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Plague Anatomy:

Health security from pandemics to bioterrorism

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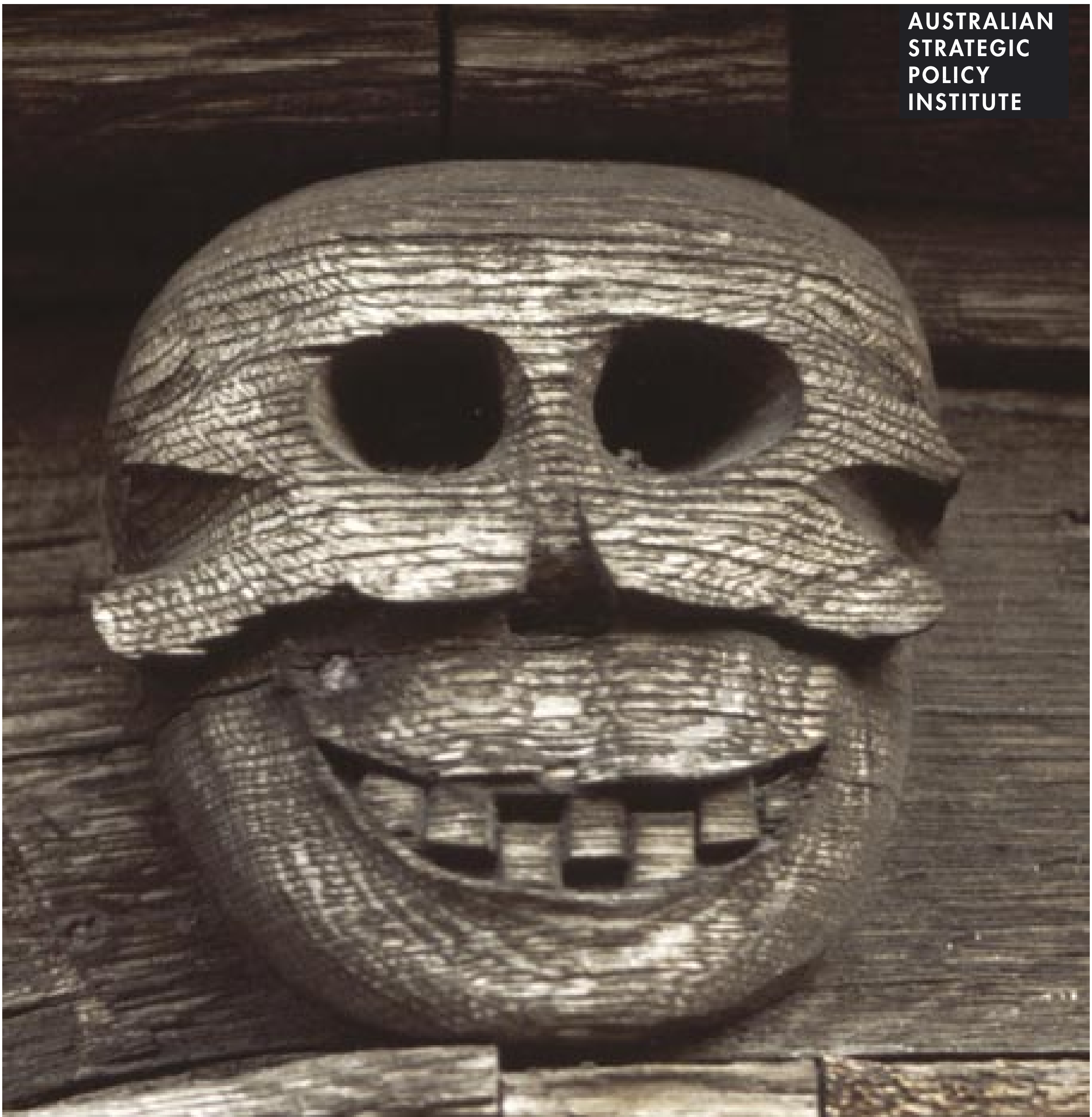

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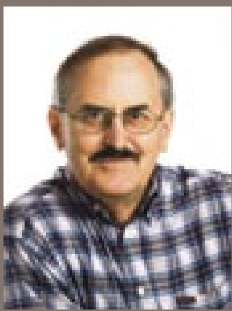

Peter Curson

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Cover image: Skull carving on wall of Plague Ossuary, Rouen.

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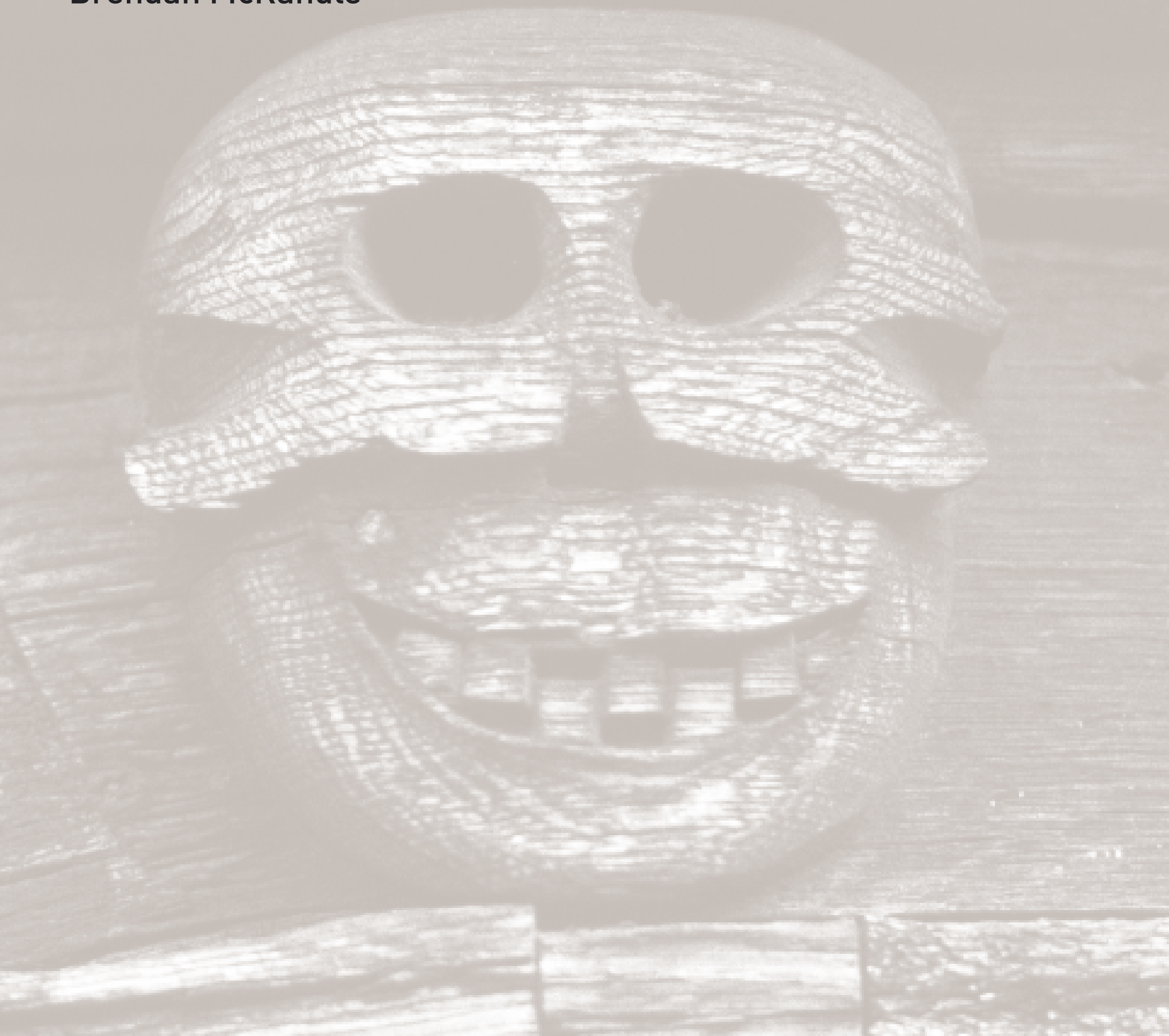

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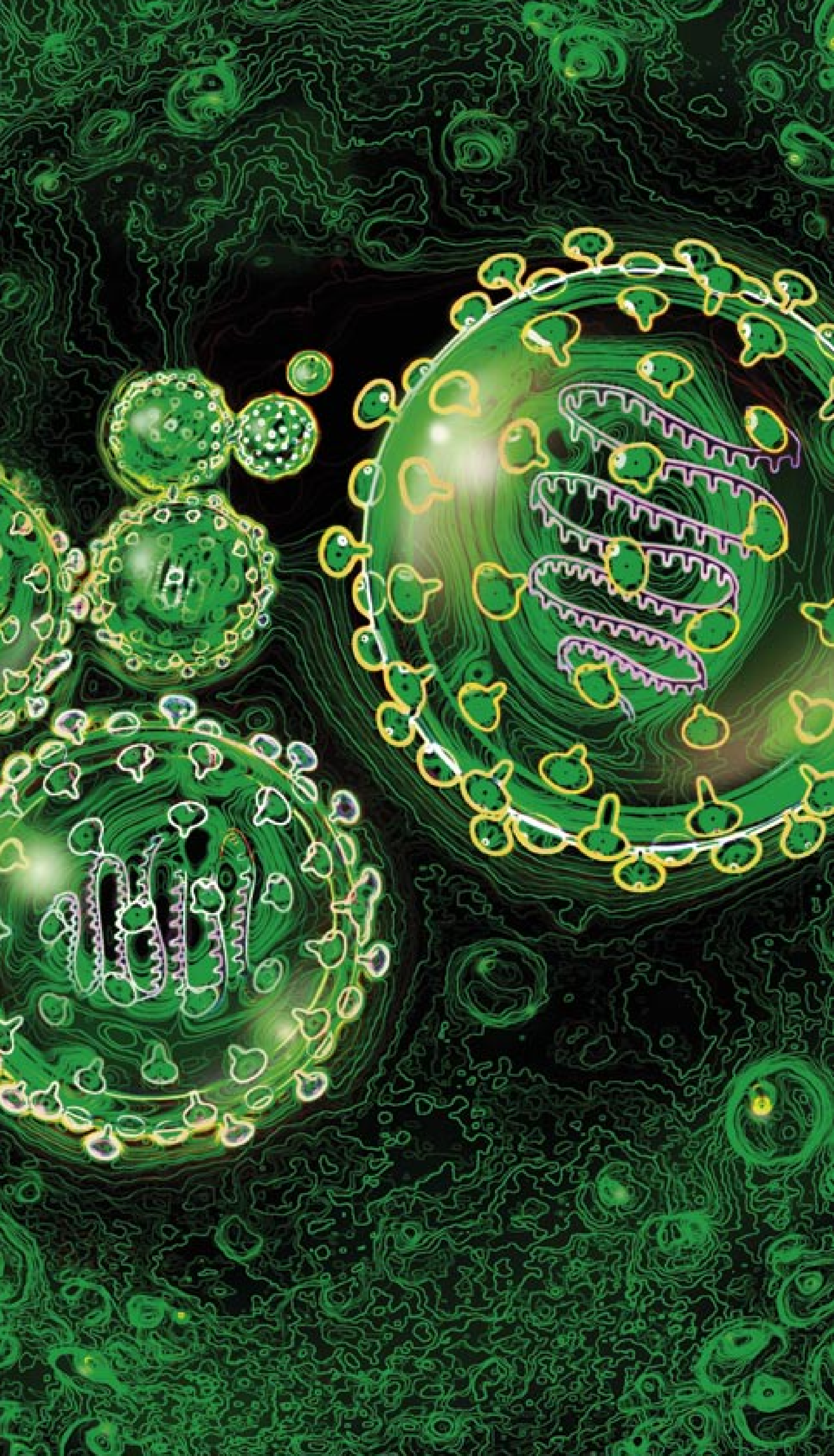
Contents



Director's introduction

Throughout history, people have tried to understand the source of disease and find ways to defeat it. Edward Jenner's discovery that exposure to cowpox conferred some protection against smallpox was the start of the discipline of immunology. Ultimately, smallpox was defeated: nearly 200 years after Jenner's discovery, the World Health Organization announced that the disease had been eradicated from the planet (save for samples retained for research by the then two superpowers).

The discovery of penicillin in the 1940s and the elucidation of the workings of the immune system by Melbourne scientist and Nobel laureate Sir Frank Macfarlane Burnet gave a sense that an era without disease was before us. In 1962 he wrote 'One can think of the middle of the twentieth century as the end of one of the most important social revolutions in history, the virtual elimination of the infectious disease as an important factor in social life.'

Yet that 20th century optimism was misplaced, in much the same way that popular sentiment mistakenly believed World War I to be the war to end all wars. As the 21st century begins, we're faced with several threats to our security from disease.

The scale of the threat requires the engagement not only of health authorities and health professionals, but of many other agencies not traditionally concerned with the consequences of infectious disease. The discussion about disease risks needs to be extended to inform the broader national security debate.

This paper addresses two types of challenge, each sufficiently important, both domestically and internationally, to be considered a threat to our security. Starting with an explanation about the sources of new disease, the paper goes on to discuss the two challenges in some detail.

The first challenge is that of naturally occurring disease and its consequences. Two diseases are considered here—the shock and awe of a major influenza pandemic, and the erosion of the state by HIV/AIDS.

The second challenge is the possible deliberate use of disease as a weapon of terror. The anthrax attacks in the US in 2001 were on a small scale, but managed to claim innocent victims and spread fear among the population. While a biological attack is probably less likely than an attack using conventional explosives, the risk is real enough, and the consequences are sobering. This paper sets out some scenarios that we should consider as we develop defences against the terrorist threat.

Our argument here is that the procedures and methods we develop to counter bioterrorism threats must be grounded in a broader understanding of the range of threats to Australia's security posed by pandemics and the emergence of natural diseases. Responding to pandemics or, on a smaller scale, to terrorist attacks will in many cases involve the same agencies and emergency responses, and will potentially result in similar community responses.

This study, therefore, is unique in that it seeks to address Australia's emerging health concerns in national security terms: from the natural emergence of a pandemic to the deliberate deployment of a biological pathogen by terrorists.

Diseases will continue to be our natural companions, taking advantage of changes in human behaviour and evading our best efforts to defeat them. Nevertheless, admitting defeat is no real option. We have new tools at our disposal and we understand diseases better now than we did at other key moments in human history. The prospect of a major crisis from an influenza pandemic is very real and deserves the serious attention of governments here and overseas. And if we're not careful, the looming HIV crisis in our region will derail our other aid and trade initiatives and cause new and permanent changes that we'll need to manage.

In the same way that governments have been seized by the generalised terrorist threat, we need to be sure that adequate precautions are being made for the devastating consequences of a major disease outbreak. Around $6.2 billion of new investment has been made by the Australian Government to fight terrorism. An influenza outbreak is arguably both more likely and likely to claim a larger number of lives, but investment to defeat the next influenza pandemic is only about $311 million.

Rarely has disease and human welfare been a central interest of those who work in the ever-broadening discipline of security. The story of disease and security isn't a new one, but among the security policy traditionalists it has tended to be overlooked. But just as 'human security' has gained more traction in the security debates of the past decade or so, it's important that we understand the range of challenges from disease we need to face to help us secure our prosperity and our community.

My thanks go to Professor Peter Curson and Brendan McRandle for their work on this important issue. Responsibility for the views expressed in this report rests with the authors and me.

Peter Abigail
Director

Executive summary

At the beginning of the 21st century the world has already experienced a number of serious infectious disease threats including SARS, avian influenza, pneumonic plague, Marburg virus, and HIV. We now face the threat of an influenza pandemic.

This strategy paper argues that public health surveillance of, and response to, emerging infections and biological terrorism are closely related. Biological terrorism sits at one end of a continuum of biological threats to our health and wellbeing. At the other end are located pandemics of infectious disease like influenza and HIV/AIDS, which still sweep away millions each year. Somewhere in between lie emerging and re-emerging infectious diseases like SARS, West Nile virus, Marburg virus, Ebola, and bird flu, as well as a growing list of infections becoming resistant to antibiotics. Compared to all these, biological terrorism is a much more unlikely danger. Nevertheless, the covert release of a biological agent into a civilian population has fearful potential that has long been recognised.

Disease and security

One of the looming challenges to Australia's national security is infectious disease. The argument that infectious disease threatens Australia's national security rests largely on the proposition that the health of Australia's population is a critical resource, vital to the stability and growth of the nation, and that the control of foreseeable risks and the maintenance of a healthy and productive population is one of the government's prime responsibilities.

Today, Australia is faced by a three-fold threat. Firstly, the persistence of a wide range of infections within Australia. Secondly, the threat of emerging or re-emerging infections 'invading' Australia via the medium of travel or trade. Finally, there is the continuing threat of a bioterrorist attack.

In addition to the risks we face directly is the prospect that our neighbours will be further weakened by disease threats. Infectious disease can place enormous strains on local economies, reduce trade, and even the capacity of the state to meet the demands of its own security and law and order. Infectious disease can compound the problems of our most vulnerable neighbours. Those states at most risk of becoming failing states face the daunting prospect of managing the impact of new infections, like HIV. The experiences of sub-Saharan Africa tell us something of how this pandemic can savage societies, trapping vulnerable states in a cycle of poverty and under-development.

Emerging infections

Hardly a week goes by without evidence of the appearance of 'new' or re-emerged infections. Many of these are zoonotic or animal infections, long present in wildlife reservoirs. In Australia, infectious disease continues to play an important part as a mortality and morbidity factor and a number of zoonotic infections remain poorly controlled. The problem is being compounded by the growing list of drug resistant bacteria and viruses. The promise of an era free of disease, apparently within our grasp in middle of the 20th century, has proved illusive.

