatory action research (PAR) differs from traditional research in that it seeks to bring about positive change, not simply investigate an issue. In addition, the research process is based on the equal and collaborative involvement of the community in which the issue is located (Kemmis & McTaggart, 1998; Stringer, 1999; 2004). It is the *community,* rather than the academic researchers, who are the instigators and owners of the research. Its focus on problem-solving aims and community control of research means it has been widely used in contemporary Aboriginal and Torres Strait Islander research:

> The internal development and ownership of the research, rather than diagnosis and imposition from outside, makes participatory action research a far more amenable social research method to Aboriginal and Torres Strait Islander research paradigms and Aboriginal and Torres Strait Islander research agendas (Jones, 2006, p.318).

Action research was developed by a social psychologist Lewin in 1946 who wanted a democratic way of involving people in the investigation of their own lives. The researcher within this kind of research is a facilitator or research coach, "rather than the owner, director and expert in the research project" (Jones, 2006, p.319). Rather than a linear model of researcher-led data retrieval and analysis, participatory action research is a cyclical process of planning, acting, observing and reflecting. This design ensures that each new collection of data is grounded in reflections formed on the previous data.

The following are key PAR components:

- The community of interest identifies a problem or issue (Planning)
- Collaborative planning about how to tackle the problem begins (Planning)
- The developed plan is put into action (Action)
- The action and its outcomes are observed (Observation)
- The final stage involves reflection and analysis before a new cycle of action begins (Reflection)

Perhaps not surprisingly for a research method so different from traditional scientific research, PAR has attracted strong criticism that the participatory aspects of the process compromise the research's validity, reliability and rigour (Jones, 2006). However, most of these criticisms have been levelled at qualitative research generally, and have been countered with detailed discussions about the need to document carefully all stages of the research process so independent observers can judge these issues. A mixed-method approach within the participatory action framework can also provide important triangulation of research results. It has also been accused of being more an ideology of research practice, than a practical research method. Here the issue for researchers is to demonstrate a detailed research plan and methods which have been independently

validated. Others have criticised the cyclical nature of the process, and the difficulty of determining the end of the research (Jones, 2006). However, within the PAR framework, this question is resolved by the collaborators who together determine when the problem they have identified has been adequately addressed, if not resolved.

Importantly, this type of research has been identified by Aboriginal and Torres Strait Islander people as meeting their requirements for ethical research. Unless Aboriginal and Torres Strait Islander people have control of all aspects of the research process, in collaboration with trusted research partners, they are unlikely to agree to participate in what has been a highly discredited process for them (NHMRC, 2003; Humphrey 2001; Anderson 1996). Indeed, some of our Aboriginal and Torres Strait Islander partners in this project talked about the need to coin another term for research because of this history.

Key stakeholders

A key component of Participatory Action Research is inclusion of all key stakeholders. The community of interest for this proposal includes a broad-based collaboration between Aboriginal community-controlled health services

- Tamworth Aboriginal Medical Service,
- Armajun Aboriginal Medical Service (Inverell),
- Hunter New England Aboriginal Health,
- Hunter New England Population Health,
- Newcastle Institute of Public Health,
- Curtin University
- Anton Breinl Centre for the School of Public Health, Tropical Medicine and Rehabilitation Sciences, James Cook University
- Mamu Health Services Limited, Innisfail
- Kimberley Aboriginal Medical Services Council

Research plan

Research methods will include the following, within a cycle of planning, action, observation and reflection:

Phase 1

Stage 1

Identification of the research problem by communities of interest. (partially completed)

Discussions with Aboriginal communities in the Hunter/New England region about a possible exploration of community responses to pandemic influenza have been ongoing for several months. These informal discussions culminated in a workshop with all of the stakeholders cited above in Tamworth in September 2007. The workshop began with an introduction to the preliminary agreement between the stakeholders in the Aboriginal Partnership and the Hunter/New England Area Health Service to undertake action research on community responses to pandemic influenza, and a general introduction to pandemics and infection control. In order to sensitise workshop participants to the relevant issues, discussion focused on those elements that would be part of a mainstream containment plan: early case finding, contract tracing, home quarantine, social distancing, pressure on health staff, antiviral medication, vaccination and other issues. There was then a broad discussion around what an Aboriginal and Torres Strait Islander pandemic plan might look like. This was followed by a discussion about the proper process for undertaking research on this topic and agreement that a participatory, action research approach with “giving both ways” was the only way to proceed.

