Smallpox Redux: An Australian Perspective

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This article briefly surveys the nature of smallpox and its potential as a biological weapon agent. Specifically, it looks at a possible deliberate release of smallpox on Australia's largest city, drawing on Australia's experience of, and reaction to, past epidemics of smallpox. It examines the spatial diffusion mechanisms and Australia's preparedness in terms of vaccination, quarantine, surge capacity and managing human response.

According to many commentators the events of 11 September 2001, and the subsequent anthrax attacks, transformed the world, reshaping the political landscape, and placing terrorism and biological weapons high on the security agenda. No longer can people seek refuge in physical remoteness from the world's centres of conflict. Now all people seem at risk from weapons of low visibility and high potency and accessibility that target humans but leave buildings intact.[1] Smallpox is of some interest not only because the disease has a long history in Australia and was probably responsible for the deaths of thousands of Aboriginals and many Europeans between 1789 and 1917, but also because there is a widespread belief that it would be a weapon of choice for a potential bioterrorist event. As Atlas has pointed out, several factors contribute to such a conclusion:

> Minute amounts of select biological agents can cause mass casualties; agents for biological weapons are easily acquired; [and the] technology for production and weaponisation is readily available.[2]

In response to such threats, Australia and many other countries have prepared management and response plans and begun to stockpile large supplies of smallpox vaccine.

Two forms of smallpox exist. Variola major or true virulent smallpox, and variola minor, a more benign form. Smallpox is a systemic, highly stable virus that retains its infectivity under a wide variety of environmental conditions for long periods outside its host. The infective dose required in humans is not known but is thought to be just a few virons usually lodged in

[1] Richard Danzig and Pamela B. Berkowsky, 'Why should we be concerned about biological warfare?', in Joshua Ledeberg (ed.), *Biological Weapons: Limiting the Threat* (Cambridge: MIT Press, 2001), p. 9.
[2] Ronald M. Atlas, 'Bioterrorism: From Threat to Reality', *Annual Review of Microbiology*, vol. 56 (2002), p. 168.

the respiratory mucosa.[3] After an incubation period of between seven and seventeen days, infection results in fever, malaise, head and backache and prostration. Prior to day four, symptoms generally resemble those of influenza. After about three to four days, however, the patient's temperature falls and a deep-seated rash appears usually on the face and extremities. This rash progresses through a succession of well-defined stages until reaching a pustular phase. The patient remains infectious until all the scabs have disappeared, usually about three to four weeks later. Smallpox victims do not die quickly and require intensive medical care including antibiotics to protect against secondary infections. If the patient survives, deep scaring is permanent. In some cases a particularly severe form of the disease may develop with high fatality rates. Overall perhaps 75 to 85 percent of those infected with smallpox will survive, but only after a very unpleasant and disfiguring illness. There remains no specific treatment for smallpox, but if the vaccine is delivered within a few days, symptoms are considerably lessened.[4]

In this article I propose to briefly survey the nature of smallpox, its history in Australia, its potential use as a biological weapon, and the possibility of a covert release on an Australian metropolis. Drawing on Australia's experience of past epidemics, the article will survey Australia's preparedness for such an event, the possible mechanisms of delivery and diffusion, issues of quarantine and isolation, and community reaction.

The release of smallpox into an Australian community would be a disaster. Among other things, it would raise a host of critical questions and issues that lie at the very heart of public health and life in Australia and are not well addressed by the Australian Smallpox Management Plan.[5] These include, to whom limited supplies of smallpox vaccine might be delivered and how this would be achieved. It seems likely that supplies of vaccine would be delivered to those considered 'most at risk', although a strong case might be made to vaccinate all the population within an infected area. In such circumstances, the question might be asked as to whether people have a right to be vaccinated and whether people could be vaccinated against their will. Currently, there would not seem to be any legal powers to force people to be inoculated against their will. Quarantine during such an outbreak also raises many important issues, including whether or not patients and their contacts should be formally quarantined, and if so, where and how? In the past, formal quarantine stations served this purpose. Today, it is more likely that people would be treated in special isolation wards of existing hospitals and possible contacts monitored in their homes. The Australian

[3] Malcolm Dando, 'Bioterrorism: What is the Real Threat?', *Science and Technology Report*, no. 3 (2005), p. 12.
[4] See for example, Donald A. Henderson, 'Smallpox: Clinical Epidemiological Features', *Emerging Infectious Diseases*, vol. 5, no. 4 (1999), pp. 537-539.
[5] Department of Health and Ageing, Guidelines for Smallpox Outbreak, Preparedness, Response and Management (Canberra: Department of Health and Ageing, January 2004).

Management Plan talks about establishing special 'Care Centres' but provides little detail on where these might be and how they might be staffed. Possibly the Government might commandeer private facilities such as University student accommodation for temporary hospitals as well as take control of private water supplies, medicine and food stocks. Given that smallpox has a long incubation period, quickly identifying and formally detaining 'human vectors' might not be easy. The actual management of the epidemic also raises important issues, particularly in relation to civil rights and liberties. Would it be necessary, for example, to curtail movement until the epidemic was deemed to be under control and people restricted to their homes? Finally, there is the issue of how public reaction might be 'managed' and whether or not the media could be expected to act responsibly. All these issues would seem critical in any bioterrorism scenario and raise the question as to whether we are currently well enough prepared, whether our society is resilient enough, and whether we have fully understood the lessons learned from previous epidemics to be able to satisfactorily deal with such a crisis.