The problem of zoonotic infections—diseases that occur naturally in animal populations but can cross the species barrier to infect humans—has become increasingly apparent over the last four decades. Probably 75% of emerging human diseases are caused by zoonosis. SARS, HIV and the H5N1 strain of avian influenza underscore the importance of these diseases to the state's wellbeing and prosperity, and ultimately its stability.

The impact of pandemics

There would seem little doubt that globalisation has transformed the world, and that with increasing interconnectedness between states and increasing trade and travel, health has ceased to be 'national' and become 'international'. Infectious disease is now just a plane journey away, and it is no longer possible to protect Australian citizens without addressing infectious disease elsewhere in the world. The revolution in cheap air travel brings with it its own concerns. With more than 1.5 billion airline passengers carried annually to all corners of the globe, the safety that was once inherent in Australia's geographic isolation has disappeared.

In parts of Asia HIV has taken hold and threatens to spread through our small Pacific neighbours. Should we fail to halt its spread, the consequences will be felt for at least a generation. Australia's interests are directly engaged by this threat, which has the potential to wind back whatever progress has been made over the last three decades.

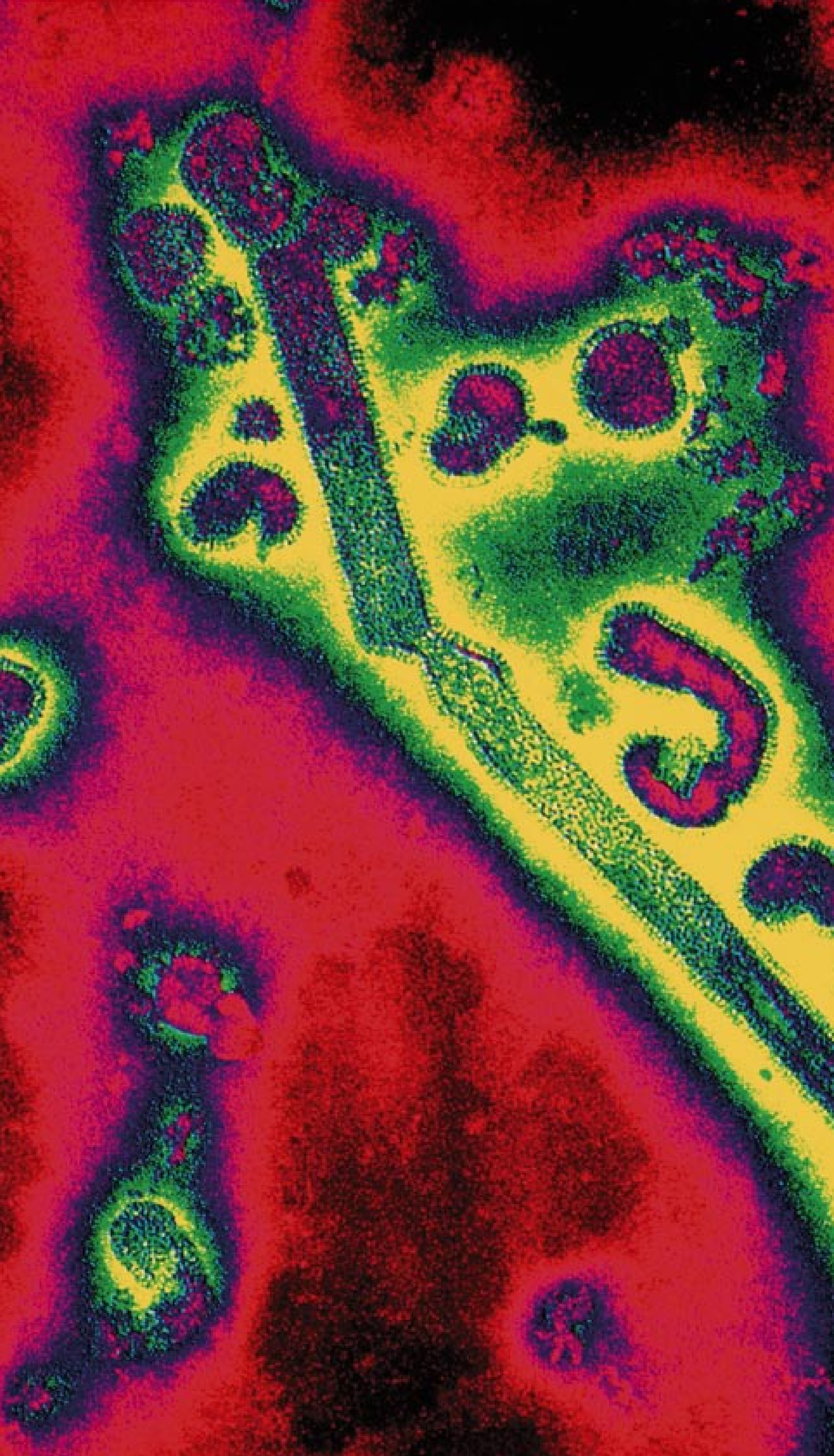
The risk of bioterrorism

The threat of bioterrorism continues to concern the Australian Government. A variety of possible biological agents and delivery mechanisms are considered here, including the use of humans as 'vectors' of disease, the use of a local endemic infectious agent, and the possibility of the use of a virulent respiratory infection.

Biological agents have several characteristics that makes them attractive as weapons and the technical expertise needed to develop bio-weapons is not especially demanding. Advances in science and the growing list of attempts to employ biological weapons gives us no cause for complacency.

The challenges for Australia

Faced with a 'new era' of infectious disease and the threat of bioterrorism, how well prepared is Australia and what responses might be considered? This paper briefly considers the surveillance and preparedness programs in place, as well as issues of control, cooperation and collaboration. It then considers particular issues of response and containment, such as quarantine, the provision of antiviral drugs and vaccines, the impact on the healthcare system, and the management of human fear.



Chapter 1

DISEASE AND SECURITY

Public health is one of the basic props upon which national security rests. Without a healthy and secure citizenry, free from fear of major health risks, Australia can't prosper, expand its economy, adequately secure its borders and maintain its national and international integrity. A government that can't maintain the health and wellbeing of its citizens is failing in one of its most fundamental responsibilities.

One of the greatest direct and indirect dangers to Australian security remains infectious disease.

This strategy paper argues that public health surveillance of, and response to, emerging infections and to biological terrorism are closely related. Biological terrorism sits at one end of a continuum of biological threats to our health and wellbeing. At the other end are pandemics of infectious diseases like influenza and HIV/AIDS, which still sweeps away millions each year. Somewhere in between lie emerging and re-emerging infectious diseases like SARS (severe acute respiratory syndrome), West Nile virus, Marburg virus, Ebola virus, and avian influenza (bird flu), as well as a growing list of antibiotic-resistant pathogens. Compared to all these, biological terrorism is a much less likely danger. Nevertheless, the covert release of a biological agent into a civilian population has fearful potential that has long been recognised.

Photo opposite: Influenza human virus strain A. Image courtesy of AUSTRALIAN PICTURE LIBRARY

One of the greatest direct and indirect dangers to Australian security remains infectious disease. The direct threat comes from infectious disease agents 'invading' Australia via the medium of international travel and trade, or through a bioterrorist act. The indirect threat arises when infectious diseases help to undermine the social and economic stability of other states with which we have connections or relationships.

Three issues dominate the current debate about infectious disease and national security:

- the threat posed by emerging or re-emerging infections
- the challenge posed by endemic infectious disease
- the threat posed by bioterrorism.

The contention that the spread of infectious disease threatens national security rests on the basic proposition that such disease threatens the health, wellbeing and quality of life of all Australians. In line with RAND's 2003 paper (Brower, Chalk), six basic points support this proposition.

First, infectious disease remains an important threat to human life and good health across most of the globe. Over the past 35 years, infectious diseases have claimed the lives of more than one billion people; even now, roughly 14 million die each year from this cause. The staggering human tragedy wrought by HIV/AIDS is one reason why infectious diseases, long the concern solely of public health authorities, have become a more pressing concern of national governments and policy makers.

Second, if left unchecked, infectious disease can undermine the normal functioning of the state, sapping public confidence, tapping into deep-seated fears about contagion, and creating widespread fear, panic and hysteria.

Third, infectious disease can highlight and deepen inequalities and vulnerabilities within societies like Australia, accentuating existing disadvantage and minority status. Trachoma illustrates the point: once associated with slums, workhouses and unsanitary living in 19th century Australia, by the 20th century trachoma had disappeared among Australia's European population only to linger as a major public health problem in remote Aboriginal communities.

Fourth, infectious diseases can undermine the economic and commercial viability of the state by placing extraordinary demands on the healthcare system, sapping business confidence, reducing the productive labour force, and destroying individual livelihoods. HIV/AIDS and SARS demonstrate just how vulnerable the economy is to major disease outbreaks. SARS is estimated to have cost the world economy somewhere between US$30–50 billion.

Fifth, infectious disease can lead to regional instability by weakening already vulnerable states. It can also lead to inter–state or national–regional antagonisms, resulting in disagreements and acrimonious debates about responsibilities for quarantine and preparedness and reactive measures.

Finally, infectious disease can threaten national security through bioterrorism. Concern about bioterrorism is one strand of the broader concern about the use of non-conventional weapons by non-state actors, the other potential weapons being chemical and nuclear. While bioterrorism hasn't had the same impact as conventional weapons to date, we know that an attack using pathogens continues to interest groups like Al Qaeda, as well as others that have no part of the jihadist franchise. There are enough examples of attempts to develop a biological weapon to worry governments and intelligence agencies. Moreover, legitimate 'dual-use' technologies make it easier for terrorists to create a biological weapon, but difficult for authorities to detect their activities. Indeed, the infrastructure and techniques needed to develop biological weapons are far less expensive or complex than those needed to make a nuclear device. According to an investigation by *New Scientist*, genetic sequences for deadly viruses can be ordered on-line with few background checks made of those who place the orders.

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Since 1999, the world community has begun to recognise the national security implications of infectious disease. In that year, the UN Security Council declared HIV/AIDS a national security threat, particularly to sub-Saharan nations. Subsequent international meetings have accorded high priority to HIV, but current concern about infectious disease as a critical component of debates about national security transcends that particular disease.

From the flow of countless migrants and refugees, to tourists and business travellers on international flights, to the regular transhipment of foodstuffs from the developing world, to ships that transport pathogens in their bilge water, the potential for the spread of infectious diseases to Australia has never been greater. As a result of our hypermobility, distance and national borders have ceased to be important barriers to the movement of infectious agents.

In an age of expanding global travel and trade, it's clearly impossible to adequately protect the health of Australia's population without addressing infectious disease elsewhere in the world.

In the 21st century, it has become necessary for Australia to incorporate a wider international perspective into our domestic health and security policies. Globalisation has transformed the world scene; with increasing interconnectedness between states and increasing travel, health has ceased to be 'national' and has become 'international'.

Infectious diseases now move around the world at the speed of jet aircraft. Nowhere's safe, and international boundaries have lost much of their traditional significance as barriers to imported disease. In an age of expanding global travel and trade, it's clearly impossible to adequately protect the health of Australia's population without addressing infectious disease elsewhere in the world.

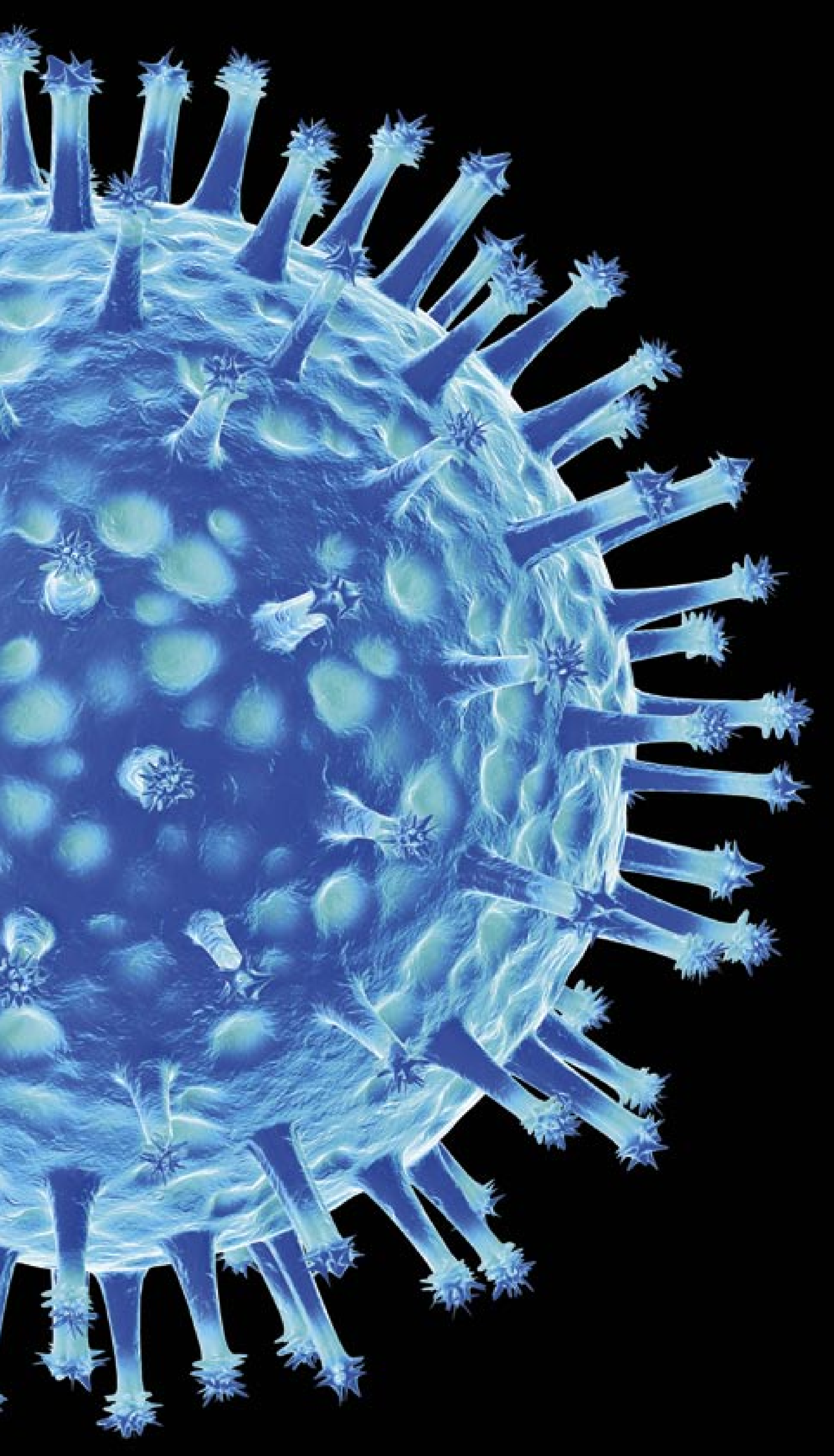
However, it's important to realise that the internationalisation of infectious disease isn't new. Disease has always played a major role in human history, and the last two centuries, in particular, are full of instances of disease accompanying migrant flows to Australia. What's new is the speed of trade and human movement, along with its range and the pace at which we have modified the biophysical environment. In many ways, these factors require governments to develop even greater levels of international cooperation to control the spread of infections.

In Australia, as elsewhere, national security has primarily been defined in terms of preserving the integrity of the state, its territorial boundaries, its political institutions, and its relationships with other states. Traditionally, national security focused on shielding citizens from external threats. Since the end of the Cold War, however, efforts have been made to extend the arena of national security debates to include consideration of non-traditional threats like bioterrorism, ethnic conflicts, economic threats and infectious disease. One of the purposes of this *Strategy* paper is to argue the case that national security needs to include consideration of infectious disease inside and outside Australia, because such a threat impinges on the territorial integrity and viability of the state. Inherent in this, is that national security needs to recognise that individual health, wellbeing and security are all intimately connected to individual liberty and the preservation of the integrity of the state as a viable political, socioeconomic and territorial unit. A government's ability to maintain the health, quality of life and basic freedoms of all its citizens is one of its prime purposes. To this end, national security needs to concern itself with the epidemiological vulnerability of all Australians and to provide, as far as possible, a risk-free and secure environment.

The disease threat also engages our wider international interests because it compounds the challenges already faced by the many weak and vulnerable states in our region.

Few would debate the proposition that the transnational spread of infectious disease over the next few decades poses a threat to Australia's national security, insofar as it directly threatens individual health and wellbeing. In such a context, national security involves a 'whole of society' approach: from general practitioners and pathologists to hospitals; state and national laboratories; education, agricultural and immigration officers; global surveillance networks; national intelligence; law agencies; and the media. The disease threat also engages our wider international interests because it compounds the challenges already faced by the many weak and vulnerable states in our region.

In essence, public health and national security are intimately entwined in the area of emerging infectious diseases and bioterrorism.



Chapter 2

THE ORIGINS OF MODERN DISEASE

Emerging and re-emerging infections

Hardly a week goes by without new evidence of the growing microbial threat to human health and wellbeing.

Looking back on the 1950s, there were many signposts to emerging infections that we tended to overlook or ignore. West Nile virus burst forth in Israel in a series of major epidemics between 1950 and 1954; Korean haemorrhagic fever appeared in 1951, in a classic example of war disrupting a natural disease environment; Junin virus appeared in Argentina in 1953, when major changes in land use in the pampas destabilised a long-established disease reservoir.