To increase the representativeness of the project, communities in North Queensland and the Kimberley have been invited to participate. The James Cook University has strong links with communities in these areas and will be able to support the project. The project may form part of a PhD for Adrian Miller an Aboriginal and Torres Strait Islander health researcher with James Cook University.

Participants of the focus groups will interpret and confirm the findings of the focus groups. This will provide the content framework for the project to proceed.

Stage 2
Collaborative planning (4-6 months)

- Obtain ethical clearance for the research
- Confirmation of a detailed research plan with all stakeholders needs to occur and submission to AHMRC.
- Identification of research-practitioners in each of the participating Aboriginal and Torres Strait Islander communities and research mentors. Where possible these will be located in the region, but external expertise will also be sought if necessary. The aim is to have paired teams, one of whom is a local Aboriginal and Torres Strait Islander person who will work closely with an experienced researcher. One research practitioner per Community Controlled Health Service (6) will be recruited, but each research practitioner will be involved as needed in the other sites. The research practitioners may be based at the Community-controlled Health Services or with the Area Health Service. A research manager will provide the coordination and link between each site. Administration of the program will be provided by Hunter New England Population Health and James Cook University.
- Training for research-practitioners, to include an introduction to action research methods, including interviewing and facilitating focus groups, and data recording (notebooks and taping). This training will continue throughout the research process so that research-practitioners receive training at the appropriate time. Where possible research training will be articulated with accredited post-secondary courses available in the region.
- Selection of sample – Aboriginal and Torres Strait Islander health services personnel (managerial and service staff) and community members (mixed ages, genders).
- Development of research instruments (interview and focus group guides). This will be undertaken by the whole research team, including research-practitioners. The aim will be to devise accessible, short instruments which research-practitioners are comfortable about using but which elicit sufficiently detailed responses.
- Systematically reviewing qualitative and quantitative evidence to inform management and policy-making in the health field

Stage 3
Research action (data collection) in the participating communities to identify responses to pandemic influenza containment measures (6 months)

- Interviews – with key individuals, such as CEOs of the AMSs. These will be undertaken by the research-practitioners in each area, and consist of in-depth exploration of the issues for approximately one hour.

- Focus group – facilitated conversations among groups such as Aboriginal Health Workers, Board members, community Elders. Focus groups may range in size from three to 10 people and will be facilitated by the research-practitioners. These may vary in duration from around an hour to two hours.
- Informal discussion and observations of community events and activities. Here the focus is on the documentation of occasions such as community meetings, funerals and other events in order to describe patterns of mobility and socialising at these times.
- Documentary search of relevant literature pertaining to pandemic responses generally, and Aboriginal and Torres Strait Islander community reactions to pandemics. This will require a detailed search of both the Australian and international literature.

Stage 4
Analysis and reflection of research data. (6 months)

- Research training for data analysis. Research mentors will work with research-practitioners on collected data to analyse material. This will include training in transcription and the analysis of qualitative material.
- Developing collaborative descriptive accounts of interview and focus group data. Here the research-practitioners and research mentors are aiming for detailed descriptions of respondents' views regarding pandemic responses.
- Developing collaborative interpretive accounts of the data. These interpretive accounts will attempt to probe how certain conditions have come into being and persisted and alternative explanations for what is being described. Ideally this stage of analysis will include, as well as the research-practitioners and research mentors, a broader group of staff from each of the health services.
- Formulation of a draft Aboriginal and Torres Strait Islander pandemic plan.

