The Road

This publication is the collection of all five sections:

The ERG Report
Policy Outcomes
An Alternative
A Fix to the Pandemic Problem
An International Fix to an International Problem

Acknowledgements

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Preface

This book has been prepared in response to the United States of America's Federal Government agency Centers for Disease Control and Prevention (CDC) requesting public submissions on their proposed regulations and plans for tracing people in response to the threat of a pandemic.

The book consists of five separate sections that have been released sequentially to inform and further the debate on an effective pandemic response. The information contained in this document is the consequence of a holistic approach and is not influenced by any political or geopolitical perspective.

The first section *The ERG Report* responds to the ERG (Eastern Research Group) report released by CDC. The ERG report is exposed as having failed to fully consider the ramifications of a pandemic and failed to supply the response required in the pandemic situation.

The second section *Policy Outcomes* points out a number of assumptions made by CDC, which threaten the effectiveness of CDC's ability to manage the pandemic threat. The likely outcome of these assumptions is briefly described.

The third section *An Alternative* analyses CDC to provide a reasonable boundary to its competencies and describes how a complementary organisation could partner with CDC in a public private partnership to provide a greatly enhanced pandemic response and management capability. The type of partner is described and a likely source of partner deduced.

The fourth section *A Fix to the Pandemic Problem* presents three scenarios and looks at some serious problems created by a pandemic that have not been considered by CDC and would almost certainly derail the US Government pandemic plans. Each of these problems is described, the consequences are considered and a practical fix is proposed.

The final section *An International Fix to an International Problem* outlines the requirements for an effective information system able to respond to, and minimise the damage from, a serious pandemic.

These documents form the starting point for meeting the real and potentially disastrous threat posed by a pandemic. We invite all interested parties, both government and private sector, to cast off their own agendas and priorities, and focus on what may become the most serious threat faced by the human race this century. There is no time to waste.

Part 2

Part 3

Part 4

Part 5

Part 1

The ERG Report

ERG Report for CDC

On 22 November CDC released a report by ERG describing proposed changes to United States regulations.

CDC wants to track all people arriving on international flights and cruise ships, and will probably extend the tracking to people travelling through hubs and all domestic air travel.

CDC is doing what it is required by law, but not what is needed to be done to protect the American people.

CDC's answer is to track you, not protect you.

CDC's answer is to get somebody else to pay for it and avoid taking responsibility.

CDC's answer is to quarantine anybody near a disease in a hospital and not be accountable for setting up facilities to take care of large numbers of the sick and the people they contacted.

You have sixty days.

Talk to your friends. Spread the news. Write to Congress. This is your last chance.

ERG Report Failure

Introduction

The 2003 SARS epidemic and increasing concerns throughout 2005 of a bird flu pandemic provides a timely opportunity to consider the use of information services in protecting the United States and world population from the possibilities of serious disease outbreaks.

However, rather than recognise the opportunity and take a visionary perspective, the CDC has concerned itself with an economic analysis extrapolating the same types of incremental policies that have led to failures such as the recent flooding of New Orleans.

What is required is a new approach, not a mere extension of government regulations. What is needed is an ability to deal with a pandemic and not just a plan. After all, there was a plan to stop New Orleans from flooding. But the water was not stopped by a plan in Washington - nor will the bird flu be stopped by another plan in Washington.

What we need is real action before the bird flu arrives.

Business Model Failure

Disease Source

A fundamental assumption is that a disease creating a pandemic will not arise in the United States.

The problem is that the bird flu comes from birds. The assumption that the risk to Americans is small because 95% of humans live outside the USA ignores the fact that North America is a large continent with a significant proportion of the world population of birds, both domestic and wild. The risk from a disease that is mutating inside birds is proportional to the bird population, not the human population.

The US also has the world's leading research capability. Genetically modified organisms are routinely tested in American labs. CDC/ERG assumes that a disease must come from naturally mutating organisms or from deliberate human release by terrorists. Yet, a simple human error could release a new disease into the environment at any time. And that risk is higher in the United States than in backward countries because of the US' advanced technology.

CDC/ERG has also paid lip service only to terrorist threats. They assume that the threat is external to the US. But the planes that hit the Twin Towers started their flights in the US, not overseas. The Oklahoma bomber did not fly to Oklahoma to bomb the FBI building. The terrorist threat is likely to be locally deployed and can spread throughout the United States by air, land and sea transport.

So, the basic CDC/ERG focus on international flights, then major hubs and last of all domestic air travel may catch a large number of people, but it does not cover a disease spreading overland within the United States.

And apparently sending the disease to other countries doesn't count. The CDC is focussing on tracking incoming people but doesn't care about people on outbound international services. What about American citizens on those flights? Don't they deserve some protection too?

State Borders

What happens if a disease becomes established in the United States? The CDC intends to track domestic flights only in its most expensive scenario.

But there is no tracking of land transport. The CDC/ERG assumes that disease moves on people in planes and boats. Presumably people driving cars, on buses and trains don't catch disease.

So, what do we do? Do we close state borders and not let people cross?

And if the disease starts in the United Sates, it can spread in five days from coast to coast through truck drivers. No planes required. Our freeways could be carriers of death and CDC/ERG wants to watch planes and boats only.

Military

The CDC/ERG excludes the military from its requirements. Politics aside, does the CDC honestly believe that military are both immune from disease and cannot carry it? Or does the CDC not care what happens to the military? Or does the CDC assume that the military is focussed on disease control when they're busy carrying out essential operations?

The CDC is gambling with the lives of all Americans with these assumptions.

The military is sworn to defend the United States against all threats. They have impressive defences against physical threats and can deploy these assets around the world at a moment's notice – and back again. It is not much to ask that DoD and other agencies do their best to defend the United States against the hidden threat of disease at the same time.

Instead of exempting the military from all reporting, the CDC should insist on complete information access on military personnel movements. The information can be classified to meet requirements. But one dead classified soldier is all that is required to become another Typhoid Mary. It takes only one secret military flight to bring foreign disease into the United States. And only one military operation can spread disease from the United States around the world.

Crews

CDC/ERG also focuses on passengers. Crew manifests are required for passenger flights. But the focus is on the passengers. The crews of aircraft and ships are just as likely to pick up disease as any passenger. These crews, whether on a freight or a passenger service, can carry a disease across borders. CDC has failed to consider the full impact on human movements in their eagerness to trace passengers.

Illegal Immigration

Another problem is that the CDC/ERG is tracking by passport details and by airline and shipping booking schedules. But not everyone bothers with these niceties. Illegal immigrants from Mexico, Cuba and other places don't arrive at the border with their passports. Any one of these immigrants could bring disease into the country.

Failed Business Case

The CDC failure is to rely on the airline and cruise industry for its sole information. The problem is bigger than just these industries. And the problem is not about tracking people just coming from outside.

The problem is tracking people's contacts wherever they have been. Air movements and ship movements are important ways that disease can travel. But the military, land transport and illegal immigration are all threats too and need to be addressed. As it stands, the CDC plan - is a plan to fail.

Economic Analysis Failure

The ERG analysis is based on comparing the status quo with their planned intervention. They consider two situations – with and without the intervention. But they do not attempt to consider long-term implications on investment patterns or upon economic development of the plans involved. They use an analysis called a 'static analysis' by economists.