Many other 'new' infections appeared in the developing world during the 1950s and early 1960s. However, it wasn't until 1967 that a new and particularly virulent haemorrhagic fever broke out in Zaire and the Sudan, only to attract headlines and a name when it affected thirty-one workers in a research laboratory in Marburg, Germany. Since then, the world has witnessed a seemingly endless parade of 'new' infections, including Lassa fever (1969), Ebola virus (1977), legionnaires disease (1977), Hantaan virus (1977), toxic shock syndrome (1981), Lyme disease (1982), Nipah virus (1998), SARS (2003), monkeypox (2003) and avian influenza (1997–2005).

The hope for an aseptic age, so triumphantly heralded in the 1960s, has proved illusory.

The hope for an aseptic age, so triumphantly heralded in the 1960s, has proved illusory. Over the past three decades, infectious disease

Photo opposite: AVIAN/Bird Flu Virus Image. © Matthias Kulka/AUST PICTURE LIBRARY has returned to the international agenda. So-called 'new' infections are triggering global epidemics, while 'older' infections, once thought under control, have reappeared, often in more virulent forms and often redistributed geographically. By the 1990s, epidemics had regained centre stage, and are now once again a major concern.

By the 1990s, epidemics had regained centre stage, and are now once again a major concern.

A number of factors have facilitated the emergence of new diseases and the re-emergence of older established ones. These include environmental changes; the globalisation of agriculture, food production and trade; human demographics and behaviour; and microbial adaptation. Other factors have also contributed, including declining expenditure on public health in many countries and a general complacency about infectious disease on the part of public health systems until relatively recently. Critically, many of the emerging infectious diseases that have appeared over the past few decades seem, as Morse (1995) has remarked, 'to be pathogens long present in the environment which have been brought out of obscurity or given a selective advantage' by some aspect of human behaviour, allowing them to infect new hosts or change their geographical distribution.

The profound changes in China's economy and demography are illustrative. Over the past two decades, China has sustained very high levels of economic growth. As the economy has transformed, millions of rural workers have moved to the cities. Living standards are rising, with consumers demanding more animal protein in their diets. To date, much of that increased demand has been met through higher domestic production, which is being achieved through more intensive agricultural practices and less government intervention and regulation. According to Chinese Government figures, China's total animal product output tripled in the decade from 1986. Poultry production alone probably increased fivefold during that time. This has created new conditions that facilitate the emergence of hitherto unknown virus strains.

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One crucial message to emerge from all this is that the biophysical environment is a powerful, ever-changing force, and that we have continually underestimated the role it plays in our lives, and particularly its significance for infectious disease.

Many would now argue that the most serious threat to our security is the destabilisation of the historically fragile relationship that has always existed between people, animals and their biophysical environments. Human populations, animals and a wide variety of disease agents and vectors have evolved together over thousands of years. The equilibrium between them has been honed by centuries of contact, by the development of the human and animal immune systems, by human and animal behaviour, and by broader political, economic and social mores. It doesn't take much to upset this delicate relationship and place human populations at risk. For example, the modern world trade in wildlife probably involves more than a billion direct and indirect encounters between wild animals, domesticated animals and people every year.

Zoonoses—infections that cross the species barrier

Many emerging infections that affect human populations result from exposure to zoonotic pathogens (that is, those normally found in animals but which can infect humans). Although only a little more than half of all human infectious diseases are zoonotic, probably as many as three-quarters of emerging human diseases in the past 40 years result from animal pathogens crossing the species barrier to infect a human host.

Many wildlife populations have long acted as natural reservoirs of infectious agents. The key trigger in the emergence of most 'new' infections is some element of human behaviour or agency that changes the delicate balance between animal and human populations, resulting in an underlying change to reservoir–disease–host ecology. Changes in human demography and behaviour can trigger a cascade of factors influencing the stability of natural reservoirs of infectious disease.

Intermixing of domesticated animals with wildlife has also encouraged the spread of infectious pathogens. So has the growing use of antibiotics in livestock farming, often encouraging the emergence of resistant disease strains. Intensive forms of farming and livestock management have also encouraged the emergence of new infections. In the 1980s, for example, many British farmers began to feed sheep products to their cattle, allowing bovine spongiform encephalopathy (BSE, or 'mad cow' disease) to jump species and eventually infect humans.

The only disease to have been fully defeated is smallpox ... a uniquely human infection, with no disease reservoir in another animal species.

The only disease to have been fully defeated is smallpox. The reason probably lies in the fact that smallpox was a uniquely human infection, with no disease reservoir in another animal species.

More recently, SARS emerged without warning from East Asia. The source of the disease is still uncertain. The palm civet was an early candidate as the natural reservoir, after evidence emerged that restaurant workers were handling these animals. However, a recent study has suggested that bats might play a role in hosting the infection.

> The microbial world has demonstrated a dynamism and capacity for change and adaptation that has rendered our 'magic bullet' approach, directed at what we believed to be a stationary target, largely irrelevant.

The microbial world has demonstrated a dynamism and capacity for change and adaptation that has rendered our 'magic bullet' approach, directed at what we believed to be a stationary target, largely irrelevant. Microbes, like all living things, are programmed for survival, and the emergence of infectious disease over the past 40 years simply underscores the fact that mutation and change are facts of life, that microbes adapt and change in accordance with changes in their hosts and environments, and that our quest to eradicate or control all infection is probably utopian.

Everything old is new again: re-emerging infections

Re-emerging infections include those that were once a problem in the past and are becoming so again, and those that remain endemic at low levels of prevalence but are now increasing in incidence or changing their geographical distribution. Some diseases meet both criteria. Re-emergence is caused by much the same factors that cause newly emerging infections: environmental modification, zoonotic encounters, human movement and behavioural change. Many infectious diseases have resurged in recent years, including malaria, dengue, cholera, tuberculosis (TB) and many childhood infections.

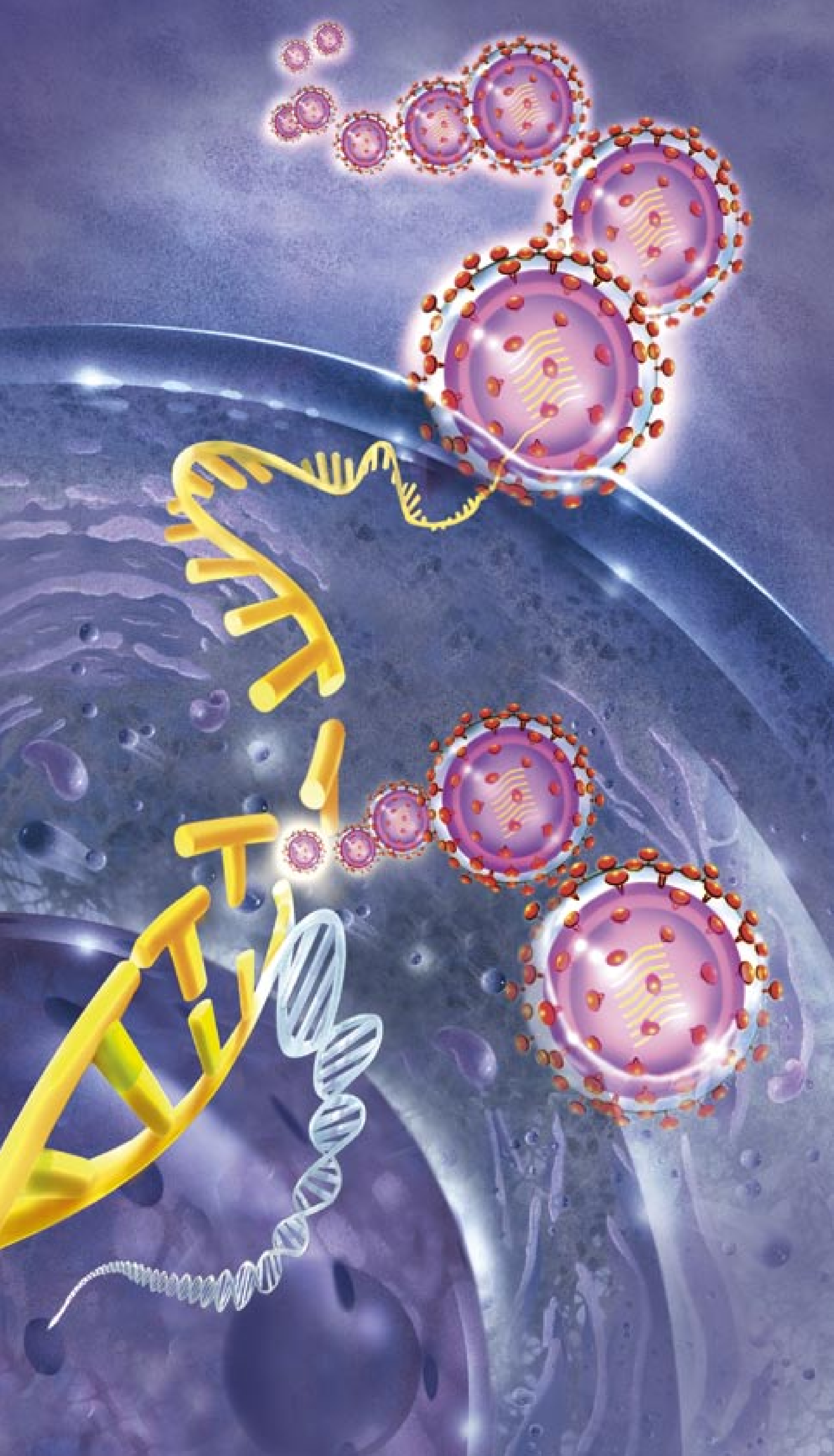
> Over the past five years, Australia has seen a spectacular increase in drug-resistant microbes affecting healthcare patients.

The development, in a wide range of pathogens, of resistance to antimicrobial drugs has also become an important problem. This is particularly the case in the healthcare industry, and hospital-acquired infections have become an important cause of mortality and morbidity. Over the past five years, Australia has seen a spectacular increase in drug-resistant microbes affecting healthcare patients. Today, an increasing proportion of patients leaving hospital carry with them an infection acquired during the course of their treatment. That is part of a worrying international trend. In the US, for example, nearly 2 million patients acquire an infection in hospital each year. Of those patients, approximately 90,000 die as a result of their infection, compared with around 13,000 patient deaths just over a decade ago. A number of factors contribute to this situation, including the widespread and often inappropriate use of antimicrobial drugs in society.

TB is a striking example of how Australia's migration policies have helped shape the distribution of health risks and breathe new life into an old disease. In Australia, TB has largely become an infection affecting distinctive minority and overseas-born populations.

In 2003, Australia's overseas-born population had a TB rate twenty-two times higher than that of the Australian-born population.

Similar stories can be found elsewhere. In 2004, Singapore faced its largest dengue outbreak in a decade, recording around 9,500 cases. This year, and despite even stricter controls and public awareness campaigns, even more people have been infected. Health authorities believe the new strain of dengue circulating around the city-state has been introduced by migrant workers, an inexpensive source of labour that makes an important contribution to Singapore's economic success. Ironically, Singapore's earlier success in controlling dengue has probably contributed to the severity of the current outbreak. Many younger Singaporeans will have had no previous exposure to dengue, making them more vulnerable to the disease.



Chapter 3

PANDEMIC INFLUENZA—THE BIOLOGICAL TSUNAMI

> [A pandemic] would be more serious than any imaginable terrorist atrocity, short perhaps of a nuclear bomb in a major city.
>
> *Tony Abbott, Minister for Health and Ageing, September 2005*

The major current preoccupation of health authorities around the globe is the H5N1 strain of avian influenza, or bird flu. Bird flu is a natural infection of waterfowl, and has circulated as a largely benign gastrointestinal infection among a variety of species of wild birds in parts of Asia.

For centuries the virus has been maintained among its natural hosts (ducks, gulls and other species), comfortably adapting its life cycle to its environment. Most of the host waterfowl species migrate in search of food and breeding sites, and regularly come into contact with farmed ducks and chickens. The wild birds transport the virus over long distances, excreting it in their faeces while remaining perfectly healthy. While there have been isolated outbreaks of bird flu extending back into the 19th century, more recently the virus seems to have begun circulating among farmed poultry. Initially, the virus seemed only to cause a mild illness among birds, but it soon mutated into a much more virulent form causing high mortality.

So far, there's no evidence that the bird flu virus has mutated to cause human-to-human infections, but the great concern of health authorities, governments and the World Health Organization (WHO) is that it's only a matter of time before that important shift occurs—an event that would signal the start of the next pandemic. Since early 2004, world health officials have been on high alert.

Photo opposite: Illustration of progression of infection by flu virus.

Influenza

Influenza is a virus that attacks the upper respiratory tract. Of the different types of influenza virus, only the A strain is responsible for pandemics. Two surface proteins (antigens) on the surface of the virus are used to classify the substrains of influenza A: haemagglutinin (H) and neuraminidase (N). There are thought to be fifteen different H subtypes and nine different N subtypes. All have been isolated from wild bird populations.

The genetic material that controls the reproduction of influenza is relatively unstable and prone to errors as the virus reproduces itself. When errors occur, the surface proteins are modified slightly and the virus undergoes what's known as antigenic *drift*. The host's immune system won't immediately recognise this 'different' virus, and so a new infection can occur. This is the reason we have a normal cycle of new flu infections each year.

Traditional agricultural practices in China and other parts of Asia, in which chickens, ducks and pigs are kept in close proximity to people, are one reason that many influenza outbreaks emerge from Asia.

Influenza A strains don't normally kill their natural hosts, but it's a different story when the virus crosses the species barrier. The genetic material can mix with another subtype of virus in the new host, forming an entirely new subtype. This is an abrupt and radical change known as antigenic *shift*. Pigs are able to host both avian and mammalian influenza virus, and it's for that reason that they can become the critical link in the process of genetic mixing and the formation of a new virus strains capable of infecting humans. Traditional agricultural practices in China and other parts of Asia, in which chickens, ducks and pigs are kept in close proximity to people, are one reason that many influenza outbreaks emerge from Asia. However, new evidence also suggests that at least some avian virus can infect humans directly, and that's where the genetic mixing occurs.

Recent research indicating that avian flu played a part in the emergence of the deadly flu pandemic of 1918–19 is a grim reminder of the potential risk. That pandemic was responsible for at least 40 million deaths worldwide (some now postulate that the real figure was closer to 100 million) and at least 12,400 in Australia.

Avian flu has come close to fulfilling the three basic conditions for causing a human flu pandemic.

Avian flu has come close to fulfilling the three basic conditions for causing a human flu pandemic. First, a novel virus has emerged to which humans have little or no immunity. Second, this new virus can replicate in humans and cause serious illness. The third and, as yet, unmet condition is a change that allows the virus to cause human-to-human infections. Why the H5N1 bird flu virus hasn't yet changed into a form more deadly to humans remains something of a mystery, given that it has had plenty of opportunity and has come into contact with the human flu virus. Many think that it's only a matter of time before a new, lethal and highly contagious disease is unleashed on the world. Governments are now acutely alert to the risks, albeit after some alarming predictions from the WHO.

Many think that it's only a matter of time before a new, lethal and highly contagious disease is unleashed on the world.

How could a human strain get here?

So far, outbreaks of avian influenza in different parts of the world have resulted from the movement of migratory birds. There's only a small risk that birds could bring the disease here, because infected birds would have difficulty making the long journey to Australia. If the virus transforms into a strain capable of human-to-human infection, however, we'll face a substantially heightened risk every day, through the large numbers of people who travel by air.

The massive expansion of air transportation is perhaps symbolic of the magnitude of changes associated with globalisation ... within the next decade well over 2 billion passengers will fly each year.

The massive expansion of air transportation is perhaps symbolic of the magnitude of changes associated with globalisation. In 1945, airlines carried just 9 million passengers; by 2004, the number had grown to a staggering 1.6 billion—around 5 million each day. According to the International Air Transport Association, within the next decade well over 2 billion passengers will fly each year.

Pandemics in the jet age

By 2003, there were promising signs that international air transport was beginning to recover from the shock of the September 11 attack in the United States and the subsequent war against terrorism. That optimism changed rapidly into pessimism with the outbreak of a new and mysterious respiratory disease—SARS. The outbreak began when a doctor who had treated patients with respiratory illness in China flew to Hong Kong, staying in Room 911 of the Metropole Hotel. Over the next 24 hours, a dozen other guests on the same floor of the hotel became infected, and the disease was soon travelling with them to Singapore, North America and Vietnam. Over the next few months, some 8,000 cases of SARS were notified globally, and 800 deaths were recorded.

Passenger numbers tumbled, particularly in the Asia–Pacific region, and airlines were forced to abandon unprofitable routes and leave their expensive assets idle. Passenger statistics illustrate the impact of SARS. Hong Kong's regional airline, Dragon Air, typically carried around 300,000 passengers a month before the outbreak. This fell to 30,000 in May 2003—a 90% drop. Elsewhere, one of the world's most profitable airlines, Singapore Airlines, reportedly lost around $6 million per day during the height of the crisis.

The SARS epidemic cost the world an estimated US$30–50 billion. Tourism, the hospitality industry, transportation and retailing were the hardest hit sectors as consumers shunned travel, restaurants and entertainment venues. Many airlines were forced to cancel flights.

In May 2003, for example, 60,000 fewer Australians departed overseas than in May 2002.