Smallpox as a Biological Weapon

Although the World Health Organisation declared that smallpox had been eradicated from nature in 1980, in recent years there has been considerable speculation about the use of smallpox as a biological weapon.[6] The threat of smallpox as a biological weapon gained some credence when a former Soviet biowarfare expert alleged in 1998 that the Soviets had reproduced tens of tons of smallpox and plague agents as well as hundreds of tons of anthrax.[7] In addition, the Soviets are reputed to have carried out a program of genetic engineering of more dangerous strains of the disease with much shorter incubation periods. The scope of the Soviet biological weapons program from the late 1960s until the early 1990s is reported to have been enormous, employing at its peak between 30 000 and 60 000 scientists. Smallpox, plague and anthrax were agents of interest for the biological weapons program and large stockpiles of each were accumulated. One project even investigated the mating of smallpox and ebola viruses to produce a hybrid of high virulence.[8] While all these stocks of smallpox were supposedly destroyed, doubt still remains, and it is even possible that a Russian smallpox biological weapons program still continues. There also remains the fear that, because the Soviet stocks of smallpox were not well

[6] See for example, Donald A. Henderson et. al., 'Smallpox as a biological weapon', *Journal American Medical Association,* vol. 281, no. 22 (1999), pp. 2127-2137; Atlas, 'Bioterrorism: From Threat to Reality', pp. 167-185; Dando, 'Bioterrorism: What is the Real Threat?', pp. 1-46; V. Rugy and C. V. Pena, 'Responding to the Threat of Smallpox Bioterrorism', *Policy Analysis*, no. 424 (2002), pp. 1 -16.

[7] Jonathan B. Tucker, *Scourge: The Once and Future Threat of Smallpox* (New York: Atlantic Monthly Press, 2001), pp. 139-165; Statement by Dr Kenneth Alibek before the Joint Economic Committee, United States Congress, 20 May 1998, <www.house.govt/jec/hearings/intell/alibek.htm > [Accessed 11 May 2008].

[8] K. Alibeck and S. Handelman, *Biohazard* (New York: Random House, 1998).

guarded, some may have fallen into the hands of terrorists or 'rogue' states.[9] The Soviet Union was not alone in such activities. After 1942, the US began an ambitious biological warfare program including experiments with anthrax. By 1960 the US has assembled an impressive array of biological agents, including bacterial pathogens, toxins and fungal agents. During the 1950s and 1960s, the US Army is said to have carried out a wide variety of biological 'attacks' on a number of major US cities by releasing what were thought to be benign bacteria into the air. Between 20 and 27 September 1950, US Navy vessels sprayed aerosol cocktails of Serratia and Bacillus microbes from giant deck hoses over the city of San Francisco. Two weeks later there had been ten hospital admissions and one death from pneumonia, thought at the time to be caused by exposure to bacteria believed to be *Serratia marcescens*.[10] In 1965, a controlled release of *bacillus globigii* was carried out at Washington's National Airport and Greyhound Bus Terminal.[11] Biological agents were also sprayed on a number of US ships at sea in the 1960s and in 1965, *Bacillus globigii* was released on the island of Oahu to simulate a biological attack on the island. In 1966, a bacterial agent was released into the New York Subway system by dropping light bulbs filled with bacillus subtilis (variant Niger), onto the railway tracks in order to study the mode of spread.[12] In 1969 President Nixon placed a ban on US production and use of biological warfare agents. Such a ban, however, had limited impact as work continued into defensive measures, such as the development of vaccines and therapies against potential biological weapon threats[13].

Some observers now believe that it is only a matter of time before smallpox is covertly released in a bioterrorist attack. The impact of such an attack was brought home by the US Dark Winter Project in 2001 which simulated the effects of a covert release of smallpox via aerosol on people in three large shopping malls in three US cities.[14] The study postulated the grim scenario that within two months, there could be more than three million cases of smallpox and one million deaths. A year later the US began its 'Call to Arms' program to vaccinate 440 000 civilian health care workers and 500 000 military personnel against smallpox. Many hospitals and individuals declined to participate in the program, and by late 2003 only some 24 000

[9] Michael Selgelid, 'Smallpox Revisited?', *The American Journal of Bioethics*, vol. 3, no. 1 (2003), pp. w5–w11.
[10] R. Harris and J. Paxman, *A Higher Form of Killing: The Secret History of Gas and Germ Warfare* (London: Arrow Press, 2002), p. 159.
[11] J. Carlton, 'Years Ago, the Military Sprayed Germs on US Cities', *Wall Street Journal*, 22 October 2001.
[12] L.A. Cole, 'Confronting the Horror of Biological Warfare', *The Los Angeles Times*, 30 November 1997.
[13] George W. Christopher, Theodore J Ciesak, Julie A. Parlin, and Edward M. Eitzen, 'Biological Warfare: A Historical Perspective', in Lederburg (ed), *Biological Weapons: Limiting the Threat*, p. 29.
[14] Tara O'Toole et. al., 'Shining Light on "Dark Winter"', *Clinical Infectious Diseases*, vol. 34, no. 7 (2002), pp. 972-983.