But even economists don't believe in static analysis. Instead, most modern economists would insist on a dynamic analysis to look at the true effects of regulation and of the CDC/ERG plan.

First, the CDC/ERG report admits that Hong Kong lost 50% of travel for a period of time and that investment was diverted from China. The assumption is that these investments would go elsewhere. However, there is a permanent loss as an economy cannot not simply catch up on lost growth, and hence both China and Hong Kong are both poorer today than they would otherwise have been. It is not reasonable for CDC/ERG to dismiss economic effects on the United States as regional. Investment relocated to another country to avoid a pandemic will likely stay there and American workers, investors and the country will be poorer as a result.

Second, CDC/ERG assumes that people being imprisoned or quarantined does not impose a social cost. The assumption is that people not being able to work has no effect on business or government. The assumption is that it doesn't matter if children cannot go to school. There is no allowance for downstream costs from business failure, lost productivity and lost school time. Workers will lose income from not working and some people could be forced into bankruptcy and lose their homes. These are all costs that society has to bear in the future and it is unreasonable for CDC/ERG to dismiss them out of hand.

Third, a pandemic such as the 1918 Spanish flu will kill large numbers of valuable people. The value of statistical life calculation of $6.9 million used by ERG is rather cold analysis. It is assumed that people are replaceable for $6.9 million. This type of calculation may work in the case of car accidents, which are reasonably frequent and spread out over time, but a rapid loss of large numbers of people can deprive whole communities of valuable skills required to main the standard of living. A pandemic killing hundreds of thousands could create a loss to the economy much greater than the number of people multiplied by $6.9 million, but instead cost society dearly through reduced productivity and lost opportunities.

The CDC/ERG also ignores the costs of the United States exporting disease to other countries. An outbreak of disease in Europe or Asia or elsewhere is not costless to the United States. It deprives the country of access to valuable resources and valuable markets. A foreign pandemic carried by people leaving the United States would affect the US economy and may lead to shortages of some products and supplies. It is in the USA's self-interest to protect other countries from an American disease just as it is in their interests to protect the USA. The CDC/ERG has not even begun to consider this side of the problem.

This type of economic analysis is based on an assessment of a limited threat with no real long-term consequences. A pandemic is something completely different and the CDC/ERG has done everyone a disservice with their failure to consider the dynamic effects on the economy.

Risk Management Failure

CDC's basic answer to a pandemic is to track down everybody and place them into quarantine. They intend to outsource planning to airlines and shipping companies rather than carry out a full risk assessment and management plan themselves.

The problem is that this approach generally ends in the sort of fiasco recently experienced in New Orleans.

A full risk management plan has to consider all aspects of risk.

First, the disease needs to be contained. The CDC needs to quickly locate all people in contact with the disease, assess the risk and if quarantine is a viable option, isolate these people both from other suspected carriers and from the population in general. Even ERG's simplistic modelling demonstrates that timely tracking of people significantly reduces the scale of an outbreak.

But where is the rest of the plan? You can't just stick people into hospitals. In China the SARS epidemic quickly filled all hospital capacity and staff were prevented from leaving the facilities. There is not the spare bed capacity in the United States or anywhere else in the world to cope with large numbers of possibly sick people. The Federal Government's recent idea of passing this problem to the states doesn't make it go away[1].

Further, quarantine can make things worse, as people who may not be sick can be infected by other people in the facility. It is not enough to protect people outside the quarantine from those inside the quarantine, but it is necessary to separate people in the quarantine from each other to prevent unnecessary loss of life. Unless we follow the CDC/ERG logic and assume that everyone potentially exposed can be exposed to the disease and increase their chances of dying.

So, where are the special quarantine sites? Where is the security for these sites? Where is the emergency food, water, energy supplies, medicines and shelter? They don't exist. CDC's answer to a pandemic is about as effective as the federal assistance to New Orleans.

Second, where is the financial risk management? Quarantine imposes costs on the people being quarantined, on the economy and on the carriers involved. High cost unlikely events can be managed financially through insurance policies. California's earthquake insurance programmes are examples of reconstruction risk being managed through insurance. CDC/ERG has failed to take leadership in managing the risk by taking a narrow view of their role in tracking and detecting diseases, rather than protecting the USA and its people.

Third, where are the protections against abuse of these powers and information by federal authorities? There is always the risk of governments holding information

[1] Entous, Adam. (2005). Top Bush aides test bird flu preparedness. Available [online]: http://news.yahoo.com/s/nm/20051211/sc_nm/birdflu_usa_dc_3. [12 December 2005].

about citizens, not treating it with the respect that it deserves and using it for purposes not consistent with the original purposes of collection. ERG acknowledges this risk by citing TSA's restriction of data to prevent function creep and misuse. ERG has not proposed any mechanism to prevent similar function creep or the use of information for purposes other than managing the pandemic threat. Instead, ERG expects everyone should simply blindly trust the CDC.

And what happens to all of the information collected? What are the protections against this information being sold to direct marketers, being used to collect tax or by insurance companies to assess your exposure to disease? Some countries protect their citizens with privacy laws to prevent misuse of information. CDC's answer to this inconvenience is to change international law so they can override these legal protections. With this attitude, how can you trust CDC as custodian of your information?

Finally, the quality of the USA's response to a pandemic will affect the country's reputation around the world. The United States became an international joke with its ability to help Indonesia within 2 days of a tsunami but its inability to help New Orleans until almost a week after hurricane Katrina. CDC's plan threatens American prestige by its inadequacy, and therefore America's place in the world. It is important that the USA is seen as the world leader and CDC needs to provide the most capable response plan to a pandemic, to ensure American supremacy after the disaster.

Technical Failure

CDC/ERG has failed to design a response to the pandemic threat.

First, the CDC/ERG solution is for airlines to keep tapes at some location, which will be presumably sent to CDC as required. These tapes could be thousands of miles from CDC. The time required to find the tapes, transfer them to CDC and to mount them for reading is lost time during which the pandemic would spread and people could die.

Second, tapes are inherently unreliable. Reused tapes often cannot be read by tape machines other than the one that wrote the tapes. It is quite possible that CDC will not be able to read the information available once they receive the data.

Third, shifting highly valuable data physically exposes the whole United States' response to risks such as motor vehicle accidents, radiation and other causes that could destroy the data. It is possible that the United States could become exposed to a pandemic because of one car accident.

Fourth, CDC/ERG's assumption is that 10-12 enquiries will be required at one time. That may sound like a nice number in normal circumstances, but a pandemic is something else. There are thousands of flights in the air over the United States every day. If CDC cannot analyse all of these flights at once, then there is no hope of tracing the spread of a pandemic.

And who is going to carry out this analysis anyway. Are there trained people isolated from a pandemic ready to respond at a moment's notice? Is the CDC facility isolated from all outside contamination? How will CDC not become infected by the delivery of the tapes?

The CDC/ERG analysis assumes that the problem can be placed onto the airlines. Their analysis ignores the realities of analysing data in an emergency situation. As one would expect from economists, their solution is technically ridiculous, hopelessly under priced and wholly irresponsible.

Data modelling failure

ERG's main strength should be its economics. After all, the company claims economic modelling as a core strength of the organisation.

However, look at the assumptions used. ERG has followed a study[2] of the Singaporean 2003 SARS outbreak in its analysis. On the surface, a commendable option.