In Australia and other parts of the Asia–Pacific region, SARS had a major impact on consumer confidence and, in particular, the travel and hospitality industry. In China, the tourism industry is reported to have lost more than $7 billion during the crisis, as well as almost three million jobs. In Australia, SARS caused a major downturn in overseas visitors and in the number of Australians travelling overseas. In May 2003, for example, 60,000 fewer Australians departed overseas than in May 2002. Internationally, SARS had a major impact on world and Asia–Pacific tourism. As Figure 1 illustrates, the period from April to June 2003 saw a substantial downturn in tourist movements.

continued

Pandemics in the jet age *continued*

Efforts to understand the risks of pandemics in the jet age have focused particularly on the quantity of fresh air entering the aircraft cabin compared with the amount of recirculated cabin air. A study of air quality by the House of Lords in the UK found that air travel provided relatively better air quality and lower risks of infection than other modes of public transport. That doesn't rule out the possibility of infectious diseases being spread among passengers, as SARS has shown, but what should probably concern us more is the opportunity for infection to spread in airport terminals at either end of journeys. It is more likely that passengers moving about freely in terminals and mixing with passengers who are travelling to or from other destinations represent a more serious threat for the rapid spread of infection. In such circumstances, surveillance at airports becomes a vital part of our defence mechanism.

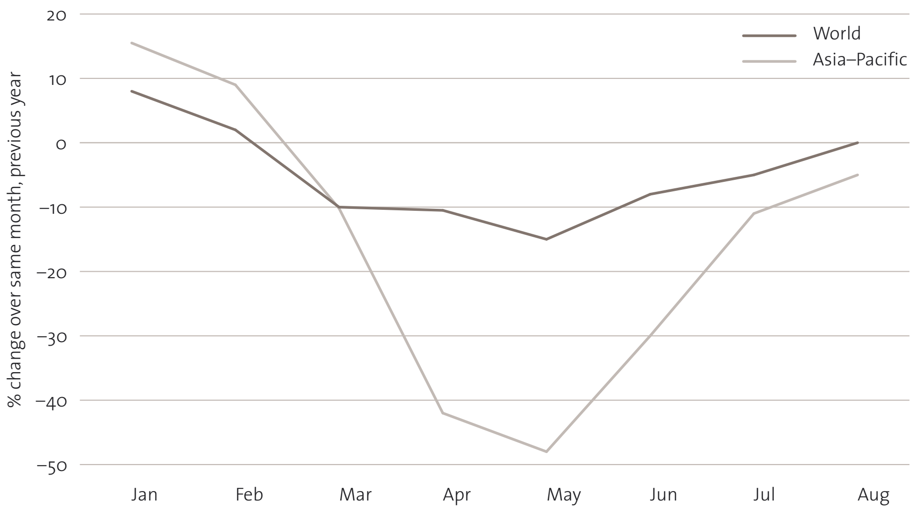
SARS is a potent reminder of the impact of infectious disease on the security of local and international economies, but only a few thousand people were infected and the SARS crisis was over after only a few months. A major epidemic of influenza would present a threat several orders of magnitude higher to more of the world.

The three major influenza pandemics of the 20th century all occurred before the revolution in cheap and accessible mass air transport.

The three major influenza pandemics of the 20th century all occurred before the revolution in cheap and accessible mass air transport. The last was in 1968, at the dawn of the introduction of wide-body aircraft and the corresponding increase in affordable travel for the masses. When, not if, the next influenza pandemic strikes, we should expect the virus to spread from its source and travel the globe in timeframes that will test the ability of governments and health authorities to detect and respond to the threat. Non-stop flights from Hong Kong to London or Sydney, or from Singapore to New York, are well within the incubation periods of most diseases, including influenza. That's a far cry from the era when travel by ship was the only choice for generations of travellers to and from Australia. We can't assume that time will be available to implement reactive quarantine measures to protect the broader population.

Figure 1: The impact of SARS on travel and tourism

International tourism movements 2003



Source: World Tourism Organisation

The possible impact of the next pandemic

In 2004, at least 150 million chickens and ducks were destroyed across Asia in an effort to contain avian influenza. The real reasons for the emergence of bird flu lie in the nature of agricultural practices and living conditions in much of Asia: people, farmed poultry and other domesticated animals often intermingle with wildlife; chickens and ducks are allowed to roam freely; antibiotics and other drugs are regularly used to protect farmed animals; and animals and fish are often raised on the faecal droppings of live birds and the carcases of dead ones.

Bird flu … has already cost the world more than US$12 billion, seen the destruction of more than 200 million chickens and ducks …

Bird flu is having a major impact on many Asian economies. It has already cost the world more than US$12 billion, seen the destruction of more than 200 million chickens and ducks, and had a devastating impact on food security and livelihood throughout parts of Southeast Asia, China and Siberia. Yet much of the talk continues to be about what might happen if the virus mutates and the world is confronted by a pandemic of influenza.

What sort of pandemic might emerge remains difficult to predict. It's possible that, like the last two influenza pandemics, it might be mild and cause mortality mainly among the very young and very old. On the other hand, if it's anything like the 1918–19 pandemic and targets young adults, it might have severe impacts. Whatever its nature, it's likely to cause substantial social disruption, high mortality and widespread economic effects.

The US Centers for Disease Control and Prevention (CDC) has estimated that a flu pandemic in the US would cause between 88,000 and 227,000 deaths and cost between US$71 billion and US$166 billion for hospitalisation, outpatient care, self-treatment, and lost wages and work days.

If, however, a flu pandemic resembled the 1918–19 outbreak, it's possible that, without intervention, deaths might exceed 70,000 and cases approach seven million.

In Australia, a pandemic could have equally dire effects. While the normal seasonal attack rate of influenza is between 5% and 10%, a more virulent strain could affect 25–35% of the population. If this were the case, then a conservative estimate would see between 18,000 and 25,000 deaths and between five and six million cases. If, however, a flu pandemic resembled the 1918–19 outbreak, it's possible that, without intervention, deaths might exceed 70,000 and cases approach seven million. A pandemic on the scale of that in 1918 seems to be the basis for some alarming estimates from the WHO, suggesting that global casualties could be in excess of 100 million. Australian modelling suggests that, subject to a range of factors including the virulence of the virus and the success of medical treatments, fewer deaths would be recorded in Australia. However, with many important factors still unclear, accurate modelling is difficult and we should be cautious about being too optimistic.

What's being done?

The centrepiece of the Australian Government's response is the Interim Australian Management Plan for Pandemic Influenza, released in June 2005. The plan, which draws on similar plans developed by the WHO and by other countries (the UK, the US and Canada), is intended to provide guidance at all stages, from preparation for a pandemic to all phases of a pandemic outbreak.

The plan was built on the foundation of the 2003 Australian Action Plan for Pandemic Influenza, which in turn, was developed from a framework developed in 1999.

The two key aims in Australia's pandemic control strategy are to:

- restrict and contain the spread of influenza through point-of-entry control measures, quarantine and the use of prophylactic antiviral treatments
- maintain essential services should general containment fail, in order to preserve as much capacity as possible within those services.

In preparation for a pandemic, the government has also established a national medicines stockpile. The stockpile provides a surge capacity for certain medicines that might not normally be needed, but demand for which would become astonishing under the conditions of a pandemic. The antiviral medicine oseltamivir, manufactured in Switzerland by Roche and marketed under the name Tamiflu, is one of the stockpile medicines.

Tamiflu is probably the antiviral medicine most in demand around the world. The drug was developed in the 1990s, but its stocks only took off once it became apparent that it may offer some help by reducing both the severity and the duration of an influenza infection. Although there are still some question marks over how effective the drug might be in helping combat an influenza outbreak, it remains one of the few options for treatment until a vaccine is developed. Other antivirals are also in line to help fight infection, including the Australian-developed Relenza.

Australia is relatively well placed by international standards, but even so Tamiflu will remain difficult to acquire in the quantities that will probably be needed.

Tamiflu is a complex product, and the manufacturer is struggling to fill international orders. Roche's output has increased around fourfold in the past couple of years, but that will prove inadequate if the pandemic occurs. Australia is relatively well placed by international standards, but even so Tamiflu will remain difficult to acquire in the quantities that will probably be needed. Moreover, the developed world has cornered the market, leaving little prospect for developing nations—particularly those most likely to be hit first in the next pandemic—to acquire the drug in anything approaching sensible quantities. Australia has provided limited amounts to Indonesia to treat those most at risk from recent bird flu cases, but should the virus develop into a pandemic of human influenza the domestic priority to safeguard the Australian population could see that form of international assistance disappear. Of the government's commitment of approximately $170 million to pandemic preparations, around $114 million was for the purchase of 3.3 million courses of Tamiflu. The cost of acquiring sufficient stocks for the entire population for around a month might cost in the order of $2 billion, although manufacturing bottlenecks mean that order couldn't be filled in any case.

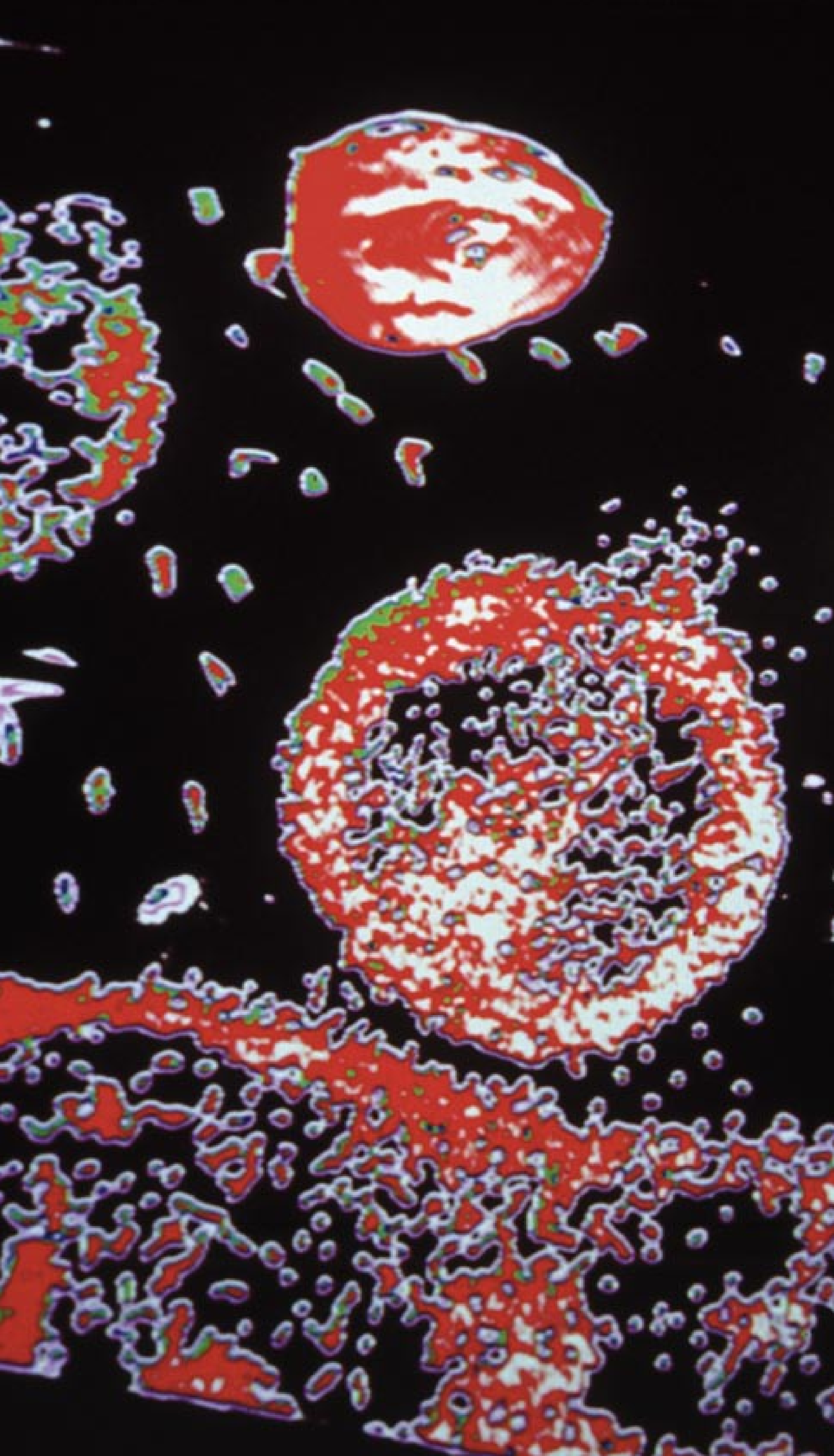
One problem facing health authorities is that the virus might quickly acquire resistance to these drugs. As we have seen with the indiscriminate use of antibiotics, the premature and widespread application of antiviral drugs may undermine our strategies, reducing the range of treatment options available for a real crisis. In June this year, it was reported that the Chinese Agriculture Ministry had advocated the use of amantadine, another human antiviral medication, in poultry to stem the bird flu outbreak. Amantadine is a cheaper alternative to oseltamivir, but is no longer effective against the virus because the virus has acquired resistance it.

One problem facing health authorities is that the virus might quickly acquire resistance to these drugs.

The Australian Government is also helping to fund vaccine development at the CSL laboratory—one of four WHO influenza collaborating facilities globally. No-one yet knows the precise make-up of the next pandemic form of influenza virus, and the vaccine production process is perhaps best described as something from the early industrial age. In simple terms, fertilised chicken eggs are injected with virus and incubated for several days. The eggwhite is harvested and the virus is inactivated and purified. Though effective, the production system won't be able to produce vaccine in large volumes until several months into the pandemic. Another complication is that the H5N1 strain is so virulent that early attempts to grow the virus failed because the chicken embryos were dying before the virus could be harvested. Some of these problems have been overcome, but they illustrate the challenges that laboratories face in developing a safe and effective vaccine quickly.

… Australia is offering around $15.5 million in support to Indonesia for current incidents involving avian influenza.

Beyond these domestic preparations, the government is offering some assistance to the region. Specifically, Australia is offering around $15.5 million in support to Indonesia for current incidents involving avian influenza. This includes the provision of around 50,000 courses of Tamiflu and technical assistance to Indonesian Government agencies, through the WHO. The government is also contributing to preparations in the region, bringing the total aid package for influenza and other zoonotic diseases to around $141 million. That includes funding for technical training as part of a longer term strategy to improve regional expertise. Those funds will be allocated over four years, with much of it administered through the WHO.



Chapter 4

HIV AND THE THREAT TO THE STATE

Countries in the developed world have only recently begun to awaken to the magnitude of the danger presented by avian influenza, which they previously treated as an essentially Asian problem. As the WHO stirred more governments into action, and health authorities started to get their message though to the political leadership, vastly more effort and resources were expended on preparing for the next pandemic.

It takes a sustained commitment by governments to meet the challenge of infections that destroy communities more quietly, taking several years for their effects to be seen.

Governments sometimes take considerable prodding to become alert to the dangers of a new virus. It helps if the consequences of the disease are clear and immediate, as is the case for pandemic influenza. It takes a sustained commitment by governments to meet the challenge of infections that destroy communities more quietly, taking several years for their effects to be seen. AIDS, the disease caused by the human immunodeficiency virus (HIV), is one such challenge.

HIV probably first emerged as long ago as the 1930s, but governments in the West only became alert to the disease once it was discovered in their own communities in the early 1980s. Unlike the explosive impact of an influenza pandemic, HIV takes years to kill. Indeed, it isn't so much HIV that kills its host, but the immunodeficiency it causes

Photo opposite: SEM of AIDS virus. Image courtesy of AUSTRALIAN PICTURE LIBRARY and the opportunistic infections that afflict the vulnerable. This gives the virus time to be passed from one person to the next, spreading through entire communities and across entire continents.

In the Republic of South Africa, probably more than 600,000 people have so far died from the disease ... life expectancy is predicted to be 43 years, or 17 years less than would have been expected without AIDS.

The global picture

So far, HIV/AIDS has probably killed more than 35 million people. In the Republic of South Africa, probably more than 600,000 people have so far died from the disease; by 2010, life expectancy is predicted to be 43 years, or 17 years less than would have been expected without AIDS. Since HIV/AIDS appeared two decades ago, as many as 60 million people have been infected with the virus. Today, North America probably has one million people living with HIV/AIDS, and Western Europe half a million. By contrast, about 45 million HIV-positive people live in sub-Saharan Africa. Even in Australia, there are more than 13,000 with HIV/AIDS. The new hotspots for infection are the former Soviet republics, Asia, and the Pacific.

Mortality figures, however, provide only a partial measure of the impact of infectious diseases. Approximately two billion people are infected with TB, and there are from 300,000 to 500,000 cases of malaria each year. All in all, major outbreaks of infectious disease over the past twenty years have cost the world more than US$700 billion in economic damage. By 2005, the total cost to the global economy of HIV/AIDS alone probably accounts for at least US$600 billion.

The lesson from Africa

The tragedy of HIV/AIDS in Africa is also a reminder of how the failure to tackle infectious disease can have long-term affects on society, the economy, and perhaps even the viability of the state.

According to the WHO global health strategy for 2003–2007, around 9% of the adult population of sub-Saharan Africa is infected with HIV. Life expectancy has plummeted, and many hard-won economic gains have been eroded. Life expectancy in Zimbabwe was predicted to be 50 years at the start of the new millennium, but the impact of HIV has reduced it to 37 years.

The disease is decimating police and military forces in some countries. Especially worrying is the incidence of HIV among peacekeeping forces that have been deployed to some of the worst troublespots on the continent.

The impact of AIDS in that region is no less destructive than that of warfare itself. Indeed, by some measures it is far worse.