Stage 5
Consultation with Aboriginal and Torres Strait Islander communities and health services, and mainstream health services. (3 months)

- Workshop draft plan with Aboriginal and Torres Strait Islander health services, community members and mainstream health services.

Stage 6
Final analysis and re-drafting of the plan (3 months)

- Prepare final plan.
- Write report for funding agencies and negotiate details of other academic and professional writing tasks.

Phase 2
If funded the research cycles will continue with communities to consider in more depth the strategies to reduce risk of pandemic influenza.

3. Outcomes

A number of outcomes are expected from this work:

- An understanding within the communities involved and within Health Services of pandemic influenza control strategies and what is acceptable and what will work.
- A process and a product (Plan) that can be taken to other Aboriginal communities and Health Services to enable understandings to be developed in each community.
- A process and a product that can be used by the Commonwealth and State Health Departments as a basis for planning in other areas.
- A number of manuscripts authored by the research-practitioners submitted to peer-reviewed journals sharing the learnings from the work plus thesis.
- The support of locally based Aboriginal and Torres Strait Islander research-practitioners that have received some high quality training and experience in the field.
- The support of locally based Aboriginal and Torres Strait Islander research-practitioners that have received some high quality training and experience in the field.
- Decreased morbidity and mortality in Australian Aboriginal and Torres Strait Islander communities.
- Application of a community approved pandemic influenza containment measures to other infectious disease outbreaks.

4. Governance

The project will be overseen by an Aboriginal and Torres Strait Islander Round table group in each state, the Partnership of Hunter New England Area Health Service, the Aboriginal Community Controlled Health Services involved, James Cook University and Hunter New England Population Health.

References cited

Anderson, I. (1996) Ethics and health research in Aboriginal communities, in Daly, J. (Ed) *Ethical intersections: Health research methods and researcher responsibility.* Sydney: Allen & Unwin.

Cleland Burton J. Disease among the Australian Aborigines. *Journal Tropical Medicine and Hygiene* 1928; 6: 65.

COAG, Council of Australian Governments. Working Group on Australian Influenza Pandemic Prevention and Preparedness, Commonwealth of Australia. National Action Plan for Human Influenza Pandemic, 2006, Commonwealth Government-Department of the Prime Minister and Cabinet. http://www.pmc.gov.au/publications/pandemic/index.cfm <accessed 27 Sept 2007>

Commonwealth of Australia. Australian Health Management Plan for Pandemic Influenza, 2006. Commonwealth of Australia. http://www.health.gov.au/internet/wcms/publishing.nsf/Content/ohp-pandemic-ahmppi-toc.htm <accessed 27 Sept 2007>

Curson P and McCraken K. An Australian perspective of the 1918-1919 influenza Pandemic. *NSW Public Health Bulletin* 2006; 17:103-107.

Emergency Management Australia. Keeping our mob safe. A national emergency management strategy for remote Aboriginal and Torres Strait Islander communities. Commonwealth of Australia http://www.ema.gov.au/agd/ema/emaInternet.nsf/Page/RWPA1A820CAE69A825CCA25731D0016EADC <accessed 9 Jan 2008>

Humphrey, K. (2001) Dirty questions: Aboriginal and Torres Strait Islander health and 'Western research', *Australian and New Zealand Journal of Public Health* 25(3): 197-202.

Jones EW. "Co-operation in all human endeavor": Quarantine and immigrant disease vectors in the 1918-1919 influenza pandemic in Winnipeg. *Canadian Bulletin of Medical History* 2005; 22: 57-82.

Jones, G. (2006) Other research methods, in Walter, M. (Ed) *Social research methods. An Australian perspective.* Melbourne: Oxford University Press.

Markel H. *Quarantine! East Jewish Immigrants and the New York City Epidemics of 1892*. Baltimore: John Hopkins University Press; 1997.