However, the SARS study noted that about half of the cases were infected by just five people. Five people infected 103 people. And SARS is different from bird flu. With SARS you can tell when somebody is sick before they become contagious, but with bird flue a person can be contagious for two days before they develop the symptoms.

Singapore is one of the most organised countries in the world and has world-class facilities. It is one city with practically no surrounding rural areas. The United States would have trouble matching Singapore's ability in containing a SARS outbreak, or any other disease. The greater complexity and size of the United States would practically ensure that the US would take longer than Singapore to recognise, let alone contain, any threat.

Therefore, ERG's model seems to be miscalibrated and probably much too optimistic. The real costs from an outbreak are probably much higher than ERG's estimate.

Further, as a pandemic would create an extraordinary stress on the economy, one must expect that costs would rapidly rise, as fuel prices rose in Louisiana as a result of hurricane Katrina, and therefore the costs of the disaster will be much higher than predicted.

In addition, ERG has excluded all of the dynamic efficiency effects from their model. The result is an overly optimistic model, and therefore a failure to provide a reasonable picture of the pandemic effects. ERG may have provided CDC a tool for budgetary approval through the political process, but it has failed to provide a realistic scenario to design a pandemic solution to protect American interests.

[2] Lipsitch *et al*. (2003). Transmission Dynamics and Control of Severe Acute Respiratory Syndrome. *Science. 3000*(5627), 1966-1970.

Conclusion

A global pandemic is a global problem, not just a US problem. The CDC has worked on the basis that a disease would almost certainly originate overseas and arrive in the United States by plane or ship. Their solution is to track passengers and quarantine.

But things are never that simple.

The CDC/ERG proposal imposes costs on airlines, creates risks of data misuse and a cost on the economy, but it fails to solve the problem. The pandemic threat is serious. The government needs to put politics aside and get real – solve the complete problem or get somebody else who will.

This report encompasses failure.

Failure to look at the pandemic business model.

Failure to analyse the economic effects.

Failure to look at the risks involved.

Failure to consider the technology required.

Failure to model existing data.

In summary, ERG and CDC have failed the American people. God help us all.

Part 2

Policy Outcomes

Introduction

The trend over the past twenty years is for politics to shift from what could be done to what is being budgeted. There has been an on-going but subtle shift from achieving goals towards allocating resources. This change has allowed political leadership to distance themselves from programme failures, as they can also claim that they allocated the resources but somebody else failed to realise the goals with these resources.

This shift from policy outcomes to policy inputs is implicit in the CDC approach to a pandemic.

CDC has been tasked with the responsibility to control a pandemic, not manage the situation. The government response is typical. Allocate resources from other areas, and often from the private sector, to demonstrate that they have carried out their responsibilities – but what responsibilities – to allocate funds or to manage the situation with minimum damage to the USA and the American people.

A national emergency comes along every now and again. At those times government is measured on its success or failure, not on whether it made reasonable steps to contain a situation. Whether a natural disaster is a hurricane, such as Katrina or a war, failure is failure.

As former Democratic 9/11 Commissioner Jamie Gorelick recently said on ABC's Good Morning America, when commenting on government failure to prepare for a disaster, "you could see that in the aftermath of Katrina. We assumed that our government would be able to do what it needed to do and it didn't do it."

There are no second chances for a congressional budgetary committee or other process to review the situation and modify budgetary allocations to ensure a better result next time. Failure is permanent.

A pandemic could leave thousands of people dead, or millions. The 1918 Spanish flu is a warning to us all of the costs of failure: 25 million dead in 25 weeks[1]. More American soldiers died in the First World War from the Spanish flu than died in combat.

Globally 2.5% - 5% of people died from Spanish flu and 20% of people were affected. An equivalent infection rate in the US today would be 7.4-14.7 million people dead and 59 million sick. Such large numbers would totally overwhelm the medical system.

And the chilling fact is that quarantines did not work with the Spanish flu. So, why is the CDC proposing the same method that failed in 1918-19 again?

[1] Wikipedia. (2005). Spanish flu. Available [online]: http://en.wikipedia.org/wiki/Spanish_flu. [5 December 2005]

The CDC Assumptions

Assumption: Virus is passed by close contact

The CDC assumes that the avian flu and similar threats to the US requires close contact to pass from person to person. The Avian flu is thought to pass only through feed, water, on equipment and on clothing[2].

However, there are two problems with this assumption.

First, the virus can pass from human to animal to human and does not necessarily have to pass directly from person to person. Animals such as birds, pigs, whales and seals bypass CDC tracing and quarantine measures and make them ineffective.

Second, evidence from Alaska suggests that some people infected with the Spanish flu could not possibly have been infected by people. These people must have been infected either by animals or, more seriously, the virus may be able to survive long enough in the air to reach isolated populations,

If the Avian flu can become airborne, then the United States can be infected by the virus being carried in winds from Asia. There will be no point in monitoring air travel, as the virus can bypass airlines and can travel directly to US territory.

Third, the bird flu can survive on clothing or equipment for periods of time. The virus could spread by freight transfer and contaminate a person coming in contact with the cargo at the destination or at transit points.

However it spreads, the problem then becomes the management of a virus in the US population and not one of managing the borders and long-distance travel.

[2] Wikipedia. (2005). Avian influenza. Available [online]: http://en.wikipedia.org/wiki/Spanish_flu. [5 December 2005]

Assumption: The sick and quarantined can be placed in Hospitals

The United States currently has 5759 hospitals with 955,768 staffed beds[3]. In 2004 these hospitals handled 36,941,951 admissions – an average of 100,934 per day.

The Spanish flu killed an average of 1-2 million people per week in 1918-19. 25 million in 25 weeks. For every person killed, up to eight people were infected.

Extrapolating these figures to current US population levels, we can expect an average of 337,142 people to become infected every day. That is over three times the current hospital admission rate, and we can expect hospitals to still have patients for other diseases, accidents and for maternity care.

And this is an average rate. The peak rate could easily be three times higher than this.

CDC is basing their ideas for coping with a similar flu on hospitals providing quarantine services with spare capacity. The figures show that hospitals would be required to quadruple their capacity to cope with the average infection causes, without the additional burden of quarantining everyone close to an infected case.

And we all know that the hospital system does not have spare capacity today.

The CDC assumption of hospitals meeting the requirements of a pandemic is unrealistic at best.

[3] American Hospital Association. (2005). Fast Facts on U.S. Hospitals from AHA Hospital Statistics. Available [online]: http://www.hospitalconnect.com/aha/resource_center/fastfacts/fast_facts_US_hospitals.html. [5 December, 2005]

Assumption: The death rate can be handled

The United States currently experiences 8.25 deaths per 1000 people per year[4]. That is an average of 6,666 per day based on current population levels.

The Spanish flu killed 1-2 million per week – or 0.1% to 0.2% of the population. A similar outbreak today would equate to 42,142 per day based on the 0.1% mortality rate. These are additional deaths, as people would still be dying of other causes.

The United States is not set up to handle a death rate seven times higher than the current rate. The existing burial and crematorium facilities will be over loaded and we can expect mass graves to prevent the spread of disease.

The CDC has not released any information on their planning for dealing with the deceased to protect the rest of the population and to respect the beliefs of the dead.

[4] CIA. (2005). The World Fact Book. Available [online]: www.cia.gov.

Assumption: Low international infection rate

CDC has designed its response to a pandemic on the twin assumptions that (1) the source of the pandemic is foreign and (2) that the level of infection in other parts of the world is low.