had been vaccinated, less than six percent of the target and the White House had been pressured into considering a compensation plan for those vaccinated who developed serious complications.[15] Many other countries rushed through orders for millions of doses of vaccine. Britain, for example, started vaccinating key medical and military staff after being briefed about the possibility of an Iraqi biological retaliation threat.[16] In addition, the British Government developed an emergency management plan which included immunising hundreds of key medical and other staff against smallpox and identifying properties that might be converted into temporary smallpox hospitals.[17] In Australia, the Government purchased its first consignment of 50 000 doses of smallpox vaccine in 2002 with the expectation of more to follow.[18]

Many people in countries like Australia take refuge in the belief that smallpox has been eradicated from nature and that, for those born before the mid-1970s, vaccination delivered lifelong immunity. There is now some doubt, however, as to whether people vaccinated thirty or more years ago continue to maintain any level of protection. Little is really known about the duration of smallpox immunity, and a recent article has questioned its longevity.[19] There are also other important problems relating to the current vaccine. For about 25 percent of the general population, post-vaccination complications can arise and in some cases can be serious. Decades ago , when vaccination was commonplace, at least two people in every million died from the vaccine's side effects and a small number suffered severe adverse reactions, including encephalitis, progressive vaccinia and a severe form of eczema.[20] Today, with a much larger proportion of the population having suppressed immune systems due to conditions like AIDS and a variety of new medical procedures involving cancer treatments and implants, the risk of adverse side effects is probably much higher. In addition, it is possible that the current vaccine may not be effective when confronted by some of the more virulent strains of smallpox thought to have been developed by countries like the Soviet Union.

[15] C. Connolly, 'Bush Smallpox Inoculation Plan Near Standstill', *The Washington Post*, 24 February 2003, p. A06.
[16] D. Bamber and C. Hastings, 'Iraq Warnings Prompt Rush to Order Vaccine', *Daily Telegraph*, 4 April 2002, <www.telegraph.co.uk/news/main.jhtml?xml=/news/2002/04/14/npox114.xml> [Accessed 9 November 2007].
[17] James Meikle, 'Disaster Centres plan for smallpox attack', *Guardian Unlimited*, 3 December, 2002, <www.guardian.co.uk/ukresponse/story/0,11017,852637,00.htm> [Accessed 31 January 2003].
[18] Richard Smallwood, 'Australia set to buy Smallpox Vaccine for National Emergency Medicines Stockpile', *Department of Health & Ageing Media Release*,2 October 2002, <www.aodgp.gov.au/internet/main/publishing.nsf/Content/health-mediarel-yr2002-dept-mr02002.htm> [Accessed 20 October 2007].
[19] A. Coghlan, 'Nightmare Scenario', *New Scientist*, vol. 174, no. 2345 (1 June 2002), p. 7.
[20] Henderson et. al., 'Smallpox as a biological weapon', note 5, pp. 2133-2135.

Recognizing that a national stockpile of vaccine would be essential in the light of any biological attack, many countries have continued to actively acquire stocks of smallpox vaccine. Recently a Danish Company, Bavarian Nordic has developed a new generation smallpox vaccine, said to possess none of the side effects of older vaccines.[21] In 2007 the US purchased twenty million doses of this new vaccine with the intention of adding to this stockpile in the near future.[22]

The next sections of the article will look at the history of smallpox in Australia and Australia's vulnerability and preparedness to meet a clandestine release of smallpox virus into the civilian population.

Smallpox in Australia

Naturally-occurring smallpox has a long and impressive lineage in Australia, particularly among the Aboriginal population and in some of Australia's towns and cities. Between 1789 and 1917, Australia experienced at least fifteen epidemics of smallpox with case fatality rates of up to 30 percent (Table 1). Some of these were demographic and social crises of considerable proportions, such as the epidemic which swept through the Aboriginal population in the vicinity of the new settlement of Sydney in 1789, and the epidemics which lingered among rural Aboriginals in New South Wales (NSW), Victoria and the Northern Territory between 1829 and 1869.[23] The most significant epidemics to affect the European population occurred in 1881-82 and 1913-14 in Sydney (later extending to all of NSW) which caused major social and economic disruption to the city, as well as smaller outbreaks in Perth in 1893 and in Launceston in 1887 and 1903. Australia's last major encounter with smallpox occurred between 1913 and 1917 when a prolonged outbreak of variola minor resulted in at least 3,000 cases.[24] After 1853 all Australian colonies with the exception of NSW and Queensland passed compulsory smallpox vaccination acts, but only in Victoria and South Australia was such legislation pursued with any vigour. In NSW vigorous opposition existed to compulsory vaccination. Advocates of this measure had to battle against complacency (born of the belief that distance from the Old World offered a defence against such diseases), strong anti-vaccination lobbies and Commonwealth-State rivalries. Even during the 1913-17 smallpox outbreak in NSW when more than 500 000 sought vaccination,