So serious is the problem that in 2000 the UN Security Council met to discuss 'The situation in Africa: the impact of AIDS on peace and security'. In the lead-up to that meeting, the Secretary-General stated:

> The impact of AIDS in that region is no less destructive than that of warfare itself. Indeed, by some measures it is far worse. Last year, AIDS killed about ten times more people in Africa than did armed conflict.
>
> By overwhelming the continent's health services, by creating millions of orphans and by decimating health workers and teachers, AIDS is causing social and economic crises, which in turn threaten political stability. It also threatens good governance, through high death rates among the elites, both public and private.
>
> And high infection rates in the police and armed forces leave African States ill equipped to face security threats.
>
> In already unstable societies, this cocktail of disasters is a sure recipe for more conflict. And conflict, in turn, provides fertile ground for further infections. The breakdown of health and education services, the obstruction of humanitarian assistance, the displacement of whole populations and a high infection rate among soldiers—as in other groups which move back and forth across the continent—all these ensure that the epidemic spreads ever further and faster.

Kofi Annan, 6 January 2000

The African experience of HIV is a chilling reminder of how disease could eventually devastate societies and economies if we fail to make sufficient effort in the early stages of an outbreak.

HIV closer to home

Asia

In Asia and the Pacific, there are alarming signs that HIV infection rates might rival those in Africa, making the region the new epicentre for the disease. Although the numbers infected are much lower than in sub-Saharan Africa, the South and Southeast Asian regions have one of the fastest growing epidemics anywhere in the world. Around 5 million people in India are estimated to be living with HIV/AIDS.

Thailand is the one success story in the region. In a part of the world where the WHO estimates that less than 10% of HIV-positive individuals know of their infection, Thailand reports closer to 90% of its cases. Prime Minister Thaksin has recently undertaken to expand the delivery of antiretroviral therapies. More importantly, Thaksin has delivered the political leadership necessary to deal with the impending crisis. In a country where an estimated 30% of sex workers were infected with the virus by the early 1990s, infection rates have been reduced dramatically by a very public program advocating condom use and breaking long-held social taboos to put AIDS on the public agenda. The government is also contributing to easing the regional crisis by supplying generic antiretroviral drugs produced by the government laboratory.

Only recently has the military government acknowledged the seriousness of the epidemic—too late for perhaps half a million Burmese.

Thailand's approach stands in stark contrast to that of Burma. Nearly all the strains of HIV found in Asia can be traced back to Burma, yet too little is known about the true picture of HIV/AIDS in that opaque state. Burma presents some particular difficulties for international aid programs. Its repressive regime means that many nations are cautious about the kinds of support they're prepared to provide. Injecting drug users and the sex trade are driving the HIV threat in Asia, and Burma is at the heart of the Asian drug business. Years of conflict with ethnic minorities have created further destabilisation and significant flows of refugees, many of whom can't find a safe and permanent haven. Instead, many young women are forced into the sex trade, while injecting drug use is all too common, assisted by an ample supply of opiates. All these factors create the conditions for the generalised HIV pandemic now affecting Burma's people. Only recently has the military government acknowledged the seriousness of the epidemic—too late for perhaps half a million Burmese.

PNG's workforce could be more than a third smaller by 2020 than it would have been without HIV, and economic growth may be around 7.5% lower than we would have otherwise expected.

The Pacific

Papua New Guinea has the highest reported rate of HIV infection in the Pacific area, with an estimated prevalence of around 1% among urban women in three surveyed prenatal clinics. Limited capacity, lack of knowledge, geographical isolation and cultural mores place PNG at high risk of a major AIDS epidemic. Despite numerous international alerts, relatively little attention was paid to the disease until fairly recently. Rapid urbanisation, the cash economy, increasing mobility and a breakdown of the traditional methods of social control have produced significant changes in sexual behaviour. These factors place PNG at risk of developing a major heterosexual HIV/AIDS epidemic along the lines of those currently under way in parts of sub-Saharan Africa. Many of these factors apply elsewhere in the Pacific, and the dramatic increase in sexually transmitted infections and risky sexual behaviour among young people throughout the region has set the stage for an equally dramatic increase in HIV infections, particularly in French Polynesia, Guam, New Caledonia and Fiji.

HIV/AIDS, if left unchecked in small, isolated island microstates with limited financial and healthcare resources, threatens to wreak havoc on the social and economic fabric of whole societies over the next three generations and severely compromise regional stability and security. Ten years ago, the UN estimated that even a moderate HIV/AIDS epidemic could decrease the economic growth of Pacific Island nations by between 0.5% and 1% of gross domestic product each year. Today, as much of the Pacific confronts an impending epidemic of HIV cases, such estimates seem conservative. According to a 2004 AusAID report, on current trends, PNG's workforce could be more than a third smaller by 2020 than it would have been without HIV, and economic growth may be around 7.5% lower than we would have otherwise expected.

Challenges for Australia

Australia's broader security is intimately tied to the development of stronger and more resilient Pacific states. Many South Pacific nations are struggling to achieve or maintain economic viability and stable societies. The breakdown in law and order in Solomon Islands was the grounds for the Australian-led Regional Assistance Mission to Solomon Islands (RAMSI) assistance program in 2003. Before then, Australia, New Zealand and other Pacific nations had invested heavily in people and financial resources to resolve the Bougainville secessionist movement in the late 1990s. Assistance to the Pacific consumes a substantial portion of Australia's aid budget.

HIV/AIDS threatens to keep microstates trapped in the poverty cycle by creating a drain on state budgets and by reducing the size and productivity of the labour force.

The credible threat of an HIV epidemic in this region is a serious concern. Most states won't have the resources to adequately manage the health impact of such a crisis. Moreover, as we can see from other parts of the world where the virus has taken hold, the costs aren't just direct, but also indirect as the labour pool evaporates and social services come under increasing pressure. HIV/AIDS threatens to keep microstates trapped in the poverty cycle by creating a drain on state budgets and by reducing the size and productivity of the labour force.

PNG is already confronted by problems in the areas of law and order, justice, economic management, public sector reform and security. These factors were the impetus for a new Australian Government program of assistance—the Enhanced Cooperation Program (ECP). High on the list of priorities was the provision of around 210 Australian police. Although the original scope of the ECP has been wound back because of constitutional questions, the fact remains that PNG will need to rely heavily on Australian aid to meet the demands of law enforcement and security. Should the rate of increase in HIV infection not be arrested, it seems plausible that the PNG Government will face even greater difficulty meeting its basic law and order and governance obligations to the community than it does now. If HIV is left unchecked, its impact on PNG's police and military forces could overwhelm Australia's substantial efforts to date, and the country will slide further.

As we have seen in parts of the world already in the grip of a serious HIV epidemic, law enforcement and military personnel suffer unusually high incidence of the disease. Reports from India suggest that its armed forces are losing more soldiers in Kashmir to AIDS than to conflict. In Africa, some states are facing a serious crisis as police and soldiers succumb to AIDS and the pool of young men free of HIV becomes ever smaller. The South African police force is recruiting two police for each vacancy to counter the high attrition rates brought about by AIDS. The capacity of weak states to defend their national interests and provide adequate law enforcement will become more challenging.

To make our policies work in the Pacific, we'll need to treat HIV as a serious risk factor for regional stability and economic viability.

In recent times, there have been suggestions that Australia might consider boosting its defence force numbers by recruiting in the Pacific. There are good reasons to give this idea serious consideration. We would benefit from more diversity in our armed forces. Recruits from the Pacific would be offered opportunities not currently available to them in their own military forces, and their remittances could have a positive impact in their home economies. However, if we extrapolate the HIV data from the region, and we consider how HIV has placed additional pressures on forces in Africa, there might be some serious impediments to long-term plans to recruit in the neighbourhood. While underemployment in the Pacific means that recruiting would not disadvantage Pacific Island states now, over the next decade the situation might be different. It is conceivable that the ADF would then be competing with local military and police forces for the best recruits from a pool of people far smaller than population growth rates in the Pacific would suggest.

To make our policies work in the Pacific, we'll need to treat HIV as a serious risk factor for regional stability and economic viability.

However, while our domestic strategies have succeeded, we now face the challenge of arresting infection rates among our neighbours.

Australia's response

Australia's domestic response to HIV in the late 1980s involved a major public awareness campaign, which at the time was controversial in some quarters but which was undeniably effective. Complacency and 'message fatigue' are now the biggest dangers we face with the long-term management of HIV in Australia. However, while our domestic strategies have succeeded, we now face the challenge of arresting infection rates among our neighbours.

Australia is making a substantial contribution to reduce the effects of the pandemic in our region. At the Second Asia–Pacific Ministerial Meeting in Bangkok in July 2004, the Minister for Foreign Affairs launched Australia's international HIV/AIDS strategy, *Meeting the Challenge*. The new initiative builds on the $200 million HIV/AIDS program announced three years earlier, increasing Australia's financial commitment threefold by 2010. It aims both to reduce the spread of HIV/AIDS and to mitigate its effects on people living with the disease and on their communities. A sizeable portion of the allocated funding will go to UN agencies to assist multilateral efforts. Other funding will be allocated through bilateral arrangements, with most of the effort focused on Indonesia and PNG. A number of non-government organisations' activities are also supported, particularly in Africa and Burma.

… the real test will be whether government agencies can deliver the programs fast enough.

Australia's HIV strategies are well funded, and reflect a government alert to the seriousness of the threat facing our region. However, the real test will be whether government agencies can deliver the programs fast enough. Approaching the halfway point in these programs it seems likely that capacity constraints in recipient countries might impede the Australian Government's ability to deliver all of its programs within the 10 year time frame. As the projects mature, spending might increase, but our efforts in prevention must be accelerated before HIV gains a stronger foothold. With no cure in sight and some evidence of developing drug resistance, prevention remains the only option to halt a deepening crisis.

Chapter 5

TERRORIST ATTACKS—BIOLOGY AS A WEAPON OF TERROR

The world has come to accept that the use of such weapons against civilian populations is no longer in the realms of fantasy.

Bioterrorism

The threat of bioterrorism has heightened in recent years. Events such as the anthrax incident in the US, the sarin nerve agent release in Japan and the ricin incident in Britain have cast an ominous shadow. The world has come to accept that the use of such weapons against civilian populations is no longer in the realms of fantasy. Many now believe that a bioterrorist attack against a civilian population is inevitable sometime in the 21st century. In such a context, preparedness for a possible bioterrorist event has become a high national security priority.

Of all known cases involving bioagents since 1900, 85% have occurred since 1990.

Interest in bioagents, and the incidence of cases involving them, have increased markedly since the early 1990s. Of all known cases involving bioagents since 1900, 85% have occurred since 1990. Further, of the

Photo opposite: Bio-terrorist weapon—Plague or Yesinia Pestis bacterium. © Pallava Bagla/ AUSTRALIAN PICTURE LIBRARY twenty-seven bioterror incidents since 1900, nineteen have taken place since 1990. In the past five years, there has also been a rapid increase in the number of bioterror hoaxes: the Center for Nonproliferation Studies estimates that the number of hoaxes increased from thirty-four a year to 600 between 1999 and 2001.

Table 1: Selected bioterror incidents since 1990

Date	Perpetrator	Target	Agent	Dispersal	Result
1990–1993	Aum Shinrikyo	Mass civilian population. With the goal of seizing control of the Japanese Government	Anthrax, botulinus toxin, Q fever, Ebola	Dispersed as an aerosol	No reported casualties from the ten known attacks
1997–1999	Al-Qaeda	Israel–West	Anthrax, Ebola and salmonella	Unknown	Al-Qaeda obtained agents via mail from former Soviet states. No reported use
2000–2001	Al-Qaeda	Mass civilian population in US	Anthrax	9/11 hijackers enquire about acquiring crop-dusters for delivering anthrax	Crop-duster project abandoned in favour of 9/11 attacks
2001	Unknown	US media and two US Senators (Daschle and Leahy)	Anthrax	Mail	22 cases of pulmonary anthrax; 5 victims died
2002	Al-Qaeda–JI	Israel–West	Anthrax	Unknown	Yazid Sufaat, a US-educated JI member, spent months producing anthrax in Afghanistan before the overthrow of the Taliban
2003	Al-Qaeda	US troops based in Kuwait and Afghanistan	Ricin	Unknown	Plot uncovered and 11 al-Qaeda operatives arrested in London
2005	Unknown	Indonesia Embassy, Canberra	Unknown suspicious substance	Mail	Embassy closed and staff quarantined until analysis completed
2005	Unknown	Several embassies in Malaysia, including Japan, Singapore, Australia and Canada	Unknown suspicious substance	Mail	Substance found to be harmless

Source: Center for Nonproliferation Studies

… biological agents have a number of characteristics that make them attractive weapons for terrorists.

While the use of biological agents by terrorists has been very limited to date, they have a number of characteristics that make them attractive weapons. These include their toxicity; the difficulty of detecting them; their relative flexibility; the relative ease and cheapness of their production; the relative simplicity of their dissemination; the timelags between release, incubation and effects, which reduce the chance that the perpetrator will be discovered; the fact that they affect people indiscriminately and are initially unnoticed; and the terror, panic and fear that they provoke among the affected population.

Optimal conditions for effective release of biological agents

The agent

- highly contagious
- infective in low doses
- easy to release and disseminate
- difficult to diagnose at outset
- incubation period of approximately 1–6 days (long enough for the perpetrator to 'disappear')
- relatively easy to obtain or manufacture
- stable after release
- produce high morbidity and mortality
- inspire fear and terror.

The target population

- little or no immunity to agent
- limited access to immunisation or specific treatment.

… the technical expertise required to culture microorganisms or produce toxins isn't particularly high … someone with training equivalent to that of a second-year medical or microbiology student might have little trouble preparing an agent.

Several biological agents occur naturally in the environment, and others can be produced either at home or in a small laboratory without sophisticated scientific equipment. Generally, the technical expertise required to culture microorganisms or produce toxins isn't particularly high, especially where such organisms exist naturally. Basic procedures for producing many biological agents are published widely in the microbiological literature and are available in most public libraries or on the internet. It is generally accepted that someone with training equivalent to that of a second-year medical or microbiology student might have little trouble preparing an agent.

Advances in biotechnology have revolutionised the potential for developing biological agents by providing a new class of fully engineered agents. Historically, biological weapons have included a relatively select group of naturally occurring pathogens and toxins. With the advent of DNA technology, it has become possible to alter an organism's or vector's genetic makeup, making the bioagent harder to detect, antibiotic and vaccine resistant, more pathogenic, or more easily transmissible. It is now possible, for example, to develop transgenic mosquitoes that could produce and secrete a highly toxic protein in their saliva, delivering the protein by inoculation during the normal feeding process. Dengue might also be easily delivered to a susceptible population in this way.

The effective delivery of a biological agent seems much more problematic than its production ... contamination of food supplies is a possible and even likely avenue for bioterrorism.

The effective delivery of a biological agent seems much more problematic than its production. One possible scenario would see terrorists poisoning the municipal water supply of a major Australian city by placing a biological agent into a main water reservoir. In reality, however, the purification system (involving hydrolysis and chlorination) and the amount of bioagent required would both militate against the effectiveness of such an action. Nevertheless, it's theoretically possible that a nation's water supply could be contaminated by dumping a vial containing billions of genetically engineered bacteria into a main water reservoir. A number of authors argue that contamination of food supplies is a possible and even likely avenue for bioterrorism.

Biological agents considered as potential weapons

The US CDC has ranked biological agents according to their potential for bioterrorist release, denoting the severity of their effects, their ease of dissemination, and the public reaction they might engender.

Category A

- Includes the most dangerous and easiest to disseminate disease agents that produce the highest death rates, and are likely to cause the most panic and hysteria
- Require a broad-based public health response
- Includes diseases such as anthrax, plague, smallpox, tularaemia, Marburg virus, Ebola virus, Lassa fever and other haemorrhagic fevers.

Category B

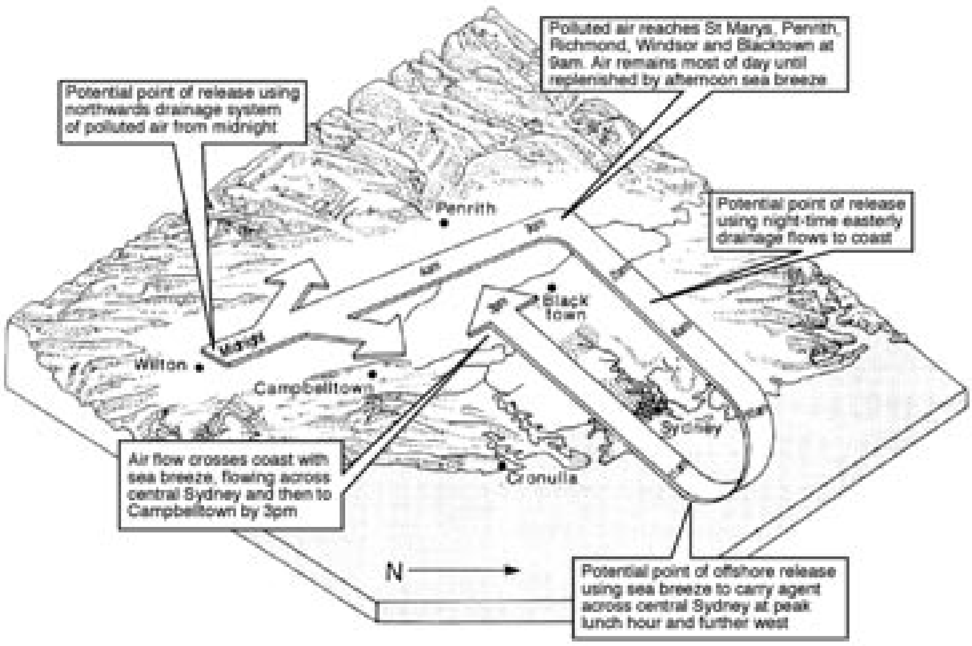
- Agents that produce fewer cases in those exposed, as well as lower death rates, but are still easy to spread
- Includes zoonoses such as glanders, brucellosis, Q fever, foot-and-mouth disease, as well as salmonella and cholera.