Maye JD. Geography, ecology and emerging infectious diseases. *Social Science & Medicine* 2000;50: 937-952.

National Health and Medical Council (2003) Values and ethics: Guidelines for ethical conduct in Aboriginal and Torres Strait Islander health research, http://www.nhmrc.gov.au/publications/synopses/e52syn.htm. Accessed

NSW Health. Background to influenza pandemics. http://www.health.nsw.gov.au/pandemic/background.html <accessed 27 Sept 2007>

Oxfam Australia (2007). Close the gap. Solutions to the Aboriginal and Torres Strait Islander health crisis facing Australia.

Smith, L.T. (1999) *Decolonizing methodologies: Research and Aboriginal and Torres Strait Islander peoples*. Dunedin: Zed Books.

Stringer, E. (1996) *Action research. A handbook for practitioners*. Thousand Oaks: Sage.

Whyte, W.F. (1991) *Participatory action research*. Newbury Park, Ca: Sage.

Brucellosis risk reduction strategies for feral pig hunters

Interview questions – semi-structured interview

1. Please describe for us what happens on a usual pig hunting session.
    a. How often do you go pig hunting? How many times in the last month?
    b. How many people usually go with you?
    c. What type of hunting do you do? – dogs, guns, etc
    d. How many pigs did you catch on your last session? How many were taken to the 'chiller'?
    e. How does the pig usually get killed?
    f. Describe what happened last time you dressed a pig before taking it to the 'chiller'. How did you dress the pig, where, what did you use, what sort of knife, what was done with the remains.
    g. Do you dress the pig yourself or do others help out?
    h. When/if putting the pig up on the rack, do you do this with the others?
    i. When you get to the 'chiller' what actions occur?
    j. If the pig is rejected at the 'chiller', what do you usually do with the pig?
    k. Do you do anything particular with the truck or the hunting gear after hunting?

2. Over the last year how many times have you had an injury while pig hunting?
    a. Knife injury
    b. Gun injury
    c. From the dogs
    d. Accident with the truck
    e. Falling over in the bush or track
    f. Other types of injuries

3. When you get cuts or abrasions on your hands and arms while hunting or dressing pigs what do you do?

4. There is a risk of getting brucellosis and other infections from feral pigs, some people have suggested ways to reduce the risk and we are interested in what you think about each idea. So tell us whether you would do the following and if not what is it about the idea that is no good, and what would be better.

    - Cover all cuts or abrasions with waterproof dressings.
    - Wear gloves, overalls and facemasks when slaughtering animals or handling carcasses, especially goats or pigs.
    - Or just wearing disposable gloves when dressing and cleaning feral pigs;
    - Thoroughly wash hands and arms in soapy water after handling animals or carcasses.
    - Avoiding contact with blood and reproductive organs of the feral pigs;
    - Take particular care when handling or disposing of birth products, such as placentas, vaginal discharges, aborted foetuses or the mother animal itself.
    - Wash off all urine, faeces, blood and other body fluids and thoroughly clean all working areas.
    - Burning or burying gloves and remains from dressed feral pigs
    - Cooking thoroughly meat from feral pigs.

5. Are there any other things you want to tell us about feral pig hunting?

6. Would you be interested in being in a focus group to talk about what you reckon is the best way to get health messages to pig hunters?