[21] See Bavarian-Nordic, <www.bavarian-nordic.com/composite-153.htm?templateid=21> [Accessed 18 April 2007].
[22] Bavarian Nordic, 'US Government Chooses Bavarian Nordic as Supplier for 20 million doses of IMVAMUNE', *Announcement to Copenhagen Stock Exchange*, No. 13-07, 16 April 2007.
[23] See Judy Campbell, *Invisible Invaders: Smallpox and other Diseases in Aboriginal Australia 1780-1880* (Melbourne: Melbourne University Press, 2002); Peter Curson, 'We Don't Want No Smallpox Here': The Epidemic of 1881-2', in Peter Curson, *Times of Crisis: Epidemics in Sydney, 1788-1900* (Sydney: Sydney University Press, 1985), pp. 90-119.
[24] W. G. Armstrong, 'Outbreak of Mild Smallpox at Sydney, 1913', *Report of Director-General of Public Health, NSW* (Sydney: Government Printer, 1915), pp. 102–125.

attempts to pass a compulsory vaccination bill through the NSW Parliament foundered.[25]

Table 1: Smallpox Epidemics in Australia 1789-1917

Year	Location	Cases	Deaths
1789	Sydney/NSW	000s(?)	000s(?)
1829-45	NSW/Victoria	000s(?)	000s(?)
1857	Melbourne	16	4
1860-69	Northern Territory	000s(?)	000s(?)
1868-69	Melbourne	43	10
1872	Bendigo	7	0
1877-78	Sydney	12	3
1881-82	Sydney	163	41
1884-85	Sydney/Melbourne	120	10
1884	Border Town	3	0
1887	Launceston	33	11
1893	Perth	52	9
1903	Launceston	66	19
1913-17	Sydney/NSW	3,000	4

(?) Number of cases and deaths unrecorded. Source: Peter Curson, *Times of Crisis: Epidemics in Sydney, 1788-1900* (Sydney: Sydney University Press, 1985), p. 92.

Australia's State of Preparedness

The backbone of preparedness against any outbreak of infectious disease, whether naturally occurring or covertly released, remains an excellent system of disease surveillance, a rapid response structure including a ready supply of vaccine and/or antivirals and antibiotics, and the means of delivering this to a designated population in a timely fashion.[26] Since 2001 the Commonwealth Government and the Australian States and Territories have produced a number of Counter Terrorism and Emergency Management Plans and have moved to establish an infrastructure of emergency response groups. In 2004 the Australian Government produced a Preparedness, Response and Management Plan against a smallpox outbreak.[27] In addition, Australia began to stockpile supplies of the smallpox vaccine.

[25] Peter Curson, 'The Return of an Old Pestilence: The Smallpox Epidemic of 1913-17', Manuscript in Preparation.
[26] World Health Organisation, 'Smallpox Revisited', *Journal American Medical Association*, vol. 287, no. 9 (2002), p. 1104.
[27] Commonwealth of Australia, *National Counter-Terrorism Plan* (Canberra: Attorney-Generals Department, September 2005); Commonwealth of Australia, *Guidelines for Smallpox Outbreak,*

Table 2: Response Codes and Management Actions for Smallpox Outbreak Australia

Response Levels				
	0 **No Recorded Smallpox**	**1** **Imminent Threat of Overseas Case**	**2** **One Case in Australia**	**3** **Unrelated Cases/Clusters in Australia**
Response Teams	Establish, train and vaccinate	Vaccinate additional teams	Increase Surveillance	Wider vaccination, quarantine
Healthcare Personnel	Vaccinate selected physicians	Selectively vaccinate and screen	Widen vaccination	Expand vaccination
Emergency Personnel	Nil	Nil	Pre-scan	Vaccinate
Care Centres	Identify	Operationalise	Activate	Establish new centres as required
Vaccination Centres	Identify	Operationalise	Activate	Extend if necessary
Airport Isolation Facilities	Discuss	Initiate	Consider landing/travel restrictions	Landing/travel restrictions
Department of Health and Ageing	Initiate discussions, coordinate state plans	Plan response	Initiate communications centre	Daily national teleconference

Note: Table omits response 'Outbreak Controlled'. Source: Commonwealth of Australia, *Guidelines for Smallpox Outbreak, Preparedness, Response and Management* (Canberra: Department of Health and Ageing, January 2004).

The Management and Response Plan, modelled closely on those developed in other countries, identifies five response stages ranging from no threat, through the appearance of an overseas case of smallpox, to a single case and cluster of cases in Australia, and finally to a situation where the outbreak is totally controlled. Each developmental stage is associated with a progressive series of response and management strategies. In essence, the Australian Plan places emphasis on epidemiologic vigilance, early detection of cases, vaccination of contacts and the surveillance of distant contacts. At least two response teams would be established in each state and territory and would assume overall responsibility for planning and management of the

Preparedness, Response and Management (Canberra: Department of Health and Ageing, January 2004).