If we follow the first assumption as given for the moment, the second assumption has some problems.

First, the incubation period for bird flu is 1-7 days, with 1-3 days being common[5]. People can have the disease for five days and be contagious for two days without knowing that they have contracted it. Modern air travel is sufficient to allow people to travel from any point of the planet to any other point of the planet in that time. Long-haul international flights around the globe, such as Hong Kong to London or Sydney to New York can carry an infected person to the other side of the world within the incubation period.

Second, CDC has implicitly assumed that people will be flying from the point of origin to the United States. They have cast their design on tracking 10-12 events at one time.

However, what happens if a pandemic becomes established overseas? The CDC response is to assume that all other countries are as vigilant as the CDC. However, if a disease arises anywhere in the world, international air travel can rapidly spread the disease everywhere else.

In 2004 there were 649 million international travellers[6], an average of approximately 2 million per day. It is reasonable to assume dozens of flights will have travelled around the world by the time the outbreak is recognised. CDC and their international equivalents will be able to isolate some travellers, but other travellers flying to less advanced countries will undoubtedly proceed to infect the local population.

The spread of the disease will lead to an exponentially increasing number of cases arising in flights. At some point, the number of traces required will overwhelm CDC's data collection and analysis capacity.

CDC has planned on a minor outbreak. However, a virulent outbreak that becomes established in the US population will require a different response.

[5] Ministry of Health. (2005). New Zealand Influenza Pandemic Action Plan. Available [online]: http://www.moh.govt.nz/moh.nsf/0/5F5694E4A5736DD2CC256C55000788A3/$File/influenzapandemicactionplan-v14-nhep-appendix3.pdf. [12 December 2005].
[6] ICAO. (2005). Annual review of Civil Aviation 2004. Available [online]: http://www.icao.org/cgi/goto_m.pl?icao/en/jr/jr.cfm. [11 December 2005].

Assumption: Foreign source

The CDC plan assumes that a pandemic will arise outside the United States. The ERG report notes that 95% of the world's population lives elsewhere and uses this rationale to dismiss the case for a domestically sourced pandemic.

However, there are a series of problems with this assumption.

First, a pandemic may be deliberately released. The publication of the Spanish flu genome in 2005 raised concern that the virus could be synthesised and released as a terrorist act.

Second, the testing of bird flu requires the use of a level 3 laboratory. It is possible that an accident could see the release of the bird flu, or another contagious disease, from a US based laboratory.

Third, a human targeted version of the bird flu can develop in the United States. The USA has a substantial bird population and it is possible that the virus will mutate to humans naturally within United States borders. The 2000 outbreak of rabbit fever in Martha's Vineyard is a reminder that disease can emerge in the USA as well as being imported from other countries.

Assumption: Virus can be contained at the borders

The CDC response to the bird flu threat is to contain the virus at the border and to isolate possible sources of infection before they can become established in the population.

If one assumes that the virus comes from a foreign source and does not originate in the United States, then the question is can the CDC response be effective? If a virus is airborne and can survive the trip from Asia to North America carried by wind, then CDC cannot protect the border.

However, if we assume that the outbreak requires close contact to spread, then the CDC faces the risk that the virus can arrive carried by non-human carriers. A bird flu carried by migratory birds would pass through the borders without checking in for passport or customs clearance. This is a wholly creditable scenario that has been raised by the World Health Organisation.

The CDC could find flocks of ducks or geese contaminating water supplies, passing on the virus to the local bird population and directly infecting the human population. The CDC cannot eradicate the entire bird population, and hence in this case, the CDC strategy of containing the virus at the borders must fail.

But, if we take the further proviso that the virus, once mutated, only affects humans and cannot be transmitted by animals – despite the World Heath Organisation concerns to the contrary – then CDC must be able to monitor all human entrance to the United States to be effective. The problem is that not everyone arrives by commercial airliner or ship. People arrive by land from Mexico and Canada by car, freight trains cross the border carrying crews, freight and private aircraft arrive with crew and passengers and ships arrive carrying crews.

Further, not everyone arrives in the US legally. The Mexican border is frequently penetrated by illegal immigrants seeking a better life. The sea between Cuba and the US is the scene of desperate people risking their lives to get out of Cuba. People smugglers bring people into the US as illegal workers.

Imagine the border situation if Mexico or Cuba became massively infected with bird flu. The border may be assaulted by hundreds of thousands of desperate people at once. Then what do the border guards do? Shoot them?

The CDC assumption of maintaining the border can only be effective if the disease is (1) not airborne, (2) cannot survive in animal carriers and (3) there is no internationally established pandemic. If any of these assumptions is invalid, the CDC has failed to keep the disease at the borders and their plan to protect the American people will have failed.

Assumption: No significant economic losses

The ERG report published by CDC states that there is no social cost from the planned quarantines of victims and the people they contact. The only costs identified are the social costs, put at around $6.9 million each person.

The CDC assumption is based on low levels of infection.

If we change the assumption above, and assume instead major infection around the world, then CDC will naturally pass the responsibility for maintaining the quarantine to Homeland Security. One possible response would be to close the United States border to incoming flights and ships.

The Spanish flu of 1918-19 required eighteen months to die out. If the United States closed its borders for eighteen months to prevent a similar disease entering the US, then there would certainly be a social cost from the lost trade and from lost access to resources, especially imported oil.

Further, important economic sectors have shifted production offshore in recent years. Much of the world's production of electronic components is now located in Taiwan and China. It is highly likely that the US would have to stop production of many domestically produced items for lack of small quantities of imported components. The redesign and retooling required to use only domestically available components would disrupt production for at least one year.

However, if the CDC failed to trace and quarantine every case of the disease that entered the country, then the economic cost of lost production from sick people would be enormous. The Spanish flu affected some 28% of Americans and 20% of people internationally, and left people so weakened that they could not carry out their work. If one assumed that 20% of workers were affected and unable to work for a period of one and a half months, then the lost production alone could cost the US around $294 billion. The Congressional Budgetary Office, using different assumptions, has calculated the lost cost of production in a serious pandemic at $690 billion[7].

Further, if one person in eight infected died from the disease, the US would also lose around 7.375 million people at a cost to society of $50.9 trillion (based on a $6.9 million value of statistical life).

Thus, there are real and major losses to the United States by failing to implement real protection for its citizens.

[7] Arnold, Robert, De Sa, Jeanne & Gronniger, Tim. (2005). A Potential Flu Epidemic: Possible Macroeconomic Effects and Policy Issues. Available [online]: http://www.cbo.gov/ftpdocs/69xx/doc6946/12-08-BirdFlu.pdf. [12 December 2005].

Assumption: No significant economic dislocation

However, the losses continue if the disease becomes established.

The CDC intends to track people through airport hubs and by domestic air travel.

What happens if a virulent disease becomes established in part of the United States? One response is for Homeland Security to seal off the affected state. The federal government has limited powers within each state, but can seal off one state to protect the others.

Once this situation became known, you could expect panic. Large numbers of people will try to flee the infected area in fear for their lives. Cell-phone organised mobs could storm the quarantine lines with little notice. And then what? Do you shoot citizens? If you don't shoot at a distance, then the troops enforcing a quarantine will also become infected.

And of course, many American states have borders that are almost impossible to enforce anyway.