Brucellosis risk reduction strategies for feral pig hunters

Focus Group questions

When we can work out health messages about pig hunting that make sense, such as …….. (informed from Interviews)

1. How and where would you like these messages to be received?
   Prompts:
   a. Magazines such as Bacon Buster, articles or ads
   b. Poster at chiller
   c. Information from your Doctor
   d. Internet sites such as Aushunt.com.au or another Blog or Facebook site
   e. Radio, TV, local paper, articles or news or ads

2. Who should the messages come from?
   Prompts
   a. Health people such as Doctor
   b. Hunting groups
   c. Shooters Party
   d. Local people who are well known

Nature of exposure to risk for Q fever in notified cases from HNEAHS

SURVEY TOOL

Preferred contact number ……

Contact attempts (date, time)

1……

2……

3……

4……

5……

A Introduction

Hi, my name is …… from Hunter New England Population Health. We wrote to you recently about Q fever. We are contacting people who have had a positive test for Q fever. Someone from the Public Health Unit may have already spoken to you however we are now asking questions about your work and risk factors for getting Q fever. This is a quality assurance project that we hope will improve our understanding of Q fever and how to prevent it. Your participation in this investigation is voluntary and your information will remain confidential.

The questions will take about 15 minutes to complete

Are you happy to continue?

□ Yes □ No

We will be asking about the dates of your illness so it may be helpful to get a calendar.

If NO is there a more convenient time we can contact you?

□ Yes □ No

If YES, an appointment has been arranged for ……

ADMIN ONLY	
Date of interview:	**Name of interviewer:**
NDD number:	**Case initials:**
Time start:	**Time finish:**
Total time of interview (mins):	**Date entered onto ACCESS:**

B Occupation / Contact with animals

According to your pathology results you developed Q fever during 2007/2006/2005 *(circle)*

PROMPT: You were diagnosed with Q fever on _____ and our records show you became sick around _____

The following questions relate to **THE MONTH BEFORE** you developed the fever (or other symptoms) of Q fever.

	QUESTION	YES	NO
1	**In the month before you had Q fever, were you WORKING?**	☐ *Go to Q2*	☐ *Go to Q10*
2	**In the month before you had Q fever, did your WORK involve contact with animals?**	☐ *Go to Q3*	☐ *Go to Q7*
3	**In the month before you had Q fever, did you WORK at an abattoir?**	☐ *Go to Q4*	☐ *Go to Q7*
4	**What types of animals were processed at the abattoir?** (*More than 1 response allowed)*		
	a. Cattle	☐	☐
	b. Sheep	☐	☐
	c. Other (specify) _____		
5	**What type of work did you do at the abattoir?** (*More than 1 response allowed)*		
	a. Slaughtering	☐	☐
	b. Boning	☐	☐
	c. Packing	☐	☐
	d. Trade work	☐	☐
	e. Office work	☐	☐
	f. Other (specify) _____	☐	☐
6	**At the same time as working in the abattoir, did you do any other WORK that involved contact with animals?**	☐ *Go to 7*	☐ *Go to 10*

	QUESTION	YES	NO
7	**In the month before you had Q fever, what type of animals did you have contact with as part of your WORK?** *(Ask for a response from each category. More than 1 response allowed)*		
	a. Beef cattle	☐ *Go to 8a*	☐
	b. Dairy cattle	☐ *Go to 8b*	☐
	c. Sheep	☐ *Go to 8c*	☐
	d. Goats	☐ *Go to 8d*	☐
	e. Kangaroos, feral pigs or other feral animals	☐ *Go to 8e*	☐
	f. Pets – Dogs or Cats (specify) *Type*_____	☐ *Go to 8f*	☐
	g. Other animals (specify) *Type*_____	☐ *Go to 8g*	☐
8	**In the month prior to you having Q fever, for each type of animal what sort of contact did you have with the animals?** *(only complete the sections that relate to the animals the case stated they had contact with in question 7)*		
8	**a. Beef cattle** (*More than 1 response allowed)*	☐	☐
	i. Yarding	☐	☐
	ii. Calving	☐	☐
	iii. Marking	☐	☐
	iv. Castrating	☐	☐
	v. Drenching / inoculation / backlining	☐	☐
	vi. Dehorning	☐	☐
	vii. Butchering	☐	☐
	viii. Transporting	☐	☐
	ix. Veterinary type of contact	☐	☐
	x. Other (specify)_____	☐	☐
	xi. Unknown / can't recall	☐	☐
8	**b. Dairy cattle** (*More than 1 response allowed)*	☐	☐
	i. Yarding	☐	☐
	ii. Calving	☐	☐
	iii. Marking	☐	☐
	iv. Castrating	☐	☐
	v. Drenching / innoculation / backlining	☐	☐