response. Table 2 summarises the key sequential responses in a smallpox outbreak. Interestingly, the Australian Plan is silent on a number of important issues. These include, details of just who might be expected to be vaccinated, how vaccines and other drugs might be delivered to the infected and exposed community, how centralised and home quarantine would be arranged and supported, and how community fear and panic might be managed. And finally, could we have confidence as to who would take control and manage the outbreak? What if local, State and Commonwealth priorities differ or conflict? The Management Plan optimistically presumes cooperation at all levels. Yet the history of epidemics in Australia is littered with examples of disagreements and outright battles between the States and the Commonwealth over measures like quarantine, isolation and vaccination.[28]

A Covert Release of Smallpox in Sydney: The Past as a Guide to the Future

MECHANISMS OF DELIVERY AND DIFFUSION

A state or terrorist group having obtained stocks of smallpox virus would still face the difficult task of delivering this to a susceptible population. In the case of Sydney, a possible scenario has been postulated whereby smallpox might be released into the atmosphere from various strategic on and off-shore locations within the metropolitan area using the normal daytime and nighttime air circulation and drainage flows to spread the infection across the urban area.[29] Equally, an aerosol release within a crowded shopping mall or on a commuter peak hour train might produce the same effect. In both contexts it is interesting to speculate on the mechanisms of diffusion through the community. Smallpox is normally spread by sneezing, coughing, speaking or even breathing. Direct contact with infected people, their clothes and bedding can also spread the infection. Normal internal air currents and particularly air flows engendered by air conditioning can also facilitate the spread of the infection. A smallpox patient isolated in a German hospital in 1970, for example, managed to infect nineteen other people, including a number who had no contact with him. In this case the patient developed a cough and, similar to what might be expected in a bioterrorist attack although on a micro scale, a large volume of small particle aerosol release was carried by internal airborne currents, stair wells and open windows to people on higher floors.[30] Generally, however, smallpox is a

[28] See for example, Michael Roe, *Nine Australian Progressives: Vitalism in Bourgeois Social Thought 1890-1960* (St Lucia: University of Queensland Press, 1984), p. 123; P. Curson and B. McRandle, *Plague Anatomy: Health Security from Pandemics to Bioterrorism* (Canberra: Australian Strategic Policy Institute, 2005), pp. 50-53.
[29] Curson and McRandle, *Plague Anatomy*, p. 41.
[30] P. F. Wehrle et. al., 'An Airborne Outbreak of Smallpox in a German Hospital and its Significance with Respect to Other Outbreaks in Europe'*, Bulletin World Health Organisation*, vol. 4 (1970), pp. 669-679.

plodding virus moving through a population at a much slower rate than that of influenza or measles.

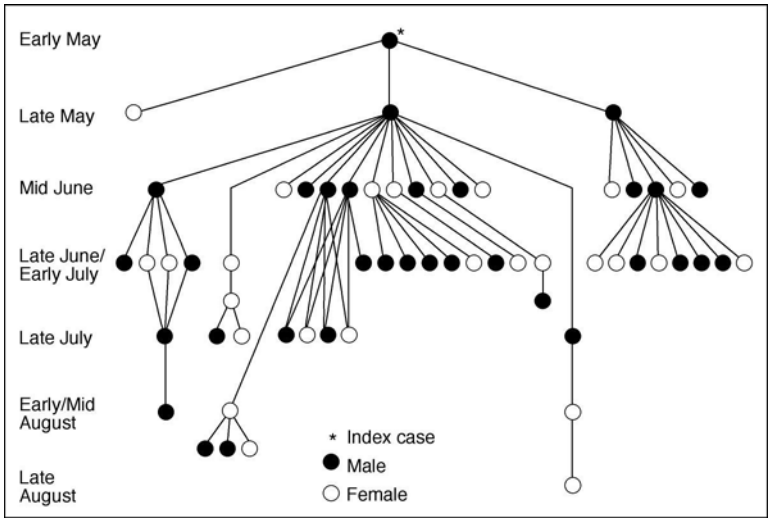
Historically in Australia, smallpox spread slowly by following a number of well-defined routes reflecting the social networks and spatial mobility of infected individuals, and their interaction with friends, kin and business colleagues within their local neighbourhoods. In addition, the nature of quarantine, vaccination and other control measures played an important containment role. As was the case in all Australian epidemics, smallpox could be expected to follow a contagious cascading effect, spreading outwards from an index case via individual contact fields. This would involve intra-workplace diffusion where the disease spread from one worker to another, as well as spread in local residential neighbourhoods. Figure 1 illustrates this form of diffusion by reference to the 1903 smallpox epidemic in Launceston, Tasmania, where the exposure of two people to a travelling comedian thought to have had mild smallpox at a local theatre resulted in the disease spreading via social networks to family and friends.[31] The 1881-82 smallpox epidemic in Sydney also provides an example of the role of social networks in spreading smallpox through an urban community.[32] In 1881, Sydney was a city of approximately 250 000 people and this was its first major encounter with smallpox. The first identified person with smallpox in 1881 was the seventeen months old son of On Chong, one of Sydney's leading Chinese merchants. While the source of his infection remains inconclusive, he most probably caught it from his nurse who had developed a similarly eruptive disease some weeks earlier. From On Chong's shop and house smallpox spread to neighbouring homes and to nearby streets following the movement of friends and customers who had visited his shop. In this way the disease had soon penetrated much of the innermost streets and lanes of the city centre. Workmen who carried out repairs on On Chong's property carried the disease to their homes and work sites in neighbouring streets and to the suburb of Surry Hills, while one of On Chong's neighbours who moved to Waterloo, and the friends who helped him move, carried the disease with them. Once established in neighbouring suburbs, everyday family and neighbourhood contacts spread the disease further. After On Chong's house was formerly quarantined, a police constable on duty and a workman charged with disinfecting the property were both suspected of contracting the disease and removed to quarantine. Children's contacts with friends saw the disease leapfrog from Surry Hills to the outer suburb of Croydon.[33]

