Introducing Kat Haynes

Kat Haynes has recently arrived at Risk Frontiers having just submitted her PhD thesis. Her primary interests are risk perception and risk communication in relation to natural hazards. Like so many arriving on these Australian shores before her, Kat was pallid and malnourished as a result of her PhD write-up in the months leading up to her departure. Her doctoral research was carried out within the Centre of Environmental Risk, a centre within the School of Environmental Sciences, at the University of East Anglia, Norwich, UK.

Following a trans-global foray to explore the world beyond the hills of Aberystwyth, Wales, Kat undertook her undergraduate degree at University College London. A strong interest in the earth sciences led Kat to study Environmental Geosciences, a combination of physical geography, geology and global environmental issues. Kat also took the opportunity of London's bright lights to pursue her love of dancing and performing.

Having completed her degree, Kat once again disembarked British shores boarding a (very small) sailing yacht in Vancouver and sailing with two friends to Hawaii. This enabled Kat to further add to a growing list of countries in which she has climbed volcanoes, a list which now includes: a number in the Cascades, (Pacific NW) including Mt St. Helens; New Zealand; Chile; Hawaii; Indonesia; Italy; and the Caribbean. A brief amount of time was spent volunteering for the US Forest Service before heading to a small market town in the east of England to begin the PhD program.

Kat carried out her fieldwork on the volcanically active island of Montserrat in the West Indies, using interviews and survey techniques with a range of respondents (government and emergency management officials, scientists and members of the lay public) to identify differences in perceptions of risk and reactions towards the emergency management activities. Her key findings were that differences exist within the public and between the public and authorities concerning the interpretation of levels of risk and uncertainty. Influencing factors included levels of tolerability; co-operation with authority relating to risk management decisions; the communication and management roles of the authorities and scientists; and also knowledge, misconceptions and belief in competing scientific information. Trust in the information sources was also identified as an important factor.

The most important demographic variables associated with these issues were found to be individuals' cultural outlook and place of birth, evacuation history and location. Experience was also an influencing factor creating an 'availability bias'. This allows those who have experienced certain events to only expect that already experienced, i.e. those whose homes had so far been safe during 9 years of eruptive activity on the island felt that they would always be safe and perceived the risks as minimal. These people were complacent and could not perceive that the situation could worsen and affect their homes.

The research also investigated the efficacy of typical hazard/risk maps compared with 3D maps and oblique aerial photographs. The hazard maps were found by the majority of respondents to be very difficult to comprehend. While the 3D maps were an improved method, the oblique aerial photographs showed surprisingly superior results. Individuals did not have to decode contours, symbols or false colours in the photographs and were able to interpret their own information. These findings may have serious implications for emergency management where regular maps are an integral part of emergency plans.

The research on Montserrat demonstrated that risk communication is not simply a process of communicating clear messages and instructions to the public. It must be recognised that a complex web of social influences and filters will act to amplify or attenuate the risks. The process must incorporate feedback and be interactive so that lay views are incorporated into communications and management plans.

Kat's post at Risk Frontiers is based upon the realisation that social issues are an important part of natural hazards research. It is also an admission that some of the staff (due to John McAneney's ruthless work regime) may have lost touch with the outside world. Either way, Kat's mix of social science input and lively social gatherings, e.g. tea and cake mornings, should add an important and dynamic element to the work at Risk Frontiers.

The staff of Risk Frontiers would like to wish all our readers a very Merry Christmas and Happy New Year

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This Issue

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A Future Pandemic

Jeffrey Fisher and Peter Curson

It is difficult to pick up a paper or watch television today without seeing some reference to bird flu, H5N1, or a possible influenza pandemic and the world's lack of preparedness for it. One thing seems clear: in an increasingly interconnected world, where 1.5 billion people cross international borders by air every year, a virus could circle the globe very rapidly, possibly even before it was detected. In contrast, the so-called 1918-19 'Spanish Influenza' took some 18 months to circle the globe and about four to six months to do its damage in any one country. This article examines some implications of such an event for the life insurance business and the wider economy.