Alternatively, imagine a city being quarantined. What happens when starving people start looting for food, as occurred in New Orleans? Do you intervene and expose security forces to disease? Do you shoot anyone who tries to leave? Do you send in supplies, and if so, how do you do that and prevent truck drivers or other personnel becoming infected?

What we can say is that in this scenario, local production and the economic structure would rapidly collapse. The significant lost production would lead to shortages in other parts of the economy, and the result is inevitably a degree of economic dislocation.

Assumption: The virus will die out

The real question is how quickly will a virus die out?

The 2003 SARS virus failed to gain a significant foothold in North America. The virus came under control and in some ways provided false hope that a virus outbreak can be contained.

The Spanish flu, on the other hand, affected 20% of all populations. The virus failed to sustain itself in its virulent form in the long-term and disappeared from the general human population.

Two major differences exist in human populations compared with 1918.

First, our population is much more concentrated now. In 1918 over half of the population of practically all countries lived in rural areas. The lower population density reduced the chance of physical contact and allowed infected households to be isolated from the rest of the population, while the infected people were largely self-sufficient for food and water supplies for the infectious period.

Today, the vast majority of people live in cities and towns. The urban population depends on water utilities and food retailing sites for essential supplies. These people need to go to central locations to collect supplies, and these places can become major sites for transmission of disease.

Further, the cramped nature of apartment living in many cities and widespread use of air conditioning systems result in people breathing reticulated air – air that could contain viruses. One infected person could infect an entire apartment building even while staying at home.

Second, our population is much more mobile than in 1918. The car has made travel commonplace for up to hundreds of miles. In 1918 people rarely travelled more than twenty miles from home. The increased mobility of the population vastly increases the ability of an infected person to spread a disease from one locality to another.

Further, our freight distribution system means vehicles travel across the United States every week. A single infected person can travel half-way across the US in the typical one- to three-day incubation period of the Spanish flu – before they even knew they had the disease.

The CDC's reliance on tracking air and sea travel fails to take account of the great mobility of people. A future outbreak similar to the Spanish flu could spread across the United States by land in five days. The high concentration of people in cities and towns leaves them more vulnerable to exposure.

It is reason to suggest that a future outbreak will infect more than the 20% exposed to the Spanish flu. The CDC assumption of rapid containment and that the virus will die out without affecting large numbers of people is difficult to substantiate.

Assumption: Sufficient stocks of medicine will be available

Some countries are currently stocking up on anti-bird flu treatments. The Congressional budgetary Office report[8] on the economic effects of a pandemic listed six countries actively stockpiling anti-flu treatments: Japan, the United Kingdom, France, Norway, the Netherlands and New Zealand. But not the US.

The problem is that global demand far exceeds global supply.

One common thread throughout many countries is that available medicines are being prioritised for government officials, security forces and medical personnel. The drugs required for the general population may be ordered, but are unlikely to be available by the time an epidemic emerges.

In the US there are sufficient stocks to treat four million people by February 2006. The recently announced proposal to increase anti-bird flu treatments would increase this capacity to 20 million people by 2009 and create a surge capability by 2010 to treat all Americans within six months of the start of the pandemic[9]. However, this plan still falls far short of the World Health Organisation recommendation of having treatments in stock for at least 25% of the US population[10].

[8] Ibid.
[9] Ibid.
[10] Ibid.

Assumption: medicine is effective

The medicines available to combat bird flu are of unknown effectiveness. Three drugs exist to combat bird flu - oseltamivir, zanamivir and amantadine. However, two of these have been used to treat chickens in Vietnam and China, and as a result drug-resistaant strains have develop in those countries.

Further, as both China and Vietnam have been traditionally secretive regarding the use of drugs in treating chickens, it is possible that a drug resistant strain can appear. China has recently announced that they have inoculated 6.85 billion birds in 2005, of which 5 billion birds were treated during October-December, and intend to inoculate their entire annual production of 14 billion fowls in the future[11]. The quality of China's inoculation programme may create the circumstances for a vaccine resistant strain of the virus to mutate, and thereby render stocks of vaccines ineffective.

Hence, we cannot assume that the medicines that are available will either work or will be completely effective.

[11] Agence France Presse. (2005). China confident of containing bird flu after 15 days without outbreak. Available [online]: http://news.yahoo.com/s/afp/20051214/hl_afp/healthfluchina_051214103232&printer=1;_ylt=Ar1FKxZX6pNmALxpZH9zX3qKOrgF;_ylu=X3oDMTA3MXN1bHE0BHNlYwN0bWE-. [15 December 2005].

Assumption: no civil unrest

There is a further implicit assumption that the population will calmly co-operate with CDC. People will accept quarantine, or CDC can enforce a quarantine by force.

However, this assumes that security forces can cope with the situation. The problem is that people can become desperate when they realise that they are in mortal danger of being infected. Recent riots in Paris, Sydney and Leeds have shown that cellphone organised mobs can overwhelm security forces with little warning. Add some desperation, and it is hard to see how security forces can retrain well organised civilians without resorting to deadly force – a case of using deadly force to save lives.

While CDC can probably maintain control in the early stages of an outbreak, once a substantial pandemic arises then one should expect that people will flee infected regions, with some unwittingly carrying the disease with them.

In these circumstances, CDC faces the prospect of either calling upon Homeland Security to impose martial law or losing control of the situation. Either way, there is a strong prospect that the government will lose control of the situation and large areas descend into chaos.

Assumptions: People only travel by air and sea

The CDC has focussed its attentions on passengers arriving at the international airports, at the major hubs through which they may transit to their destination and domestic air travel, and on travellers embarking on cruise ships and ferries.

However, people do not travel only by air or sea.

First, there are large numbers of people travelling by private car at any one time. The border between Canada and the United States is especially porous, with many people commuting across the border.

Second, long distance rail travel still exists and provides a method by which people can travel across the country within the incubation period of the bird flu without using domestic air travel.

Third, an established disease in the USA is likely to spread by freight operators from state to state, by commuters from the city to the suburbs, and within the city at essential distribution points such as supermarkets and at transport hubs.

The CDC's focus on air travel is based on the assumptions that a disease will be sourced from another country, that CDC will become aware of the outbreak quickly and that people arriving from overseas will stay in one place once they have reached the sea or air travel destination.

Assumptions: data provided to airlines is accurate

However, let's assume that the CDC is correct that the risk can be contained by tracking airline passengers and sea travellers. There is an inherent problem that CDC is assuming that the data collected by the airlines is accurate. In fact, many travellers do not declare information fully or provide false information.

The US restrictions on working in the US encourages people seeking employment without a green card to lie. The visa restrictions on people with a criminal record, even for a crime that does not exist in the United States or for a crime that has been expunged in their own country, encourages people to lie. By international law foreign diplomats arrive in the US without restriction.

And then there are people who are travelling with illegitimate documents. These people may work for foreign governments, organised crime or terrorist organisations. One could hardly expect these people to honestly record information useful for tracking a pandemic outbreak.

A natural CDC response to data problems would be to place responsibility for data corrections on the airlines. But the airlines do not have the statutory powers, resources, skills or incentives to carry out intelligence activities on travellers on behalf of the United States or any other government.

Hence, we can expect a degree of problems with the data collected by CDC. These problems can delay or prevent the tracking of people in response to an outbreak, thereby placing the whole CDC response at risk.