Today, smallpox would probably spread in a like fashion although undoubtedly hindered, on the one hand, by the lower residential population

[31] See Michael Roe, 'Smallpox in Launceston, 1887 and 1903', *Papers and Proceedings of Tasmanian Historical Research Association*, vol. 23, no. 4 (1976), pp. 111-163.
[32] Curson, *Times of Crisis*, pp. 96-101.
[33] Ibid., p. 97.

densities in the centre of Sydney, but aided on the other hand by increased mobility and the array of daily activities and contacts of people. Schools and places of education, hospitals, places of recreation and shopping malls, which regularly bring large numbers of people together, would also encourage transmission. The virus would also be also passively transported from places of work and school to the home environment, possibly infecting a number of those who shared the journey to home. Once reaching the residential environment, local social contacts would play an important part in diffusion. As happened in 1881-82 and 1913-17, the virus could also be expected to make long distance leaps following the spatial patterns associated with visiting friends and relatives, commuters returning to far-distant suburbs and people travelling by air, train or bus to other parts of Australia. The critical factors in all of this, would be the numbers of people exposed, the length of time before definitive diagnosis, the institution of control measures, the geographical dispersion of cases, and the difficulty of contact tracing.

Figure 1: Diffusion Process of Launceston Smallpox Epidemic, 1903



Source: Based on data in J.S.C. Elkington, 'Outbreak of Smallpox in Launceston', *Parliament of Tasmania Report*, no. 47 (1903).

VACCINATION

If there was a major smallpox attack on Sydney, how effective could we expect the response and management measures to be in containing the outbreak? For example, how would the authorities respond to those exposed to infection? Who would be offered vaccination? Currently, the Australian Management Plan indicates a progressive program of vaccination, commencing with healthcare and emergency workers, and ultimately moving to adopt a wider program of vaccination. Little detail is spelt out, and there is

virtually no discussion of the logistics or timing of delivery. Leaving aside for the moment the fact that Australia only possesses small stocks of smallpox vaccine, would this be the best strategy to contain the outbreak? Would, mass vaccination be considered or even feasible? Given the limited supplies of vaccine and the logistics of quick delivery, it is doubtful. Moreover, recent studies strongly suggest that mass vaccination would be unnecessary and that rapid detection and response combined with targeted vaccination would produce better results.[34] Yet the question remains as to how vaccination would be delivered to those infected or at risk, given limited stocks of vaccine, and the demands on public health staff that would undoubtedly ensue. In 1947, following an outbreak of smallpox in New York City, the health authorities vaccinated more than six million residents, which required operating 179 clinics, from 9 am to 10 pm, seven days a week for more than three weeks.[35] In Sydney in 1913, during the smallpox epidemic, approximately 36 percent of the metropolitan population, more than 230,000 people, were vaccinated over a six month period, the majority within the first three weeks, from public vaccination depots.[36] A further 270,000 people were vaccinated in areas outside Sydney. The pressure that this exercise placed on health personnel and private practitioners and the scenes of public hysteria that it engendered were extreme. During the 1900 plague epidemic in Sydney, vaccination was offered to the general public three weeks after the onset of the outbreak. On the first day, a huge crowd besieged and overran the Board of Health offices, destroying property and forcing the abandonment of the vaccination program. Following this, a decision was made to offer vaccination only to those deemed 'at risk'.[37] Again, during the 1913 smallpox epidemic, there were violent scenes in central Sydney as hundreds of people fought each other in a frenzy to get into the Town Hall Vaccination Depot.[38] Would such things happen today? The US TOP-OFF simulation exercise in 2000, an exercise designed to test a city's ability to react to the release of a biological agent, suggests that it might. The emergency room in a city in Colorado was so overwhelmed by hundreds of 'patients' that the Governor had to declare a state of emergency, and in a companion East Coast simulation, the National Guard had to figuratively 'shoot' desperate citizens who overran antidote depots.[39] Given all this, it would seem more probable that the health authorities would consider creating a series of infectious 'firewalls', simply vaccinating health and emergency workers and those people in the area immediately affected and their contacts. Following a good Australian precedent, there would also

[34] Chris L. Barrett, Stephen G. Eubank and James P. Smith, 'If Smallpox Strikes Portland', *Scientific American*, vol. 292 (March 2005), p. 49.
[35] Israel Weinstein, 'An outbreak of Smallpox in New York City', *American Journal of Public Health Nations Health*, vol. 37, no. 11 (1947), pp. 1376-1384.
[36] Armstrong, 'Outbreak of Mild Smallpox at Sydney', p. 111.
[37] P. Curson and K. McCracken, *Plague in Sydney: The Anatomy of an Epidemic* (Sydney: University of NSW Press, 1989).
[38] 'Crush at Town Hall', *Daily Telegraph* (Sydney), 9 July 1913, p. 9.
[39] D. Glenn, 'Panic Button', *The Chronicle of Higher Education*, vol. 49, no. 27 (2003), p. A14.

probably be vaccination of all government, business and professional leaders in the community. Vaccination efforts would also probably differ from state to state and undoubtedly public unrest would grow as vaccine supplies dwindled.