	QUESTION	YES	NO
8	vi. Dehorning	□	□
	vii. Milking	□	□
	viii. Transporting	□	□
	ix. Veterinary type of contact	□	□
	x. Other *(e.g. paring hooves)(specify)* _____	□	□
	xi. Unknown / can't recall	□	□
8	**c. Sheep** (*More than 1 response allowed)*	□	□
	i. Yarding	□	□
	ii. Lambing	□	□
	iii. Marking	□	□
	iv. Castrating /mulesing	□	□
	v. Drenching / innoculation / backlining	□	□
	vi. Butchering	□	□
	vii. Shearing / crutching	□	□
	viii. Transporting	□	□
	ix. Veterinary type of contact	□	□
	x. Other *(e.g. skinning/tanning) (specify)* _____	□	□
	xi. Unknown / can't recall	□	□
8	**d. Goats** (*More than 1 response allowed)*	□	□
	i. Yarding	□	□
	ii. Kidding	□	□
	iii. Marking	□	□
	iv. Castrating	□	□
	v. Milking	□	□
	vi. Drenching	□	□
	vii. Butchering	□	□
	viii. Transporting	□	□
	ix. Veterinary type of contact	□	□
	x. Other (specify)_____	□	□
	xi. Unknown / can't recall	□	□

	QUESTION	YES	NO
8	**e. Kangaroos or feral pigs** (*More than 1 response allowed)*	□	□
	i. Shooting	□	□
	ii. Butchering	□	□
	iii. Skinning	□	□
	iv. Other (specify)_____	□	□
	v. Unknown / can't recall	□	□
8	**f. Pets – work contact with e.g dogs or cats** (*More than 1 response allowed)*	□	□
	i. Household	□	□
	ii. Working dogs	□	□
	iii. Veterinary type of contact	□	□
	iv. Other (specify)_____	□	□
	v. Unknown / can't recall	□	□
8	**g. Other animals (eg deer, rabbit, foxes)**	□	□
	i. Type of contact _____	□	□
9	**In the months prior to having Q fever, did you have contact with new livestock (at your place of work or a sale yard)?** *(If yes please comment on the circumstances)* _____ _____	□	□
10	**In the month prior to having Q fever, did you have any other NON-WORK direct contact with animals or animal products?**	□ *Go to 11*	□ *Go to 14*
11	**What type of animal/s did you have direct contact with?** _____		
12	**What type of direct contact was this?** _____		
13	**Where did this direct contact occur?** *(More than 1 response allowed)*		
	a. Farm	□	□
	b. Zoo	□	□
	c. Park	□	□
	d. Household	□	□
	e. Yard	□	□
	f. Other (specify)_____	□	□
	g. Unknown / can't recall	□	□

C Residential area and environment

	QUESTION	YES	NO
14	**In the month before you got Q fever were you were living:** *(One response only allowed)*		
	a. on a farm OR	□ *Go to 15*	□ *Go to 21*
	b. in a semi-rural area or village OR	□ *Go to 21*	□ *Go to 21*
	c. in a town OR	□ *Go to 21*	□ *Go to 21*
	d. in a city OR	□ *Go to 21*	□ *Go to 21*
	e. other (specify)_____	□ *Go to 21*	□ *Go to 21*
15	**How many people 15 years and older LIVE in your household?** *(For those who live on a farm only)*	No._____	
16	**How many of these people have direct contact with livestock?** *(For those who live on a farm only)*	No._____	
17	**How many people 15 years and older LIVE on the farm, excluding your household members?** *(For those who live on a farm only)*	No._____	
18	**How many of these people have direct contact with livestock?** *(For those who live on a farm only)*	No._____	
19	**How many people 15 years and older WORK on the farm in total (include your household members, those who live on the farm and those who live elsewhere)?** *(For those who live on a farm only)*	No._____	
20	**How many of these people have direct contact with livestock?** *(For those who live on a farm only)*	No._____	