Assumption: CDC data transfer is risk free

CDC is assuming that the airlines will place data onto tape and that this tape will be made available to CDC as required. Theoretically, this arrangement sounds nice. However, what would happen in reality?

The airlines are located across the United States and foreign airlines are scattered across the world. When CDC requires an airline or shipping company to provide the data, it could easily require one day to transport the tape to CDC's centre.

Of course, CDC could establish a high-capacity network for transferring the data electronically, but there is no provision for either the costs of such a network or the protection of such a network from disaster or from interference by third parties. CDC may be assuming that it can access the Department of Defense communications network, but as has been shown in the past, these networks are likely to be overloaded in the time of crisis with Defense's own traffic.

So, assuming CDC is transferring data physically, the Federal Government is prepared to place the success or failure of its measure to protect the US economy and the American people on the safety of a single tape. What if an unlikely event occurred, such as a vehicle crash, that destroyed the data? In this case, CDC would need another copy (assuming that another copy exists, which is not a requirement of the CDC plan). The result would be another day lost in a time-critical situation and the possible loss of control of the situation.

CDC is gambling with the American future with its reliance on transferring data from the airlines and shipping firms to CDC.

Assumption: CDC can analyse data in a timely fashion

So, if we assume that CDC has managed to transfer data successfully, that the data still requires to be analysed.

CDC has scoped the requirement on 10-12 data requests.

But how realistic is that?

In the SARS case, six people in Singapore each inflected more than twenty people[12]. If one of these people was on a flight into the United States, then the person may have been infected less than one day before arriving in the US. But, with SARS the person is not contagious until after they develop symptoms, and a vigilant screening programme can detect the infected person before they infect other people.

In the case of bird flu, the person can be contagious 1-2 days before they even know that they have been infected. If that one person on the plane had been infected with bird flu one day prior to the flight, then that one person could infect twenty people on the plane. Five of those twenty newly infected people are likely to be going to five different destinations. Within another day six different cities could be infected with people becoming infectious, and still nobody knows they have the virus. At this point of time CDC would still not know that there is a problem.

Five days after infection, the first sick person develops a fever, cough, sore throat and/or muscle ache. A common problem with colds and flu's. If we assume that the person immediately recognises that they have bird flu, or is sufficiently concerned to seek medical advice, they may have still infected more people. Further, the twenty people infected on the flight are now starting to infect their local areas and are in turn spreading the disease. At this time we could already have twenty times twenty cases (i.e. four hundred), with the six flights traced consuming half of the tracing capacity planned by CDC.

Further, if a pandemic becomes established overseas, then the number of cases arriving may number in the dozens or hundreds. In this case, CDC may be required to trace every passenger arriving on every flight every day.

The result would be information overload. CDC would not have the staff, computing power or capability of handling the situation. They would quickly fall behind and fail.

One example of CDC in action was the Martha's Vineyard rabbit fever outbreak in 2000. CDC used 26 staff to track a disease that killed one person. Based on the same pattern of response, in the event of a pandemic like the Spanish flu becoming established in the US, CDC could require over eight million staff to track the number of outbreaks – assuming that they could clear each outbreak in a week. This level of resource is beyond the scope of CDC.

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[12] Lipsitch *et al.* (2003). Transmission Dynamics and Control of Severe Acute Respiratory Syndrome. *Science. 3000*(5627), 1966-1970.

Of course, CDC could avoid the analytical problem and just treat anyone with flu systems or a cold as a potential carrier. But in this case, CDC is immediately facing hundreds of thousands of leads from the beginning of the pandemic, and the hospital system would be immediately overwhelmed.

The Likely Outcome

The situation facing CDC is a difficult one. So long as a pandemic is contained and there are low levels of infection internationally, then the CDC plan has some chance of success. However, rising levels of infection would expose the gaps in the CDC tracking coverage, and eventually the disease would become established in the US.

Further, a pandemic is not a problem just for the United States. Most other countries lack the CDC's capability of tracking small volumes of cases. It is likely that a pandemic would become established in other regions of the world and become a rising threat to the US border. Eventually a pandemic on the Spanish flu scale would overwhelm CDC with information overload and CDC would fail.

The US Government would then be faced with a terrible choice:

(1) Quarantine infected areas from other areas of the United States and all goods passing between areas would need to be sanitised. Eventually this policy would probably lead to a modern version of the European medieval policy of walling inhabitants inside cities until the plague passed.
(2) Stopping all trade and communications, resulting in economic costs and possible economic collapse.
(3) Letting the pandemic run its course, and treat people as possible with available medicines while accepting large numbers of casualties.

So, why has CDC not planned better? The problem is that there are large numbers of specialists involved in examining this problem. Each of these specialists would understand their field to a greater extent than the lay person. But there is no-one with an overall system-wide perspective guiding the whole process. Even the CDC is focussing on its job of tracking and ignoring the related problems of quarantine stations, medical treatment and data collection.

History shows that eventually a pandemic will arise. We still have time to plan for the inevitable. We need to develop the capability of restricting a pandemic globally rather than for each country to wait for the pandemic to arrive on its shores. The alternative is disaster.

And faced with a disaster, it is possible that governments may choose the cheapest option, not the one best for the people. It is time to take action to ensure that an effective pandemic strategy is put into place before it is required.

Part 3

An Alternative

Introduction

The CDC is planning to introduce a tracing capability to trace people's air travel and sea movements as part of their response to a pandemic from the bird flu or other disease.

This document first examines the CDC's stated mission statement and values to determine their applicability to the situation. The organisation is analysed to illustrate some weaknesses that would affect CDC's ability to respond to a real pandemic, and their planned response is checked to highlight any gaps that may exist.

A Public Private Partnership (PPP) is then defined and proposed as a method by which CDC can use a complementary organisation to overcome the weaknesses inherent in CDC and take advantage of strengths to provide a more flexible and nimble response capability. A Porter's analysis is conducted on the US and a conclusion is drawn that a suitable PPP is more likely to be found in a small, isolated foreign economy with skills in data integration and in operating sophisticated information systems with limited or no personnel in times of infrastructure failure.

This analysis provides CDC with a perspective not yet recognised in the debate on pandemic management. CDC with the right PPP could provide a response to a pandemic that could not only detect incoming threat, but enable management of a pandemic after it became established to allow CDC to focus on minimising risk to life and fulfilling its goal of providing an optimal lifespan for Americans.

The CDC Mission

The organisation's role is explicitly listed in its name: Disease Control and Prevention.

CDC has translated this role into two goals:

- "All people, and especially those at greatest risk for health disparities, will achieve their optimal lifespan with the best possible quality of health in every stage of life.
- People in all communities will be protected from infectious, occupational, environmental, and terrorist threats."[1]

These goals are interesting in that they link two phrases that are important in the case of a pandemic. CDC looks to achieve *optimal* lifespan and to *protect* against infection.

A dictionary[2] gives the word 'optimal' the definition of 'Most favourable or desirable'. However, there is an unanswered question regarding who defines the optimal lifespan for an individual? Will CDC seek the optimal lifespan for each individual or will it sacrifice some individuals to maintain the optimal lifespan for the average population?

This issue is not relevant in normal conditions, as there is no real need to make such decisions. However, in a pandemic, this definition can become all important for the future of many people and communities.

Assuming that CDC carries out its duties based on this mission, the interpretation of the mission at the time may lead to different results than otherwise expected.