Some insurance and reinsurance companies have prepared for the eventuality of a pandemic, assessing their risk and taking steps to offset expected losses. Financial instruments such as mortality bonds, the life insurance equivalent of catastrophe bonds, have been used to transfer some of the risk to the capital markets. However catastrophe modelling, now standard for non-life lines of business, seems far less sophisticated in the case of life insurance. Many companies still appear to be working out what their losses might be.

Some Basic Numbers for Australia

So how many people are likely to die if a flu pandemic reaches Australia? If there were a repeat of the 'Spanish Influenza' pandemic, the death toll in Australia could be somewhere between 60,000 and 80,000. To put this in some context, some 130,000 Australians die in any one year, a sum that includes about 2,000 from influenza. Thus a repeat of the 1918-19 scenario would represent an increase in the annual death toll of over 50%.

Circumstances today, however, are very different from 1918. Medical and community health standards have improved dramatically. In 1918, intensive care wards had yet to be developed; there were no effective drug therapies for pneumonia; knowledge of viruses was rudimentary; and doctors had no antibiotics or antiviral drugs. Taken together, these factors could reduce the death rate considerably below that experienced in 1918-19.

On the other hand, the mobility of people today could allow the disease to spread very rapidly causing a dramatic increase in patient numbers in a short space of time. This has the potential to overwhelm the health system and reduce the benefits of modern medicine because of a shortage of drugs and hospital beds. Thus while the death rate is unlikely to be as high as for the 1918-19 pandemic, it nonetheless remains a good benchmark as a plausible worst-case scenario.

An Optimisation Problem

The current strain of bird flu has killed over half the people known to have become infected with it. While this is cause for concern, a flu pandemic could not develop with a *mortality rate* this high. The *mortality rate* is defined as the proportion of the infected population that dies from the disease.

Influenza viruses have an initial period when an infected person exhibits no symptoms. This is the virus's window of opportunity to spread; once symptoms appear, it is fairly easy to isolate cases and prevent further transmission. Furthermore, approximately half of all people who catch the virus get only a mild case with no obvious symptoms while still being infectious. These two attributes allow a flu virus to spread throughout a population. An influenza virus that kills its host too quickly will die out before it can cause a global epidemic.

Risk Frontiers has a simple simulation model to examine this issue. A typical simulation deals with a population of 10,000 people. They are assumed to be a fairly homogenous group in the same geographic area – imagine a small Australian town or suburb. One way of incorporating the viral attributes mentioned above is to assume some degree of negative correlation between the length of the infectious period and the *mortality rate*. Negatively correlating these variables means that, on average, as the *mortality rate* increases, the length of the infectious period decreases and so less people catch the disease. Figure 1 shows this trade-off. Initially, as the *mortality rate* increases, more people die. Beyond a rate of around 1.6%, however, the tide turns as the likelihood of someone dying after catching the disease increases but the total number of people infected goes down.