D Your Q fever illness

	QUESTION	YES	NO
21	**When you were sick with Q fever did you have time off from work or reduce your hours of work?**	☐	☐
22	**How many DAYS did you have off work whilst you were sick with Q fever?** No._____		
23	**Were you admitted to hospital whilst you were sick with Q fever?**	☐	☐
24	**Which hospital(s) were you admitted to?** _____	☐	☐
25	**How many DAYS were you in hospital?** No._____		
26	**Have you now fully recovered from your Q fever illness?**	☐ *Go to 27*	☐ *Go to 28*
27	**How long in WEEKS did it take you to fully recover from Q fever and get back to normal life?** No._____ *Go to 29*		
28	**If you have NOT fully recovered, what problems related to your Q fever do you still have?** (*More than 1 response allowed)*		
	a. fatigue	☐	☐
	b. fever / sweats	☐	☐
	c. joint pain (arthralgia)	☐	☐
	d. endocarditis	☐	☐
	e. other (specify)_____	☐	☐
29	**Did you have any pre-existing medical conditions at the time of having Q fever like?** (*More than 1 response allowed)*		
	a. having diseases or treatments that affect your immune system	☐	☐
	b. being pregnant	☐	☐
	c. having known problems with your heart valves or having had replacement/s of your heart valve/s	☐	☐
	d. other (specify) _____	☐	☐
30	**Prior to having Q fever did you know about the disease?**	☐	☐ *Go to 33*
31	**Prior to having Q fever were you aware that there was a vaccine against Q fever?**	☐ *Go to 32*	☐ *Go to 33*
32	**What were the reasons that you were not vaccinated?** _____ _____ _____ _____		

E Other exposures

	QUESTION	YES	NO
33	**Are there any other situations you can think of when you have been exposed to dusts that may have been contaminated by animals?**	☐ *Go to 34*	☐ *Go to 35*
34	**Please describe these situations?** _____ _____ _____ _____ _____		
35	**In the month before you became sick with Q fever did you drink unpasteurised milk?**	☐	☐
36	**Are you happy for us to contact you again if we have any further questions?**	☐	☐

END Thank you for your assistance in this investigation.

Do you have any questions or comments?

Risk factors for malaria in a group of travellers to Papua New Guinea – a cohort study
Survey Tool
Group member ……..

Contact details ……

Contact attempts ……
……
……
……

A Introduction

Hi, my name is …… from Hunter New England Population Health. We wrote to you last week about some members of your recent travel group getting malaria, to warn you of the risk. We would now like to ask you some questions about your travel and exposure to mossies to help determine what factors lead to some of your group getting malaria on return. Your participation in this investigation is voluntary and your information will remain absolutely confidential. The information that you provide may help us better understand the prevention of malaria for future travel groups.
The questions will take about 15 minutes to complete

A1 Are you happy to continue?

□ Yes □ No

B Demographics and malaria history

B1 Name ……

B2 Age …….. years

B3 Sex □ male □ female

B4 Address ……

……

B5 Are you a resident of Australia

□ Yes □ No

B6 Which Team were you in on your trip to Papua New Guinea?

□ Team 1 □ Team 2

B7 Prior to this trip in August 2006 when was the last time that you travelled to a malaria endemic region?

Year …… Month …… Region ……..

If less than 12 months ago how many months were you in this region? ……. months.

B8 Do you have a disease that suppresses your immune system?

□ Yes □ No

B9 Are you taking any medication (steroids, cancer therapy) that could suppresses your immune system?