[1] CDC. (2005). CDC Protecting Health for Life: The State of the CDC, fiscal year 2004. Available [online]: http://www.cdc.gov/cdc.pdf. [7 December 2005].
[2] American Heritage Dictionary. (2000). *The American Heritage Dictionary of the English Language, Fourth Edition.* Houghton Mifflin Company.

CDC Values

CDC defines three core values for itself:

> "ACCOUNTABILITY — As diligent stewards of public trust and public funds, we act decisively and compassionately in service to the people's health. We ensure that our research and our services are based on sound science and meet real public needs to achieve our public health goals.
>
> RESPECT — We respect and understand our interdependence with all people both inside the agency and throughout the world, treating them and their contributions with dignity and valuing individual and cultural diversity. We are committed to achieving a diverse workforce at all levels of the organization.
>
> INTEGRITY — We are honest and ethical in all we do. We will do what we say. We prize scientific integrity and professional excellence."[3]

Accountability, respect and integrity are all commendable traits in any organisation. Further light is shown on CDC's interpretation of these values by their own description.

First, accountability. There are two aspects to this value: (1) stewardship and (2) research and services. Stewardship is the holding of resources and acting in the best interests of a third party. CDC's intention to act decisively and compassionately is commendable, but in practice, difficult to reconcile with stewardship. The basic problem is a steward facing a complex and uncertain situation would be obliged to seek further information to access the degree of risk rather than acting decisively with the strong likelihood of wasting resources. Hence, there is a degree of contradiction in CDC's statement here.

The second component of accountability is the linking of research with good science and services with real public needs. These linkages are again commendable, but good science and the identification of real public needs again require significant amount of time. The implicit assumption of CDC appears to be that they can forecast requirements in good time and carry out such research and provide such services as required. Such apparent foreknowledge would astonish the scientific community.

Further, it is interesting to note what is missing in the CDC definition of accountability. One definition of accountability is 'Liable to being called to account, answerable'[4]. However, CDC does not include any accounting for the results of its stewardship in its definition. There is no performance measure upon which CDC can be called to account.

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[3] CDC. (2005). CDC Protecting Health for Life: The State of the CDC, fiscal year 2004. Available [online]: http://www.cdc.gov/cdc.pdf. [7 December 2005].

[4] American Heritage Dictionary. (2000). *The American Heritage Dictionary of the English Language, Fourth Edition.* Houghton Mifflin Company.

The second value is respect. Respect for people's contributions and diversity, and for staff. Respect is a worthy attribute in any organisation, but particularly difficult for an agency to achieve when it has a power advantage over others.

What is missing is a sense of equality of contributions towards a common cause. CDC may respect the assistance of others, but is there a sense of true partnership with other capable public and private organisations around the world. The proposed tracing system for tracking people on air and sea travel is being forced onto the airlines without a sense of joint participation of equals working towards a common goal.

Of course, critics would suggest that it is the responsibility of government to act on behalf of others and to provide leadership. That interpretation is completely valid, but it does lead to the definition of the respect of CDC to others being the respect of a lord to one's subjects rather than respect of peers. The danger is that this type of respect between unequals can lead CDC to miss or misinterpret or ignore inputs from others when opportunities exist to improve the situation through alternative thinking or by radical means.

CDC's third value is integrity. Integrity is a noble virtue. A dictionary definition[5] gives integrity the meaning of : 'Steadfast adherence to a strict moral or ethical code'. A strong ethical position would certainly be needed by CDC to avoid potential unethical sacrifices in the name of convenience in the case of a pandemic. The only question that arises is which moral or ethical code is CDC going to adhere to? And what happens in the case of a conflict between moral and ethical situations? This is a difficult question, and we wish any CDC official faced with this dilemma our best wishes for acting in the ethical and moral way to maintain the integrity of the organisation.

However, there is a second meaning of the word integrity in the same dictionary: "The quality or condition of being whole or undivided; completeness". In this interpretation CDC would put its continuance as a complete and whole organisation as one of its basic values, and presumably be prepared to use resources to this end. We would trust that this is not the interpretation intended by CDC.

Thus, the three CDC values are all noble-sounding on the surface, but issues can be raised with each in turn. Deeply embedded values are empowering ideas for an organisation and we hope that CDC takes the positive from each of its values while limiting the impact of the negative aspect of each value.

Still, it is just a little disappointing that ORGANISATIONAL PERFORMANCE[6] or some similar performance–orientated concept is not one of these values.

[5] Ibid.
[6] Collins, James C. & Porras, Jerry I. (1994). *Built to Last*. USA: HarperBusiness.

CDC Strategic Transformation

In all fairness, CDC is an organisation that is transforming itself to meet the challenges of the future. This transformation is commendable on all levels. The following table[7] illustrates CDC's transformation strategy.

TRANSITIONING FROM:	TRANSITIONING TO:
Disease orientation	Health protection focus
Designing and implementing sponsored programs	Informing and guiding health system actors
Allocating agency resources	Leveraging resources to steer larger health system investments
Emphasis on clinical prevention	Focus on continuum of prevention and health protection actions
Transaction-based relationships	Partnerships and strategic alliances
Program requirements	Incentives for participation/cooperation
Interacting with health care and public health providers	Engaging the full array of health system actors, including communities and the private sector
Collecting and analyzing health data	Creating integrated health information systems
Issuing advisories and guidelines	Building decision-support systems

The strategic transformation list also provides a set of measures to evaluate CDC's planned action to handle a future pandemic.

[7] CDC. (2005). CDC Protecting Health for Life: The State of the CDC, fiscal year 2004. Available [online]: http://www.cdc.gov/cdc.pdf. [7 December 2005].

CDC – The Organisation

CDC is a component of the US Government's Department of Health and Human Services. As such, CDC has a common element with all government agencies: (1) it is annually funded, which drives year-based strategising rounds; (2) it is subject to political oversight, with a consequential requirement to fulfil politically mandated objections rather than being directly responsive to end-consumer wishes; and (3) has capacity to mandate the cooperation or transfer of resources from third parties rather than being required to access requisite resources on an exchange basis.

These realities influence how CDC will implement the positions in its transformation strategy. It is worth acknowledging that these factors provide the CDC with both strengths and weaknesses when dealing with a pandemic.

First, CDC has demonstrated a remarkable capability in tracking back sources of infection to a ground-zero event. There are few other organisations that have such a competency, and CDC can both be proud to have achieved such results in the past and should be expectant that such a competency can be used to leverage results in the future.

However, this very competency exposes CDC to two weaknesses: (1) an overly optimistic expectation of dealing with future outbreaks; and (2) an underestimation of the complexities of a pandemic.

CDC's successful response to the Martha's Vineyard rabbit fever infection in 2000 was the result of some good luck, as the infection was detected by local medical professionals at an earlier stage than would be the normal case in a pandemic. A later detection of a virulent disease would lead to a greater number of cases and a more complex problem in tracing all people potentially linked with the disease.

Further, CDC used a substantial number of people to trace the Martha's Vineyard outbreak. A pandemic involving thousands of people arriving from overseas or from a domestic outbreak would require much greater resources. The proposed CDC tracing system is a step in the direction of coping with this reality, but the level of complexity would almost certainly rapidly overwhelm CDC's organisational and computational capabilities. CDC would be overwhelmed by the number of cases and amount of information required to track all infected cases back to their source, and the whole pandemic plan would thus unravel.