Category C

- Disease agents, including emerging infectious agents, that might be 'engineered' to make them more pathological and easier to spread among human populations
- Includes yellow fever, hantaviruses, *Cryptosporidium*, encephalitis viruses.

Some form of aerosolisation would probably be the preferred mode of delivery of a biological agent to a susceptible Australian population. The movement of a biological agent by this method would, at the very least, require some knowledge of local topography and air circulation flows and drainage patterns. The rate of dispersion would depend on the prevailing atmospheric conditions. Figure 2 illustrates how the normal pattern of air circulation and drainage flows in Sydney might be used to release a biological agent over the metropolitan area. Airflows over other Australian cities, where offshore breezes are relatively predictable and local topography channels lower-level winds, also produce recirculation over the urban environment.

Figure 2: Delivery of a biological agent using Sydney's air circulation and drainage flows



Source: Peter Curson

A number of potential 'launch sites' could be used. One, using the late morning onshore sea breeze, could easily distribute an infective agent across central Sydney during the lunch hour. Another could see a release from the south, relying on the northward air flow. Yet another might use the eastward drainage flow of air towards the coast to distribute an infective agent over the city's northern suburbs.

The number of people who would be at risk of being infected by the release of an airborne disease agent would largely be a function of the concentration of pathogen droplet nuclei in the air and chance encounters of droplets and human subjects. Once the agent was released, its viability would depend on relative humidity, atmospheric composition, temperature and solar radiation. A little meteorological knowledge would probably contribute to the effectiveness of such a release.

One or two litres of anthrax spores released in such a site could affect thousands of people.

A smaller scale attack confined to a restricted and enclosed space, such as a shopping mall with central air conditioning, might be a more feasible option for terrorists. Another possibility would be dispersal through an underground railway network. One or two litres of anthrax spores released in such a site could affect thousands of people.

Planting fear—food and biosecurity

Agricultural and food terrorism would generally be intended to cripple an economy, instil fear and create panic although, depending on the agent used, the consequences could be vastly more serious. Disruption of the agricultural sector could cause profound dislocation, including loss of crops and animals, food shortages, loss of export markets, food price increases and unemployment. A widespread disease outbreak is also likely to result in the slaughter of large numbers of exposed animals. There's also the possibility that an exotic disease agent might infect native wildlife and become permanently entrenched.

Over the past few decades, a number of attempts have been made to deliberately contaminate agricultural or food products with chemical or biological agents.

Over the past few decades, a number of attempts have been made to deliberately contaminate agricultural or food products with chemical or biological agents. Most attacks were small scale and lacked significant impact. In 1981, an ecoterrorist group threatened to distribute anthrax-impregnated soil over a number of sites in Britain to draw attention to the ecological dangers of chemical and biological warfare. In 1984, members of a disaffected cult in The Dalles, Oregon, upset over local land-use and building regulations, deliberately contaminated salad bars in ten restaurants with *Salmonella Typhimurium* in an effort to make people too sick to vote in local elections. In total, 751 people were infected, including forty-five who required hospitalisation.

Of likely agents in agricultural attacks, some animal pathogens (such as foot-and-mouth disease virus) are highly infectious, would not need culturing, and would only require a small amount to produce an epidemic. In May 2005, New Zealand's Prime Minister received a letter warning that foot-and-mouth disease had been deliberately released on Auckland's Waiheke Island, home to a flourishing agriculture/viticulture industry. No evidence was found of such a release, but the episode demonstrated the vulnerability of modern societies and the panic that might be engendered.

Australia has an enviable record of high-quality and well-organised animal health surveillance systems, but there are some important gaps. One is in the area of data collection from remote cattle properties in northern Australia, where difficulty of access makes collection by veterinarians impossible. The data currently available is patchy and lacks consistency, and needs to be integrated into a broader national human infectious diseases network. In an era of newly emerging infections, rapid detection of exotic animal diseases is a high priority, particularly in more remote areas.

For terrorists, the most vulnerable sites for the covert release of a disease agent directed at the food supply would probably be abattoirs and auction yards, where security is fairly lax.

The drain on emergency services resources shouldn't be underestimated, and simultaneous threats would be very demanding for state and territory authorities.

Three possible bioterrorist scenarios

While the likelihood of a bioterrorist event in Australia may seem remote compared with the likelihood of conventional attacks, the growing number of 'white powder' incidents shows us that the threat of bioterrorism needs to be taken seriously. Even though many of these events later turn out to be hoaxes, each needs to be treated as a potentially harmful attack until proven otherwise by laboratory analysis. They are therefore very demanding of emergency services, create fear and anxiety among those affected, and cause costly disruption to the affected organisations. The drain on emergency services resources shouldn't be underestimated, and simultaneous threats would be very demanding for state and territory authorities.

Three examples have been selected here to provide some insight into other possible bioterrorist scenarios in Australia. The first briefly examines the use of humans as vectors of infectious disease. The second involves the use of a biological agent endemic in parts of Australia and easily accessible and disseminated, but of low pathogenicity. The third focuses on the use of pneumonic plague, a much more deadly infection with very high mortality, but no endemic focus in Australia.

Scenario 1: Humans as vectors

Infectious disease can turn people into vectors (carriers and transmitters of infection). The potential for people to be used as vectors of biological agents, either knowingly or unknowingly, seems high. In Australia, regular dengue epidemics result from a viraemic tourist or traveller visiting Queensland and being bitten by a local mosquito, after which the infection spreads to involve, in some cases, thousands of people. While dengue may not be a major threat in a relatively healthy and robust population, and while dengue epidemics are highly dependent on the geographical distribution of the mosquito vector, such a transmission route is still a major public health risk. New strains of influenza are probably spread in Australia by much the same route.

Arguably, various more deadly infections could be spread in this fashion by a terrorist knowingly infected and incubating an infection flying to Australia, and then walking around a crowded shopping centre for some hours, coughing near people or over surfaces.

Scenario 2: Sourced from our backyard—Q fever

Q fever is a zoonotic disease caused by *Coxiella burnetii* that circulates among its natural hosts (birds, animals and ticks) in permanent reservoirs. The disease is endemic in parts of Australia, particularly in northern NSW and Queensland, where it's closely linked to the livestock industry, particularly in areas where autumn and winter months are characterised by drought and dusty winds. The disease agent is very resistant to environmental conditions, surviving for months or even years in dust and animal litter.

… as with most bioterror agents, the knowledge that an agent had been released and could cause disease would be enough to raise public fear and anxieties.

In humans, Q fever presents either as an acute, largely self-limiting, febrile flu-like illness, or as atypical pneumonia, lasting up to four weeks. In some cases, a chronic form of the disease may develop, presenting months or even years later as endocarditis and/or hepatitis. Whereas the acute form of the disease responds well to antibiotic treatment, the chronic phase is much more difficult to treat. Q fever is interesting as a potential biological weapon because the disease is endemic in parts of Australia, it would be relatively easy to obtain, it's highly infectious, and an aerosol of very few disease organisms could cause disease in humans. Theoretically, a truck or car equipped with nothing more than a common commercial sprayer used to spray trees or plants could quite easily disseminate the disease agent. Equally, the agent could be disseminated in the Sydney area by using offshore and onshore air flows, as described earlier. However, its use as a bioterror agent is made less likely because the disease has a relatively long incubation period (2–3 weeks), infections are occasionally asymptomatic and resolve spontaneously, and infection is usually self-limiting, with a mortality rate in untreated cases of less than 1%. Nonetheless, as with most bioterror agents, the knowledge that an agent had been released and could cause disease would be enough to raise public fear and anxieties.

Scenario 3: Importing plague

Plague, caused by the bacterium *Yersinia pestis*, remains a disease with a complex and poorly understood epidemiology. Although a human disease of considerable antiquity, plague is a true zoonosis—in its naturally occurring form it's primarily a disease of ground-living rodents and field animals. Among such animals, which vary in their susceptibility, plague circulates permanently, presents as a chronic infection, and only rarely causes epidemics. Some animals tolerate the infection with little sign of disease, some develop low levels of infection, some develop immunity, and occasionally some die from the disease. Plague has adapted perfectly to the microclimate and life cycle of such animals, even to the extent that when an animal hibernates in the winter so too does the plague agent, only to reactivate when the animal awakens in the spring.

Over 200 species of rodents and other small mammals have been found to carry plague, including prairie dogs, ground squirrels and other rodents in the US. The disease is permanently entrenched in natural reservoirs in every continent except Australia and

Antarctica, giving the disease a wider geographical spread than at any time in its history. Plague has been maintained this way for centuries, only rarely reaching out to affect human populations. It is also interesting to note that, while plague never established a permanent natural reservoir in Australia, there were numerous occasions during the 20th century when the disease penetrated into the native wildlife. Theoretically, if released in Australia, plague could infect native wildlife and establish a permanent reservoir.

Plague is usually spread from one animal to another by the bite of an infected flea. In the case of humans, transmission often requires the intervention of an intermediary species, such as a rat or mouse, which acts as a bridge between the natural reservoir of infection and a human outbreak.

Primary pneumonic plague results from the inhalation of plague bacilli and is relatively rare. Secondary pneumonic plague usually develops in a small number of patients suffering from bubonic and septicaemic plague. Pneumonic plague would seem the most likely form of plague for a covert release involving an aerosol of plague bacilli. Although the pneumonic form of plague is uncommon, epidemics occurred many times during the last century, including major epidemics in Manchuria in 1910–11 and more recently in India and the Congo. The 2005 outbreak in the Congo probably caused well over 500 cases, with many deaths. Australia has experienced one outbreak of pneumonic plague in its history, in Maryborough, Queensland in 1905.

… both the US and the Soviet Union developed techniques to aerosolise plague, and the Soviet biowarfare program probably produced large quantities of pneumonic plague for bombs and missiles.

In the years following World War II, both the US and the Soviet Union developed techniques to aerosolise plague, and the Soviet biowarfare program probably produced large quantities of pneumonic plague for bombs and missiles.

The size of a plague outbreak would depend on a number of factors, including the amount of agent released, the particular strain of agent used, the manner of release (whether by aerosol method in a confined area, or more widely over a city), and the prevailing environmental conditions. Symptoms would begin to appear within three days following exposure and, if treatment were delayed for more than 24 hours after the onset of symptoms, the fatality rate would be high. One problem is that the diagnosis of plague isn't simple—there are no widely available rapid diagnostic tests for the disease, and in its initial stages symptoms tend to closely resemble severe respiratory infections like flu, with fever, cough, shortness of breath and chest pain. If the agent responsible were not recognised quickly, the disease would cause a high mortality. In 1970, a WHO report claimed that in a worst case scenario 50 kilograms of the plague bacterium, released as an aerosol over a city the size of Sydney, could possibly result in 150,000 cases of pneumonic plague, 80,000–100,000 hospitalisations and 36,000 deaths.

> Given that much of the world is currently expecting a major influenza pandemic, it's easy to see how the disease might initially be misdiagnosed.

The first indications of such an attack would be the sudden outbreak of illness presenting as a severe form of respiratory disease. If there were initially only a small number of cases, they might be dismissed as flu rather than plague. Given that much of the world is currently expecting a major influenza pandemic, it's easy to see how the disease might initially be misdiagnosed. The Johns Hopkins Working Group on Civilian Biodefense recommends that, if a pneumonic plague outbreak is suspected, all people in an area who develop a temperature of 38.5° Celsius or higher, or a new cough, should immediately begin antibiotic therapy. People without such symptoms who have been in close contact with a suspected case should also be treated.

Historically, the preferred treatment for plague has been streptomycin, tetracycline, doxycycline, sulphonamides or chloramphenicol. If administered early, these drugs can reduce plague mortality considerably, but not all are effective against pneumonic plague. Vaccination would also be possible, but the old plague vaccine offered little protection against pneumonic plague. Currently, work is under way in the US on a plague vaccine that specifically offers protection against pneumonic plague; recently, the governments of the US, Canada and the UK signed a formal agreement to work towards the production of such a vaccine.

Problems remain, however. Vaccines that protect laboratory animals might not work on humans, and it might not be possible to produce enough vaccine quickly. The recent emergence of antibiotic-resistant strains of plague is also a considerable problem.

The US plague simulation exercises—lessons for Australia

In 2000, two exercises designed to simulate an aerosol release of pneumonic plague by terrorists were carried out in the US. Both carry important messages for Australia. The first, as part of the 'TOPOFF' exercise, postulated the release of plague in the Denver Performing Arts Center. The second postulated the intentional release of plague in a fictional east coast city with a metropolitan area containing 2.5 million people. Both exercises were largely concerned with evaluating leadership response, the role of authorities, the process of decision-making during a bioterrorist event, and the reactive capacities of the public health and emergency services to handle such a crisis.

In both cases, after plague had been confirmed by state and CDC authorities, hospitals were quickly overwhelmed by the number of patients demanding care for flu-like symptoms, and went well beyond capacity within 24 hours. There were insufficient isolation wards in hospitals, and plague patients were kept in hallways, wearing surgical masks in some hospitals. Ventilator and antibiotic shortages soon became apparent. Potentially infected people were reported coughing in doctors' surgeries and in hospital reception areas. In both exercises an epidemic action plan was implemented, limiting personal travel, although in the east coast scenario the state governor hesitated to take steps such as compulsory treatment, mandatory isolation and separation of family members. The media reported people leaving the city by car, and local radio even provided details of the fastest route out of the city. Some left for fear of contagion, some to obtain medical treatment, and others simply because they feared a breakdown in civil control.

By day 3 in both scenarios, the epidemic had gathered momentum and the public health system had begun to falter, with a lack of staff, beds, ventilators and antibiotics.

By day 3 in both scenarios, the epidemic had gathered momentum and the public health system had begun to falter, with a lack of staff, beds, ventilators and antibiotics. By day 4, the Denver simulation postulated more than 4,000 cases of plague, with perhaps as many as 2,000 deaths, while the east coast scenario claimed 15,000 sick with the plague and 3,000 deaths.

Both exercises, as well as demonstrating how quickly plague could spread and undermine the healthcare system, also revealed inherent problems in decision making in times of crisis. This was particularly the case in government agencies characterised by democratic processes and consensus in decision-making. Public health resources were stretched to the limit, despite federal aid.

Concern was also expressed about the process of prioritising and distributing antibiotics to emergency workers and their families. Such a policy caused consternation among participants when they had to defend the decision to give antibiotics to the families of emergency workers while unable to deliver them to those already ill. The distribution of antibiotics created other problems. Downtown distribution centres struggled to meet demand and could feasibly only handle about 140 people per hour. Interestingly, both exercises largely ignored any discussion of the psychosocial response to the bioterror event, and how terror, fear and panic might be managed.

The two exercises raise a number of critical issues for Australia's handling of future epidemics, whether naturally occurring or deliberate. First, they demonstrate the need for strong and decisive leadership, assisted by a council of interdisciplinary experts. Second, they show that decision-making during such crises requires immediate access to information sources, conduits and analytical capacities that don't always exist within current medical and public health infrastructure. Information systems are required that deliver real-time data on the residential and workplace location of ill or potentially exposed people, possible places of infection, and locations of community GPs, pharmacies, etc. Third, not only is there a need for clear principles to be enunciated for the priority allocation of scarce resources like vaccines and drugs, but the reasons for such allocations must be made clear to the public in intelligible language. Finally, careful assessment needs to be made of healthcare resources and their ability to meet demand during a severe and prolonged epidemic crisis.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Chapter 6

RESPONDING TO THE THREAT—MEETING THE CHALLENGE

How well prepared is Australia to meet the challenges of infectious disease and bioterrorism? What plans are in place to confront such a crisis? How effective would they be? Would the national government and the states cooperate? These are critical questions for Australia's future.

Australia needs to make maximum use of existing infectious disease and emergency response resources.

Monitoring and responding to infectious disease

To prepare for a major epidemic or a bioterrorist event, Australia needs to make maximum use of existing infectious disease and emergency response resources. While a bioterrorist event has some special features, it will share many of the characteristics of a natural infectious disease outbreak.

Basically, Australia has a number of goals when confronting an outbreak of infectious disease:

- Identify the outbreak and the disease agent involved.
- Reduce mortality and morbidity by as much as possible, and ensure that health and emergency workers are protected.
- Limit the geographical spread of the infection.
- Limit the amount of social disruption and economic loss.

Photo opposite: Capsules of AZT 1980s. Image courtesy of AUSTRALIAN PICTURE LIBRARY

Currently, Australia's organisational resources to meet such challenges consist largely of a network of national, state and territory departments and agencies responsible for the surveillance of health and infectious disease, as well various Australian Government agencies charged with the oversight and coordination of pandemic and anti-terrorism activities. The national government would also try to use its intelligence and law enforcement resources to gain prior warning of a planned bioterrorist attack.

At a broader level, Australia also depends on a variety of global disease alert and response networks for human and animal infections to provide early warning of disease outbreaks. These are run by the WHO and others, such as ProMed.