□ Yes □ No

B9 Has your Doctor said to you that you have a disease that makes you more likely to develop malaria?

□ Yes □ No

Specify …….. (if known)

C Disease

C1 Have you had fever or flu like symptoms since your return from PNG trip?

□ Yes □ No

C2 Have you been diagnosed with malaria since return from PNG trip?

□ Yes □ No go to D1

C3 If yes, how was this diagnosed? …….

C4 Species (from diagnosing doctor or lab report at PHU) ……

C5 Was your malaria treated in Hospital or at your Doctors surgery?

□ Hospital □ Doctors surgery □ Not treated

C6 If yes, onset of symptoms; number of days after returning from PNG ……days

C7 When did you first contact a medical practitioner, pharmacist or hospital about your symptoms …./…./……..

C8 When was the diagnosis made (and treatment started)? …./…./……..

D Exposure factors

For your recent trip to Papua New Guinea what were the dates of your travel?

D1 Date departed Australia …./…./……..

D2 Date of return to Australia …./…./……..

D3 What countries did you visit ……

D4 For each country, what regions did you travel in

……

……

D5 What were the dates that you stayed in each region?

…./…./……. to …./…./…….

…./…./……. to …./…./…….

…./…./……. to …./…./…….

D6 What were your main activities during travel? ……

……

……

D7 What type of accommodation did you stay in and for how many nights?

Type of accommodation	Yes	No	Nights stay
Good quality hotel (go to D8)			
Low quality hotel (go to D8)			
Guesthouse with insect screens			
Guesthouse with no or damaged insect screens			
House with insect screens			
House with no or damaged insect screens			
Tent with insect screen			
Tent with no or damaged insect screens			
Outside with no tent			

D8 If you stayed in hotel accommodation; Did you use an air-conditioner at night?

□ Yes □ No

D9 If camping were the tents pitched near water?

□ Yes □ No

E Personal protective factors

Now I will ask some questions about use of personal protection against mossies.

Can you describe how often you used this type of protection on your recent trip to PNG:

Factor	Always	Often	Seldom	Not at all
restricting outside activities during dusk to dawn				
using insecticide impregnated bed netting or impregnated curtains				
screens on windows and doors in places where you stayed				
knock down insecticides used indoors				
wearing protective clothing (Shoes & socks, loose fitting, light-coloured clothing covering exposed areas of skin)				
applying an insect repellent that contains (DEET or picardin) name ……..				
burning mosquito coils in evening and night				
if electricity was available, did you use insecticide vaporising mats				
other – describe				

F Chemoprophylaxis

F1 Did you visit a Doctor for travel health advice before going to PNG?

□ Yes □ No

F2 Did your Doctor recommend taking some medication for malaria prevention?

□ Yes □ No

F3 What type of medication was taken?

□ Chloroquine □ Doxycycline □ Malarone □ Mefloquine

□ Other (specify) ……..

F4 When did you take the first dose of the medication?

□ 2 weeks before travel □ 1 week before travel for Mefloquine

□ 2 days before travel □ 1 day before travel for Doxy & Malorone

□ Not before travel □ other…….

F5 Did you miss any doses while in PNG?

□ Yes □ No, go to F7

If Yes how many doses did you miss while in PNG?…… doses

F6 Were the missed doses consecutive? (days or weeks)

□ Yes □ No

F7 On return for how many days did you continue to take the medication?

□ …… days □ 28 days

F8 If you missed doses or did not complete the full course of medication what were the reasons that caused this to happen?

……..

……..

……..

……..

F9 Did you use any other medication, herbal preparations to prevent malaria?

□ Yes □ No

F10 If yes, name and describe use

…….

Thank you for being a part of this investigation, we will report back to you the findings. Is there any other issue about malaria and your trip that you would like to mention?

……

……

……..

If you would like to contact us about the investigation please phone me on 67678630.

ADMINISTRATIVE DOCUMENTATION HAS BEEN REMOVED