QUARANTINE AND ISOLATION

In the advent of a smallpox incident, the authorities would most probably fall back on the traditional procedures of quarantining cases and contacts. A number of Australian cities have long histories of both centralized and decentralised policies of quarantine, incarcerating cases and suspected cases of infectious disease either in their homes or in special isolation institutions such as at the North Head Quarantine Station or the Coast Hospital in Sydney, as well as quarantining and isolating particular streets and suburbs of the city.[40] Most likely smallpox sufferers and their contacts would be confined to special isolation facilities designed to care for them. What implications would this have for individual rights and liberties? From the administrative point of view, centralised quarantine has its advantages in the management of any epidemic. It is obviously easier to operationalise and enforce, but it does allow infected people to intermingle with contacts. Decentralised quarantine, i.e. restricting people to their homes, is much more difficult to put into effect, in that it requires more community resources to implement and maintain, but it does have the advantage of segregating the infected from the non-infected. In 2002, the US advanced a voluntary form of decentralized quarantine called 'Shielding', whereby an epidemic would be contained by getting people to voluntarily go home and stay there until the crisis had passed.[41] Would any of this be possible today? On the one hand, Sydney maintains no formal Quarantine Station. On the other, it would be difficult to force people to submit to removal from, or incarceration within, their homes, as happened in 1881-82, 1900 and in 1913. Would it be possible for agencies or individuals to deliver food and medicine without spreading the epidemic? Would they want to? In 1900 the forced removal of plague cases and nearby contacts from their homes in central Sydney often produced violent confrontations between residents, the police and health workers.[42] Given the separation between place of work/school and residence that exists today, would it be possible to effectively quarantine off sections of Sydney and restrict entry and exit? In 1913, an area within a radius of 15 km of the General Post Office in Sydney was formally declared a Quarantine Area and movement severely restricted.[43] Would this be possible or indeed effective today? Would State borders be formally closed and travel restricted as has happened on a number of occasions during past epidemics? Equally important, there would seem to be no legal provisions to

[40] See Curson, *Times of Crisis*.
[41] For a discussion of Shielding, see S.D. Prior, *Implementing Shielding* (Arlington, VA: The Potomac Institute of Policy Studies–National Security Health Policy Centre, 2002).
[42] Curson and McCracken, *Plague in Sydney*, pp. 167-178.
[43] Armstrong, 'Outbreak of Mild Smallpox at Sydney', p. 110.

control the movements of human 'vectors' of smallpox during the incubation period—on average up to twelve days. Should there be, and if so, how could such people be easily identified?

HANDLING SURGE CAPACITY

Past epidemic crises reveal the pressures placed on the Australian healthcare system in trying to cope with the surge of patients and people demanding vaccination. During the 1919 influenza pandemic in NSW, for example, hospitals and healthcare facilities were totally overwhelmed by the surge of ill people. Temporary hospitals, often staffed by volunteers, had to be established in community halls, schools and bowling clubs. In the event of a smallpox incident, the ability of Sydney's healthcare and emergency services to adequately respond to the sudden and unexpected surge in demand would seem critical. A recent survey has highlighted the challenges facing healthcare systems confronted by a terrorist event.[44] Although this report addresses a terrorist bomb incident, the conclusions also hold for the release of a biological agent like smallpox. There seems little doubt that in the event of a smallpox incident, Sydney's hospital and emergency healthcare services would face enormous challenges. Currently, Sydney's hospital emergency services struggle with coping with normal daily demands and Ambulance services are frequently diverted from one hospital to another. Emergency departments are frequently overrun, and patients often have to wait in corridors before an in-patient bed becomes available. Shortages of key staff also continue to plague the hospital system. In addition, most hospitals lack adequate beds, equipment, isolation facilities and trained staff to adequately respond to a smallpox event. Converting an existing hospital into one devoted to smallpox victims within six to twelve hours would be a daunting task. In addition, there is doubt whether the healthcare system would have enough epidemiological staff to trace the hundreds, possibly thousands of possible contacts, as well as staff to handle the vaccination which would be required. Triage would offer another challenge to manage not only those suffering from smallpox or exposed to infection, but also the 'worried well'. Off-site triage and acute care would also probably have to be considered.