For domestic disease outbreaks, there exists a complicated network of disease surveillance and response systems at the national, state and private levels …

For domestic disease outbreaks, there exists a complicated network of disease surveillance and response systems at the national, state and private levels, including the Australian Health Disaster Management Policy Committee, the Communicable Diseases Network Australia and the Public Health Laboratory Network; a national notifiable diseases surveillance system; an HIV/AIDS reporting system; a raft of state surveillance systems, including clinician reporting systems and animal sentinel systems; vector surveillance systems; and general reporting from the food and agricultural industries. In addition, both the Australian Government and the states have developed a series of disease-specific epidemic 'action and response plans'. Finally, the Australian Government has in place recently developed counter-terrorism and bioterrorism action plans, and the Protective Security Coordination Centre provides some degree of liaison and coordination with the states and territories.

Who's in control?

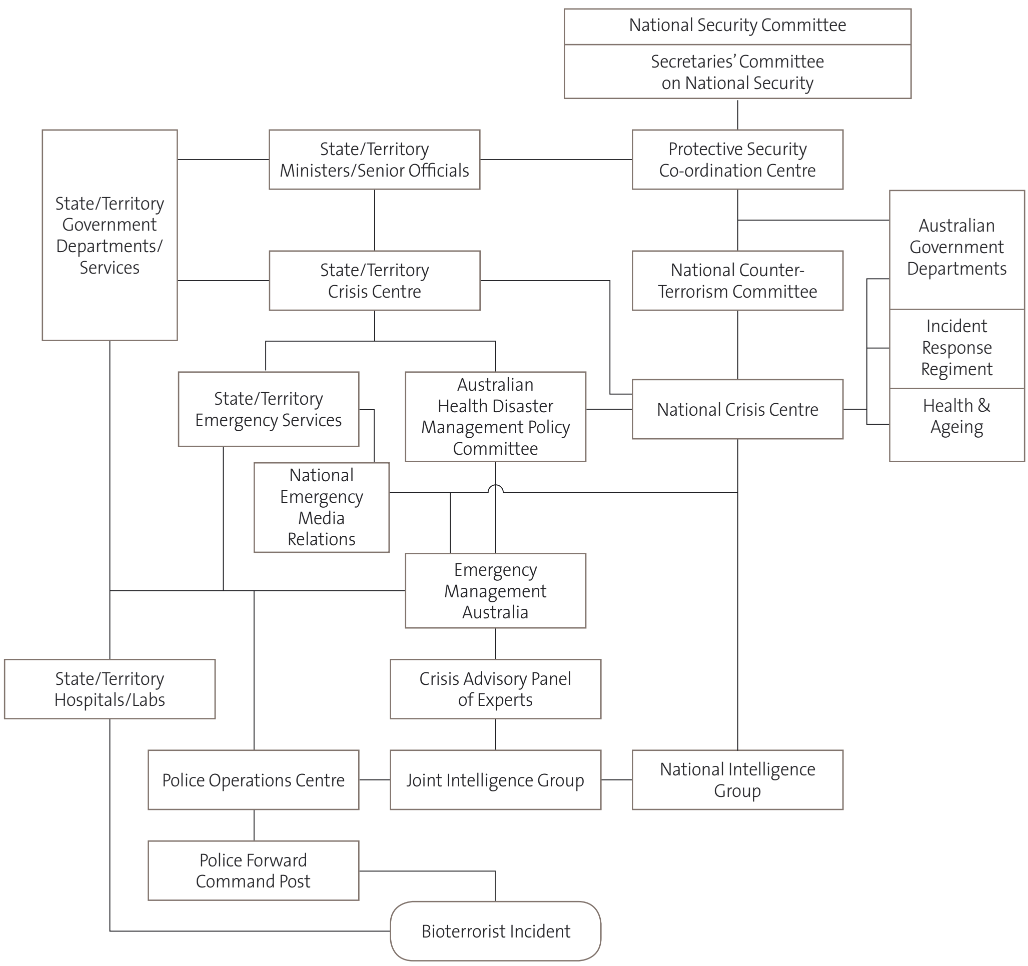
The multiplicity of government departments, agencies and committees charged with the oversight and response planning for a pandemic or bioterrorist event seems both a strength and a weakness. While a whole-of-government approach and multidisciplinary involvement seem important in understanding all the ramifications and implications of an infectious disease event, it might also seem that the array of groups involved adds a degree of confusion about coordination, areas of responsibility and reporting lines. For example, in the case of New South Wales, veterinarians and veterinary laboratories report to the state agriculture department, which may then notify the Communicable Diseases Branch of the Department of Health.

To deal with terrorism, the Australian Government has adopted an inclusive approach involving:

- the National Security Division in the Department of the Prime Minister and Cabinet (PM&C), to provide strategic advice to the government
- the National Counter-Terrorism Committee, which involves the states and territories and is coordinated by the National Security Division
- the National Security Committee of Cabinet (NSC), chaired by the Prime Minister
- the Protective Security Coordination Centre, under the Attorney-General's Department, which coordinates national and state counter-terrorism arrangements
- the Secretaries' Committee on National Security, chaired by the Secretary of PM&C
- the National Crisis Centre, established during a terrorist incident
- the Commonwealth Counter-Terrorism Committee
- the Commonwealth Counter-Terrorism Policy Committee, to facilitate policy coordination at the Commonwealth level.

Figure 3 shows the overall arrangements between the states and Canberra, with the main linkages in this network.

Figure 3: Commonwealth and state counter-bioterrorist arrangements and coordination



The Australian Government has prepared a National Counter-Terrorism Plan, which states that all states and territories 'will maintain emergency management plans and capabilities to respond to chemical, biological and radiological incidents'. As well, Emergency Management Australia would maintain a 'crisis advisory panel of experts list' to share with the states and territories. The Department of Health and Ageing is charged with maintaining a stockpile of vaccines, antibiotics and antivirals to meet any threat, and an Incident Response Regiment has the responsibility of rapid deployment in the case of an emergency.

In the final analysis, whether it be a pandemic of influenza or a bioterrorist event, the states and territories and their agencies remain responsible for the operational response, although the Commonwealth would provide support where appropriate.

Most states and territories have established 'crisis and emergency management centres', which would act in conjunction with police operations and command posts, linked to the various intelligence agencies. In the final analysis, whether it be a pandemic of influenza or a bioterrorist event, the states and territories and their agencies remain responsible for the operational response, although the Commonwealth would provide support where appropriate. In the case of a declared 'national terrorist situation' or a severe pandemic, the national government can assume overall responsibility for policy and broad strategy by invoking either the National Counter-Terrorism Plan or the Quarantine Act. Even then, however, operational management and the coordination of emergency and health services would still rest with the states and territories.

… a really critical question is whether the national and state/territory governments and agencies could cooperate during a time of crisis.

In many ways, the 2005 Interim Australian Management Plan for Pandemic Influenza summarises some of the critical problems associated with the chain of command during an epidemic crisis. While the states and territories have developed specific protocols to address an influenza threat, there is still some confusion about which group health and emergency workers at the local or state level should take advice and instruction from. In a pandemic, local governments are supposed to contact and respond to the advice of the Australian Health Disaster Management Policy Committee, their own state departments of health, the national Department of Health and Ageing, the National Influenza Action Committee, the Communicable Diseases Network Australia, the Public Health Laboratory Network, and Emergency Management Australia, who will all alert PM&C, as well as the WHO. Coordination and reaction times are likely to be tested in such a situation.

Finally, a really critical question is whether the national and state/territory governments and agencies could cooperate during a time of crisis. Given the wide array of government departments, committees and agencies involved and the lack of an overall senior-level coordinator, who would take control over all the emergency response activities? Looking back on more than a century of epidemic crises in Australia, most were marked by endless disputes and disagreements between national and state governments about their respective powers and responsibilities, particularly in relation to quarantine, border restrictions and compulsory vaccination. Cooperation would probably be more forthcoming in a well-defined bioterrorist event; in a drawn-out pandemic extending over many months, the situation might well be different.

Issues of response and containment

Faced with the prospect of a pandemic, a bioterrorist attack, or both, the Australian Government has prepared a Pandemic Management Plan and a National Counter-Terrorism Plan, and urged all states and territories to follow suit. At the same time, the government has been stockpiling antiviral drugs and placing laboratories on high alert to produce new vaccines. For pandemic influenza, the management plan emphasises increased surveillance; isolation of severe cases; home quarantine for the ill; closure of public institutions; travel restrictions; cancellation of public events; the delivery of antibiotics, antivirals and vaccines to designated priority groups; and the rapid development of a vaccine.

Quarantine is fairly central to Australia's reaction to a pandemic and possibly also to a bioterrorist episode … How easy would it be, for example, to quarantine 20% of Sydney's population?

Quarantine is fairly central to Australia's reaction to a pandemic and possibly also to a bioterrorist episode. Faced with the possibility of very large numbers of people being ill, the Australian Government has elected for a system of home quarantine. Ill people would be told to go home and remain there until well, or until the pandemic crisis lessens. Home quarantine raises many important issues, including powerful civil liberties concerns. Not only is quarantine a deprivation of liberty and privacy, but its enforcement can be threatening and intrusive. How easy would it be, for example, to quarantine 20% of Sydney's population? Would people actually stay home? Who would maintain essential food and medicine deliveries, and what about loss of wages and compensation? Would mobile medical teams have to tour around infected suburbs?

There are also important emotional and psychological effects to be considered. People quarantined at home in Canada during the SARS epidemic showed high levels of depression and experienced a sense of isolation. Quarantined people were told to remain in their homes and not to have visitors. They were instructed to wear masks when in rooms with other family members, and to sleep in separate rooms. There seems little doubt that home quarantine would need to be 'enforced' in a humane and supportive way.

The best way to contain a pandemic might be to give antivirals and/or vaccines to a high proportion of the people immediately around the initial cases.

Supplies of antivirals and possible vaccines raise other problems. Given that it might well take up to three months to identify the particular influenza strain and produce a vaccine, and up to six months to produce enough for widespread distribution, it's quite likely that the pandemic would by then have run its course. And who should such drugs be delivered to? The best way to contain a pandemic might be to give antivirals and/or vaccines to a high proportion of the people immediately around the initial cases. In the initial stages of a pandemic—the containment phase—antivirals would be provided to treat new cases and as a prophylactic for close contacts. Should containment fail, however, the priority would shift to maintaining essential services.

Currently, the Australian Government has stockpiled about four million doses of Tamiflu, the only antiviral drug effective against bird flu. Given that there are around one million health and emergency workers in Australia (not including their families), and probably at least 3.5 million elderly and chronically ill people, the availability of the drug raises many critical questions. Do people, for example, have a 'right' to expect protection during a national emergency? Could 'at risk' people be vaccinated against their wishes? Given limited supplies of antivirals and vaccines, should health and emergency workers' families have higher priority than those already ill?

More critically, perhaps, would four million doses of Tamiflu be enough? Like all antivirals, Tamiflu's effectiveness is fairly short-lived and one dose would probably only provide protection for about five days. Sixty days protection would require about 12 doses. Therefore, Australia would need at least 20 million doses just to protect health and emergency workers and their families as well as designated high-risk groups over the course of a pandemic.

Current counter-terrorist preparedness will undoubtedly assist hospitals and health professionals to prepare for a pandemic emergency, but a terrorist event is more likely to be short, sharp and localised…

Finally, there's the impact on the healthcare system. Even if a pandemic turns out to be mild or a bioterrorist event sharply concentrated in time and space, the sheer volume of people seeking medical care will place considerable demands on the system. In a pandemic extending over several months, hospitals could well be flooded and stretched beyond breaking point. Respiratory support equipment, including ventilators, would presumably be in short supply. Could Australia's hospital system cope with an influx of, say, 2,000 severely ill new patients a day for six to eight weeks? Could community doctors cope with a tenfold increase in patients and the 'worried well' over a two-month period? Would temporary hospitals or 'fever clinics' have to be established and staffed by volunteers, as in 1919? Would they be able to handle the flood of ill or quarantined patients? And what constraints would exist for medical staff? Presumably, some would be ill and unable to report for duty.

Current counter-terrorist preparedness will undoubtedly assist hospitals and health professionals to prepare for a pandemic emergency, but a terrorist event is more likely to be short, sharp and localised, perhaps only affecting a handful of communities, whereas a pandemic is certain to affect all Australians. It seems reasonable to assume that Australia's healthcare system could cope with 400–500 critically ill or injured people and up to a few thousand 'walking ill or injured'. It's another thing entirely to consider the impact of 2,000 new hospital admissions a day for two months or more.

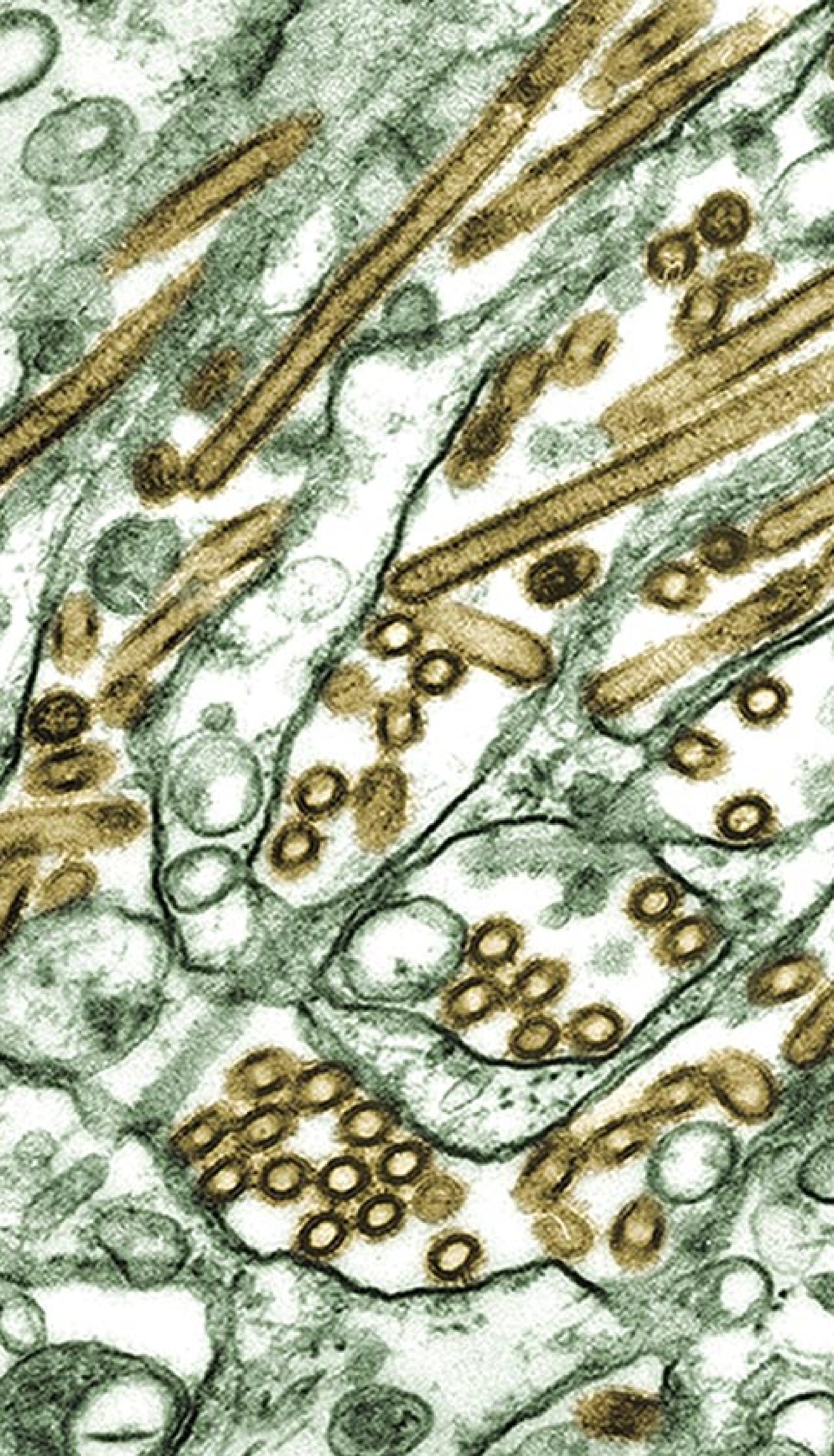
Managing fear and panic

Understanding and managing the psychosocial and behavioural side of epidemic outbreaks seems critical to implementing a successful response and containment plan. Experience from previous epidemics shows that people harbour deep-seated fears and apprehensions about infectious disease, contagion and 'outsiders', particularly when victims don't witness a 'defined' event with visible signs of onset and impact, as with other natural disasters. Perhaps fear of 'plague' and fear of contagion are the most basic of all fears—a mix of rational and irrational apprehension about disease generally. Fear of infectious disease isn't really related to science or empirical evidence, but is shaped more by personal attitudes and the way we construct the world around us. Such fear is also linked to our subjective feelings of control. The word 'pandemic', like the word 'bioterrorism', also has ominous connotations and inspires images of uncontrollable infectious disease sweeping across the world, leaving death and illness in its wake. The idea of infection caused by invisible agents touches something deep in the human psyche. Attitudes to disease develop largely as a result of past experience; they are learned, and are possibly acquired through parental and societal conditioning, through observing and being influenced by other people's attitudes, and through being taught to hold certain attitudes. It's possible that anxiety and fear are transmitted from one generation to another.

Perhaps fear has its uses. Arguably, if people are aware of a threat and its likely outcomes, they're more likely to be better prepared, engage in preventive defence, and react better to official advice. In this way, fear may function as a useful coping tool during times of severe crisis. But how much fear is healthy? How do we measure the 'reasonableness' of fear? Faced with myriad threats, which ones should we really be most fearful of?

Certainly, not all fear is useful. Fear that leads to outpourings of panic and hysteria can often overwhelm official and personal coping strategies. SARS recently demonstrated how an epidemic can overwhelm the resources of the state and virtually paralyse normal operations.