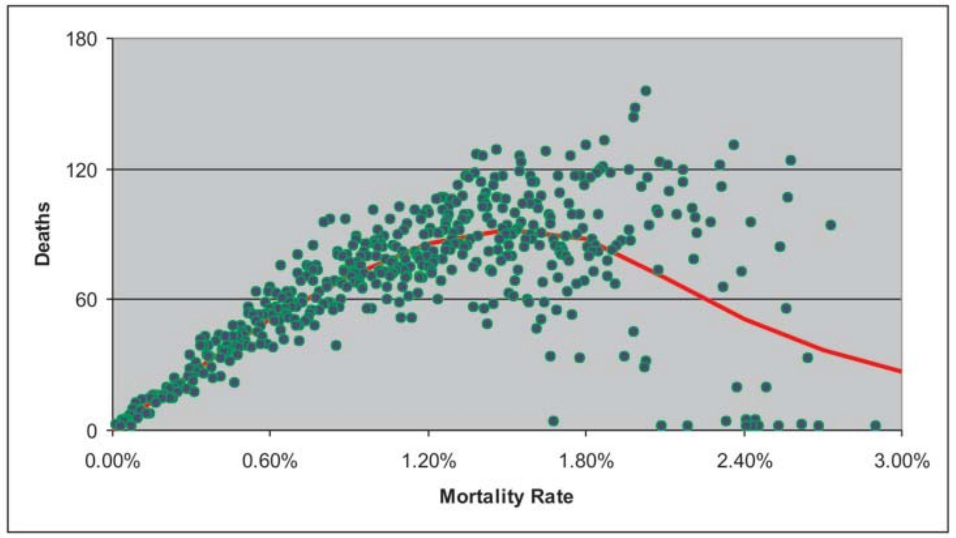

***Figure 1**: Modelled deaths in a population of 10,000 as a function of mortality rate.*

The real concern is that the current strain of bird flu will combine with human flu viruses or develop the ability to jump directly to humans. If this were to happen then the global death toll could be very high. The 1918-19 flu virus killed, depending upon different reports, somewhere between 1.2% and 2.8% of people who contracted it, i.e. close to the optimum shown in Figure 1. A very well-designed bug!

Vaccination

Clearly, targeted vaccination at the source of an outbreak is likely to be the best means of avoiding its wider dissemination. In a recent article, Ferguson et al. (2005) explores the efficacy of using such targeted preventative medicine. These authors argue that if good detection measures are in place, if anti-viral drugs are stockpiled appropriately and deployed quickly, then the chances of containing an outbreak at source by treating everyone in the vicinity would be greater than 90%. While this conclusion is encouraging, neither sufficiently rapid detection nor efficient implementation of preventative measures can be taken for granted in the countries where outbreaks are most likely to occur.

Australia is an unlikely source of the disease and it is far more likely that the general population would have to be vaccinated. Let's assume for the moment that this is possible. The proportion of the general population that must be vaccinated to stop an epidemic depends on the *Basic Infection Rate* (BIR), essentially a measure of how easily transmissible the virus is. The BIR is the average number of new cases caused by each virus-infected person in a population with no immunity to that virus. For the current strain of bird flu, we might prudently assume that no one has immunity. According to Ferguson et al. (2005), a typical pandemic strain of influenza would likely have a BIR of around 1.8, a figure that implies the need to vaccinate roughly one half of the population in order to arrest the spread of the disease (see Inset). In other words, about nine million people in Australia.

All this presupposes the availability of a vaccine. In fact, it would take about six months to isolate a particular strain and produce a vaccine in sufficient numbers. By this time the pandemic would be over. So will there be enough vaccine to go around? Given current global development and production capabilities, the answer is no.

Insurance Costs

What would a modern day pandemic cost the Australian life insurance industry? If we assume a very rough estimate of $300,000 for a life insurance payout, then it is simply a matter of counting the dead or, at least, those with life insurance. The current level of life insurance penetration is around 30% of the adult workforce, who in turn comprise about 65% of the entire population. This being the case, a pandemic comparable to the 1918-19 influenza outbreak would lead to a total insured loss of around $4.1 billion. This sum is of the same order as a repeat of Cyclone Tracy that destroyed Darwin in 1974 (see the next issue of Risk Frontiers' Quarterly Newsletter.)

There are, however, other complications not considered in the above calculation. For reasons that are still not entirely clear, the 1918-19 epidemic preferentially killed people between the ages of 25 and 40, i.e. those normally at the lowest risk of dying from influenza. Thus usual actuarial assumptions about expected age at death may not apply in the case of a pandemic. Moreover people in this target age group are more likely to have life insurance and will tend to be insured for relatively higher amounts.

There may be other calls on insurance caused by the failure of some businesses to fulfil critical supply contracts due to workers being afraid to, or prevented by Government decree from turning up to work. Private medical insurance could be another source of losses for the insurance industry.