MISCONCEPTIONS AND THE GEOGRAPHY OF FEAR

Recent studies in the US and Australia suggest that the general public have a low level of understanding about smallpox and a high anxiety about a potential bioterrorist incident. A US study by Blendon and co-authors revealed that many of those surveyed firmly believed that smallpox was still a health problem in the world, that an effective treatment existed, and that

[44] National Centre for Injury Prevention and Control: Centres for Disease Control and Prevention, 'In a Moment's Notice: Surge Capacity for Terrorist Bombings', April 2007, <www.bt.cdc.gov/masscasualties/surgecapacity.asp> [Accessed 20 April 2007].

earlier vaccination delivered lifelong immunity.[45] In 2004, a national survey of more than 1,000 Australians delivered much the same message, and also revealed that a majority believed that a bioterrorist attack was possible.[46] Given such conclusions, there would seem little doubt that the threat of a smallpox release in Australia would generate considerable community reaction.

At the public level, earlier smallpox epidemics in Australia attest to the extent of community reaction and the resulting outpourings of fear, violence and discrimination that were levelled against particular sections of the population. During the smallpox and plague epidemics between 1881 and 1909, there were numerous episodes of people spying and reporting on neighbours thought to be ill, as well as episodes of malicious rumour-mongering.[47] Throughout the long history of epidemics in Australia, the media have played a critical role. For example, newspapers have fanned public hysteria with emotive and sensational headlines, articles listing the names and locations of those said to be infected and removed to quarantine, as well as stories of businesses and lives 'going to the wall', and of panicked crowds fighting to get vaccinated.[48] There is little doubt that the potential release of smallpox would provide an excellent source of media copy. Moreover, while the media provides valuable and useful information, there is little doubt that they can orchestrate the public's reaction through their use of language and image. Would we see anything different if cases of smallpox suddenly appeared in downtown or suburban Sydney? The threats posed by anthrax, SARS and pandemic influenza have led both governments and individuals around the world to stockpile surgical masks and antiviral drugs. In some cases people have stockpiled food and bottled water. It is possible that the worst effect of any bioterrorist act would be the mass hysteria and anxiety which could lead to long-term psychological illness. It is clear that in the current climate, the highlighting by some authorities and the media of the risks imposed by bioterrorism has led not only to an exaggeration of the possible threat but also to the spread of fear and hysteria. The US 'Dark Winter' exercise is a case in point.[49] This study had smallpox spreading like wildfire through a series of American cities. More recently, US authorities have drawn up a series of 'Bioterrorism Preparedness Guides' and distributed them to the media and to the general public.[50] The issue of when and how the public should be informed remains a critical one. Should people be informed as quickly as possible to maximize public confidence

[45] R. J. Blendon et. al., 'The Public and the Smallpox Threat', *New England Journal of Medicine*, vol. 348 (2003), pp. 426-432.
[46] David N. Durrheim et. al., 'Australian Public and Smallpox', *Emerging Infectious Diseases*, vol. 11 (2005), pp. 1748-1750.
[47] Curson, *Times of Crisis*, pp. 115-116.
[48] Ibid*.,* pp. 157-163.
[49] O'Toole et. al*.,* 'Shining Light on "Dark Winter"'.
[50] See for example, Centres for Disease Control and Prevention, 'Emergency Preparedness and Response', <www.bt.cdc.gov> [Accessed 10 May 2007].

and responsibility and adherence to the various control measures? Or would this simply heighten public anxiety and panic, particularly given the media's ability to scaremonger and exaggerate the risks? The Australian Management Plan includes the establishment of a national communications centre and daily teleconferences. Whether the general public would be involved in such things remains doubtful.

Conclusions

There seems little doubt that an epidemic of an infectious disease like smallpox in an Australian city would be a disaster and would give rise to a host of security challenges that go to the very heart of contemporary Australian society. These include containment of the epidemic's spread, identifying human vectors, deciding who, when and how to vaccinate, and implementing measures such as quarantine and the isolation of cases and contacts. Arguably, Australia's current state of preparedness for such an event leaves much to be desired, possibly reflecting the Government's assessment that a smallpox attack is a low-risk possibility. Little attention, for example, has been directed towards the mechanics of the timely delivery of a vaccine or indeed to what groups, other than health and emergency workers, it might be delivered to. Questions of quarantine, isolation and contact tracing also remain unresolved, as does the critical issue of handling surge behaviour in the health care system. Finally, little if any attention has been given to how public reaction might be managed and to the role of the media. All this raises many policy issues for the Australian Government. While cooperating with the international community to limit the ability of States and other groups obtaining bioweapons like smallpox, Australia must also develop a more comprehensive and sensitive homeland planning and response strategy. This must include the following: - (1) a robust and reliable centralised regional and global surveillance network designed to monitor infectious disease threats. (2) Rapid response mechanisms, including adequate supplies of vaccines, and a well documented strategy for delivering these to the population at risk, as well as mechanisms for rapid contact tracing, quarantine procedures and the support of people remaining at home. (3) A management structure that ensures that someone is 'in control' and that local-State-Commonwealth rivalries and over-lapping jurisdictions do not deflect from a coordinated and timely response. (4) Investment in understanding how people react to epidemic crises, as well as an evaluation of the social and psychological effects of quarantine and isolation and how people perceive personal risk. (5) Evaluation of the role the media plays in presenting such crises to the general public and issues of possible censorship. Only if such measures are in place could Australia feel truly safe.

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