Given what we know about fear, it's surprising that all the national and state action plans pay little or no attention to how public fear and anxiety might be managed. Media strategies to inform and support a worried public will be needed even before a pandemic begins.



Chapter 7

CONCLUSIONS AND RECOMMENDATIONS

There seems little doubt that infectious disease will continue to play an important role in our national security, and that Australia will experience a major epidemic of infectious disease sometime over the next few years. It remains to be seen whether the disease agent will be a newly emerged infection like SARS, a new strain of pandemic influenza emerging from bird flu, a resurgence of a long-established infection like whooping cough, an antibiotic-resistant healthcare infection, or a deliberately released biological agent.

... infections aren't simply unpleasant annual episodes that carry off the old and the sickly, but can be deadly contagious diseases that threaten to paralyse whole societies and bring economies to a standstill.

It's clear that the processes of globalisation have changed the nature of risks to health and national security. We've been thrust into a wider world system in which the old protections no longer apply, where the risks are international rather than national or local, less controllable, largely unseen, and unconstrained by space or time. The new risks require some form of global and national 'neighbourhood watch'.
As SARS recently demonstrated, infections aren't simply unpleasant annual episodes that carry off the old and the sickly, but can be deadly contagious diseases that threaten to paralyse whole societies and bring economies to a standstill. On top of this, the threat of bioterrorism looms large.

Photo opposite: Avian influenza virus image. © CDC/AUSTRALIAN PICTURE LIBRARY

Clearly, we have underestimated the importance of zoonotic or animal diseases for human health. At least 60% of all infections that affect humans are animal in origin, and around 75% of all the infections that have emerged over the past 40 years have come from animal reservoirs. The growing list of new diseases suggests we've become increasingly vulnerable to cross-species infections, and that we need to better appreciate the links between human health, domestic and wild animals, and the biophysical environment.

It's also clear that new infections and the threat of pandemics, whether natural or deliberate, are complex matters involving just about every branch of science, social science, law and the humanities, and that we need to adopt a holistic interdisciplinary approach, linking aspects of geography, disease ecology, epidemiology, public health and medicine with law and human rights, public policy, agriculture, trade, patterns of human movement and emergency management.

… it's doubtful whether, once a pandemic had reached Australia, we could do anything to halt its spread.

Overall, what lessons have we learned from previous pandemics and outbreaks of infectious disease? First, pandemics of influenza tend to behave unpredictably. Some viral strains are more virulent than others, and at least one has targeted young adults rather than the very young and the very old. Second, pandemics follow an 'epidemic curve', with a gradual onset, followed by a surge of cases and then a gradual decline. Third, pandemics tend to come in waves, with the second wave often being far more virulent than the first. Fourth, pandemics of influenza originate among migratory birds in South Asia (hence our current concerns with bird flu). Finally, it's doubtful whether, once a pandemic had reached Australia, we could do anything to halt its spread.

Bioterrorist events, by contrast, are much more limited in time and space. Our experience of dealing with them rests largely on observation of overseas events and on simulation exercises. Time is a critical variable in preparing for and responding to such events, and timely surveillance and response networks are a key to successfully containing any outbreak. Rapid detection of an outbreak and identification of the agent involved are critical first steps, and depend largely on sophisticated real-time surveillance systems that cover all of Australia and can deliver regular daily reports to a single, centralised, coordinated investigation and processing agency. Such a system needs to have geographic spread across the whole country, and involve a large reporting base of general practitioners in addition to hospital, laboratory and animal health networks.

There's also an urgent need for such a database to be linked to real-time data on place of residence, place of work and the activity and movement patterns of ill and potentially exposed people, as well as to material on the geographical distribution of doctors, pharmacies, public and private hospitals and clinics.

Critically, we also need to extend our surveillance systems to include exotic disease threats to wildlife here and abroad, and integrate such data into our infectious disease surveillance net.

We need models of people's everyday activity patterns—where they go in the course of a normal day, how many close and casual contacts they have, with whom and where—so that we might build models of disease diffusion and containment.

Understanding and managing community fear is as important as understanding the epidemiology and biology of epidemics.

Understanding and managing community fear is as important as understanding the epidemiology and biology of epidemics. There's a need to acknowledge that epidemics of infectious disease have two basic dimensions—demographic and psychosocial. We need not only to address the probability of great mortality and morbidity, but to understand how people manage risk, uncertainty and fear in their lives. It's disappointing that all the action and response plans developed in Australia to meet the threat of an infectious disease incident are largely silent in this important area.

Finally, in the case of a bioterrorist event, who would take overall charge of the official response? The multiplicity of national, state and territory agencies involved raises questions about cooperation, coordination, reporting lines and the capacity for decisive action—as does the fact that overall policy might be directed from Canberra while on-the-ground response is organised through myriad local and state authorities.

Australia is starting to recognise the potential impact of disease as a threat to security. In the short term, a fast-moving and devastating influenza pandemic could cripple world trade and commerce and place a severe strain on essential services. Longer term threats from the insidious spread of HIV are just as worrying. In our region, and in PNG in particular, HIV/AIDS threatens to further weaken already vulnerable states, perhaps creating a situation in which local police and military forces are no longer able to provide adequate law enforcement and national security.

We need to bring the same approach to dealing with the threat of disease as we do to other traditional threats to security: our defence can't commence at our shoreline, so regional cooperation and collaboration are vital.

The Australian Government has developed some important initiatives to deal with this problem; however, as always, there's more that can be done. We need to bring the same approach to dealing with the threat of disease as we do to other traditional threats to security: our defence can't commence at our shoreline, so regional cooperation and collaboration are vital. And we need to explore how we can encourage greater confidence-building measures and transparency in the region.

The following are some specific steps the government might consider to enhance our security against the range of current and emerging disease threats.

Raise disease threats to our security to the level of NSC consideration

The National Security Committee of Cabinet meets regularly to decide how best to handle security challenges. We need to recognise that disease threats can go beyond being the concern solely of the health portfolio. The Prime Minister might consider a special meeting of the NSC, inviting the Minister for Health to present information about the kinds of disease threats we face and how we need to prepare for them. It's clear that a whole-of-government approach is needed for the more serious threats—both naturally occurring and deliberate. The issue deserves consideration at the highest levels of government, across a range of portfolios to improve coordination. As we've seen already, agencies like the Department of Foreign Affairs and Trade and AusAID have been drafted into the effort against regional outbreaks of avian influenza.

Take the lead in building a robust and reliable regional disease surveillance and response network

Some initiatives are already under way to strengthen regional cooperation to defeat the infectious disease threat. However, they're relatively immature networks and haven't been tested in any serious way. No country in the region can isolate itself from the risk of emerging disease. There are two ways that regional structures could improve the current arrangements. First, we need to build an Asia–Pacific network of government scientists and health professionals with the capacity to share health intelligence on disease outbreaks. The network would need to build confidence among member states to encourage early and open sharing of information for a common benefit. Such a network would also help to develop a common approach to pandemic planning.

The second role of the network would be to provide a response mechanism. Many countries in the region lack the budgets and the technical expertise to adequately respond to disease threats. While the WHO is a vital part of the global surveillance and response network, a dedicated regional network would provide additional safeguards, building on the momentum for economic integration already taking place in the region. The regional network could, among other things, quickly provide expertise where it's needed, and could consider establishing a medicines stockpile for distribution at the first signs of a disease threat.

This year, the East Asian Summit (EAS) meets for the first time in Kuala Lumpur. Its membership comprises the ten ASEAN nations, Japan, China, the Republic of Korea, India, Australia and New Zealand. Given the threat disease can pose to regional trade and economic growth, Australia should propose that this grouping establish an integrated disease surveillance and response network. Canberra should offer to host a meeting of EAS health ministers in 2006 to provide the political commitment for this important aspect of closer regional cooperation.

Recognise that many traditional agricultural practices in Asia promote emerging disease threats, and target Australian technical aid at these

As Asian economies grow, changes in diet will see higher demand for meat, creating additional pressures to increase domestic production. Farming may become more intensive and may involve greater reliance on antibiotics and food supplements. These changes can create the conditions for new disease threats. Improving agricultural practices, and developing local expertise in veterinary pathology and epidemiology, will offer more chance of detecting and arresting new outbreaks at their source.

Australia already provides substantial aid to the region, including some to help improve agricultural practices. However, even in countries like China with impressive economic growth, technical expertise in disease management in the agriculture sector could be improved. Even modest levels of investment could make an important contribution to the effective management of emerging disease threats.

Accelerate the efforts to control HIV in the Pacific and elsewhere in the region

Australia's aid budget for HIV is a demonstration of our commitment to helping our most vulnerable neighbours reduce the alarming spread of this virus. However, there's a serious risk that our good intentions may be too late. Based on the current expenditure profile, most of our aid budgeted for HIV will be spent in the second half of the current ten-year program. With no cure on the horizon and treatment expensive, prevention must be our clear priority. Even in those countries that show few signs of HIV, we should devote adequate resources to pre-empt its arrival. If we wait until HIV has already become a problem, it will be too late.

Invest further in Australia's medical research and production capabilities

Australia's overall defence policy is characterised as seeking self-reliance within a framework of alliances. The same should be true of our strategy to manage serious infectious disease threats.

An important part of our self-reliant posture has been considerable investment in Australian industry. We've often paid a hefty premium to assemble fighter aircraft, and build the infrastructure to manufacture relatively small numbers of ships, submarines and armoured vehicles. The underlying philosophy is that we need to develop sufficient local capacity to maintain important capabilities, because in times of crisis we can't rely on overseas supplies.

The same logic should apply to our industrial capabilities in the fight against disease. The current supply shortfalls for antiviral drugs underscore the point. We have the research skills, but government initiatives need to foster more research investment, particularly in pharmaceuticals and vaccines. Australians have made impressive contributions to the health sciences for decades, but we shouldn't risk losing our best people and our intellectual property. Singapore has already identified biotechnology as its next growth industry; Australia is better placed to compete on global terms, but more support is needed to guarantee our success. In addition to developing greater health self-reliance, we could ultimately reap substantial economic benefits.

Enhance Australia's capacity for the collection and sharing real-time disease surveillance data

Early warning remains one of the vital safeguards for managing emerging infectious disease outbreaks. Australia's vast and remote landscape is particularly demanding, but we can ill afford to ignore the risks.

While detection capabilities are vital, we can further enhance our preparedness by ensuring that the links to the fairly complex web of organisations responsible for various aspects of the disease network are better coordinated.

Invest further in understanding how people manage risk and fear and develop strategies to deal with these aspects in pandemic plans

Australia's draft pandemic plan for infectious disease largely ignores the impact that fear and anxiety might have on communities. Yet we can expect this to be one of the more demanding aspects of pandemic management. The idea that some inherently Australian trait would mean we would respond more admirably than any other group is unsustainable. The government needs to pay greater attention to the psychosocial aspects of pandemics and bioterrorist action.

There is also the need to develop communications strategies for the community in the expectation that the current outbreak of avian influenza will transform to become a human influenza pandemic. The media interest in the subject has grown exponentially, complete with some alarming predictions about the impact of the next pandemic. It would be in the interest of state and federal government's to outline what preparations are being made now, and what the community could expect should a pandemic start. There might be some legitimate concerns that such a campaign would unnecessarily worry the public. But with in the absence of a public information campaign, the vast majority of the public will rely solely on press and news reporting.

Use the approach taken to deal with the threat of terrorism to provide greater assurance of federal–state cooperation by holding a COAG meeting on disease as a security threat

The recent report by Sir John Wheeler on airport security confirmed that federal–state cooperation and coordination are vital links in our security arrangements. In the health area, the relationship between the states and territories and the national government is complex and sometimes uneasy. It would be unwise to assume that the systems will work when we need them most. Some important new initiatives are already under way. For example, the plan to conduct a major pandemic exercise at the end of 2005 should be applauded. It isn't a trivial undertaking, and it should give us some valuable information about how well our communications and processes operate, and where they need more attention.

As a next step, the state and federal health ministers should meet to discuss the national effort to respond to emerging disease threats. The September Council of Australian Governments (COAG) meeting to consider new anti-terrorist laws highlighted the benefit of this kind of approach. Our health responses rely heavily on both the national and the state levels of government, and need to be driven by political leadership.

Coordination and cooperation should also be tested in an exercise involving a biological agent. Though these kind of rehearsals are demanding, the lessons learned will help disaster managers and government officials refine and streamline procedures and communication.

Beating the bioterrorist threat with intelligence means equipping agencies with enough technically skilled staff

Like all terrorism, bioterrorism is best dealt with through a concerted intelligence effort, but the variety of pathogens that could be used in an attack presents some challenges to our intelligence agencies. Since the September 11 attacks, the government has devoted substantial additional resources to building intelligence capabilities. As the global threat has changed since the end of the Cold War, new skills have been sought. The government should review whether our intelligence agencies have sufficient skills to cover the threat of bioterrorism.

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Acronyms and abbreviations

ADF	Australian Defence Force
AIDS	Acquired Immune Deficiency Syndrome
APEC	Asia–Pacific Economic Cooperation
ASEAN	Association of Southeast Asian Nations
BSE	bovine spongiform encephalopathy or 'mad cow' disease
CDAG	Council of Australian Governments
CDC	Centers for Disease Control and Prevention
EAS	East Asian Summit
ECP	Enhanced Cooperation Program
HIV	human immunodeficiency virus
NSC	National Security Committee of Cabinet
PM&C	Prime Minister and Cabinet
PNG	Papua New Guinea
RAMSI	Regional Assistance Mission to Solomon Islands
SARS	severe acute respiratory syndrome
TB	tuberculosis
WHO	World Health Organization

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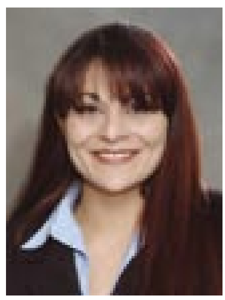

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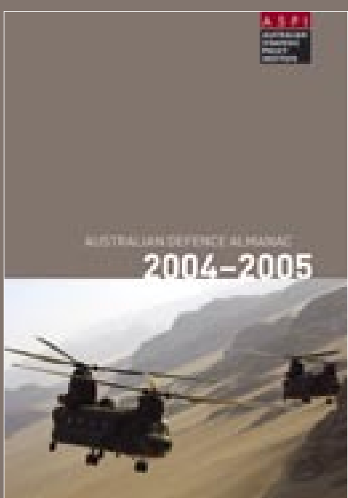

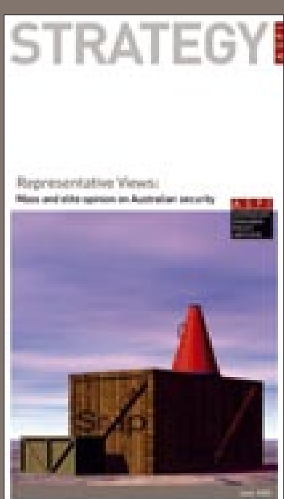

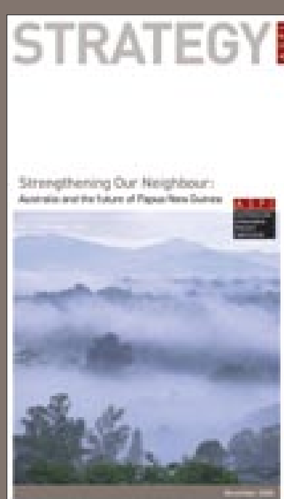

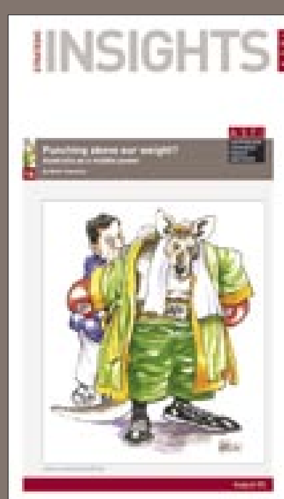

Plague Anatomy:
Health security from pandemics to bioterrorism

Each year millions of people are swept away by infectious diseases. The hope for an aseptic age, so triumphantly heralded in the 1960s, has proved illusory. Over the last 40 years new viruses have emerged, which challenge the way we need to think about disease. We have witnessed the arrival of new viruses: HIV, SARS, Marburg virus, and most recently, a new and deadly form of avian influenza. As globalisation and cheap and accessible air travel bring with them many benefits, Australia's traditional protection from geographic isolation is eroded.

In the past we have tended to think about disease and its impact on society only through the prism of public health policy. Disease and its causes have largely been the sole preserve of scientists, medical practitioners and the health departments of government.

States everywhere face new dangers from infectious disease. The scale of the threat requires the engagement not only of health authorities and health professionals, but of many other agencies not traditionally concerned with the consequences of infectious disease. The discussion about disease risks needs to be extended to inform the broader national security debate.

This paper considers the spectrum of biological threats both natural and deliberate. It considers how modern pressures have altered the biophysical environment and left open the door for new and re-emerging disease threats. Diseases like AIDS threaten the core of society and risk perpetuating the cycle of under-development and poverty. And there is the growing possibility of an influenza pandemic that could kill millions and profoundly alter the world economy.

And there is the risk of bioterrorism. Since the 1990s the number of incidents involving biological agents has increased markedly. The threat of a bioterrorist attack is no longer in the realms of fantasy, but a serious concern for governments.

How well prepared is Australia to meet the twin challenges of infectious disease and bioterrorism? *Plague Anatomy* explores these issues and offers some advice about how Australia should incorporate these challenges into our thinking about security.

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