Social and Economic Consequences

While our analyses suggest that the implications of a 1918-19-type pandemic could be significant for the insurance industry, insured losses will represent only a tiny fraction of the wider economic losses borne by society.

The recent SARS epidemic gives us some clues to the likely magnitude of these losses. The province of Ontario, for example, suffered an estimated loss of more than C$2 billion due to reductions in tourism, including lost income and jobs. Hotels in Toronto remained two-thirds empty during the peak of the epidemic and cost the hotel industry more than C$125 million. More than 15,000 people were quarantined at home for at least 10 days. If nothing else, SARS demonstrated the impact that a short-lived epidemic can have on consumer confidence, investment and consumer spending. Some sources have estimated the total global economic cost of SARS at $US 30 - 50 billion (*Financial Times*, 14/11/05).

A major flu pandemic would be much more significant than SARS. Businesses could be confronted by 25-30% absenteeism as home quarantine removed many from the workforce for up to two months; people would avoid shops, restaurants, hotels, places of recreation and public transport. There would be a run on basic foodstuffs, medications, masks and gloves. As there is little surge capacity in our hospitals, temporary hospitals would need to be established. Schools, childcare centres, theatres, not to mention pubs and race meetings - the fundamental heartbeat of our nation - would be closed or cancelled. Government imposed quarantine and absenteeism would severely disrupt interstate and international trade. All this would produce a decline in consumer confidence leading to significant reductions in consumption spending.

Some Other Issues

Let's return now to the question of preventative medicine. As has already been explained, there is simply not going to be enough anti-viral drugs, vaccines and other preventative measures to go around. The current stockpile of anti-viral drugs could be insufficient even for just all essential health care workers, emergency service workers - and politicians? And what about me? Yes moi!

Assuming Australia has the luxury of time to become better prepared then difficult choices still remain. For example, who will get the extra supply after the needs of essential workers are met? Would they be handed out by lottery, should they go to the elderly and young, would people be able to buy them? Public outcry might prevent a scheme where they were sold to the highest bidder, but it is easy to imagine somebody risking the small chance of personal death and selling their vaccine shots on e-bay for large sums of money. The problem could be an administrative and ethical nightmare.

Final Thoughts

So, where does all this leave us? As far as preventing an outbreak, the only place that this can be done is in the place of origin, most probably somewhere in Asia. If a pandemic does occur, then it is going to inevitably affect Australia. Quarantine measures that the government will feel obliged to put in place might delay its development, but are unlikely to prevent it from reaching us. Given a lead-time of six months to develop an effective vaccine, society and the government will be faced with some difficult choices about who gets access to limited supplies of anti-viral drugs. And for the life insurance industry, our admittedly rough calculations suggest that it is not good news. However only a minor proportion of the economic costs will be borne by the insurance sector. And underlying all this is a fundamental truth – a healthy population represents the human capital necessary for productivity, innovation and economic growth.

Calculating the proportion of people to vaccinate

The relationship between the *Basic Infection Rate* (BIR) and the proportion of people who need to be vaccinated to contain or prevent an epidemic is a relatively simple one. In order for the virus to propagate through a population, an infected person must infect at least one other person. Thus for a vaccine program to be effective, it must lower the effective BIR of the virus to below 1.0. Assuming no immunity within population, the proportion that needs vaccination is given by the formula:

Proportion = (BIR – 1.0)/(BIR)

Given a BIR > 1.0, then vaccinating this proportion of the population will stop an epidemic from gaining hold, although small outbreaks are still possible. With a typical value for a pandemic-type strain of 1.8 (Fergusan et al., 2005), the formula suggests 44% of the population will need to be vaccinated.

If a virus is currently in circulation, then people with it already or having low level infections can be assumed to be immune and not require vaccination. This will reduce the quantity of vaccine needed.

If the virus is sufficiently widespread, however, it will still take a long time to die out and so vaccinating as large a proportion of the population as is feasible is the best defence. Moreover, we will not know the actual BIR for some time and so once again assuming a 1918-19-like worst-case scenario may be the only prudent policy.

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