This situation would be compounded by CDC's basic realities. First, an annual planning cycle conditions an organisation to a slow pace of change. A rapidly developing situation could easily overwhelm CDC's decision-making processes, and result in a situation getting out of control.

Second, political oversight would likely hesitate when action is required and would be loath to put emergency measures in place due to a concern of the political costs. CDC would be required to liaise with other agencies to place measures in effect and the leadership of these agencies are likely to take some time to become fully conversant and committed with the issues surrounding a pandemic.

Third, CDC has an expectation that it can coerce resources and information from the private sector as required. However, in the case of a genuine emergency, these organisations may be unable or unwilling to respond to CDC above managing their other duties and interests. The lack of true partnerships with aligned goals can place the pandemic plan at risk.

On the other hand, CDC's position in government does mean that once government can decide on a course of action, it has the legal and physical power to seize assets and act decisively. The only problem is that, like Hurricane Katrina, action may be too late to prevent the disaster.

Hence, CDC is a product of its environment. By recognising its strengths and weaknesses, CDC can partner with organisations that have complementary capabilities to enable a more successful response to the threat posed by a pandemic.

The CDC Response to a Pandemic

The CDC reported its plans for a pandemic as:

> "To prepare for pandemic flu, in FY04 CDC worked with sister agencies in HHS to develop a national pandemic preparedness plan for America. The plan provides guidance to national, state, and local policy makers and health departments for public health preparation and response in the event of pandemic influenza outbreak. We also:
>
> - Stockpiled influenza antiviral drugs in the Strategic National Stockpile.
> - Enhanced U.S. and global disease detection and surveillance infrastructures to enable earlier detection of a developing pandemic.
> - Expanded our portfolio of influenza related research.
> - Supported public health planning and laboratory capacity.
> - Worked with NIH and WHO on safety testing vaccine seed candidates and developing new vaccine seed candidates, a critical first step for influenza vaccine development."[8]

On the surface, this plan is commendable.

However, if one considers each of these issues, then the weaknesses become clear.

First, CDC has stockpiled drugs that have uncertain effectiveness, as their efficacy may be undermined by the inoculation of large numbers of birds in China and Vietnam. There is a reasonable possibility that a drug-resistant strain may emerge in the near future.

Further, there is a world-wide shortage of suitable drugs. The existing US stockpile of 4 million inoculations is inadequate to protect the American people. It is highly likely that large areas of the US and whole segments of society may be infected in the event of an outbreak.

Second, the enhanced US and global disease surveillance has been watching the H5N1 virus strain spread across Asia and Europe, but has been unable to prevent the disease from gaining a stronger hold over bird populations. The risks from infection remain present and the first reported cases of human to human transmission have been reported in Indonesia. The global monitoring capability is simply insufficient to track the progress of a serious outbreak, as is implicitly admitted by CDC in suggesting the need for a tracing system for airlines and sea travel.

Third, research will take years to provide long-term solutions to the pandemic threat. It is essential that CDC continues to devote energy into a long-term solution, but the short-term situation must also be managed.

[8] CDC. (2005). CDC Protecting Health for Life: The State of the CDC, fiscal year 2004. Available [online]: http://www.cdc.gov/cdc.pdf. [7 December 2005].

Fourth, supporting public health planning and laboratory capacity is commendable, but there is no direct link to the requirements of a pandemic scenario on the scale of the Spanish flu outbreak.

Fifth and last, the support of the NIH and WHO (World Health Organisation) are commendable and essential to the long-term management of the situation both in the US and around the world.

Thus, the CDC plan provides the basis for long-term solution to the problem, but there is a limited response to the short-term threat. While it is possible that the pandemic threat may not materialise in the time required to research and develop long-term solutions, the risk remains and the consequences of an outbreak are so severe that one would expect a stronger focus on this problem.

Public Private Partnerships

One alternative response that can overcome CDC's weaknesses and allowing CDC to exploit its strengths is to develop a true partnership with a complementary organisation tailored to focus on minimising the risk and impact of a pandemic.

Public Private Partnerships (PPP) have a long tradition in the United States with its emphasis on allowing private enterprise manage significant parts of the economy that in other countries were historically usurped by the government. The traditional reluctance of the US government to infringe on the private sector has been vindicated in recent years with the victory of market economies over command and control alternatives.

However, what is it about PPPs that make them an attractive option?

First, private sector companies are separate from the government. This separation of operations from government enables the government to enforce effective regulations as required to ensure good public outcomes and to dictate necessary activities by contract. These two restraints of regulation and contract simply do not work when the body being enforced is another arm of government, as inevitably political leadership confuses their roles of shareholder and regulator, and service provider and customer, resulting in effective control of the organisation and significant underperformance in the anticipated role. PPPs allow a formal separation of roles and the focus of each organisation on its objectives within the overall objective of minimising the risk and impact of a pandemic.

Second, private sector companies operate with a different understanding of time from government agencies. Government agencies are trained to react to annual budgetary cycles and government oversight committee hearings. The organisation inevitably develops a slow mode of decision-making tuned to their environment and effective at making complex decisions within parameters that change slowly.

The private sector organisations, on the other hand, are a mixed bunch. They range from listed companies reacting to quarterly reports to the share market, to private or closely-held companies responding to the directions of a small number of people to non-profit organisations directed by large numbers of members. These organisational types exist in different time realities. The most nimble companies are those with close shareholder/management alignment and closely held ownership, with owners making an active contribution to the organisation's direction and operational effectiveness.

Third, different organisational forms are more or less capable at adapting to changing situations. The classical hierarchy is based upon well-defined missions and role clarity, enabling an organisation to be designed and fine-tuned for a particular set of circumstances. A hierarchy is effective at managing standard situations, but typically poor at recognising, adapting to and overcoming unforeseen circumstances. CDC and all government agencies are examples of classical hierarchies.

The opposite organisation form is the network organisation, where large numbers of specialised groups operate within the structure of an empowering vision, infrastructure and shared knowledge. This type of organisation is the most effective form at responding rapidly to the unknown, drawing in technologies and skills as required.

Fourth, CDC has limited access and knowledge of technology. CDC does carry out world-level research in the specific areas mandated by government, but is not an expert and does not have direct access to the level of technology required to cope with the organisational pressures of responding to a pandemic. Those skills can be provided by the right public-private partner, selected for their technical and organisational competence in the required area.

The threatening pandemic is likely to require rapid decision-making and adaptation to the situation. The private sector can bring knowledge, adaptability, nimbleness and technology to partner with CDC's knowledge of disease control, access to resources and regulatory capabilities. Such a partnership can be made effective through relevant contracts and regulations to ensure that the public policy objective is achieved.

The ideal type of partner for CDC would be one who brings all of the strengths identified: A closely-held private company structured in a network form, with relevant technology and knowledge to enable CDC to effectively trace an emerging pandemic. Such an organisation may be difficult to work with, as it would have a very different culture from CDC, but would make the ideal partner for handling the current threat.

The PPP Source

So, a PPP with the right organisation could allow CDC to respond more rapidly and more effectively to a fluid and unpredictable situation. The ideal type of organisation has been described. But where does such an organisation exist?

The larger United States technology firms tend to be publicly listed and less than nimble-footed. Intel's two-year response to the threat of the AMD Athlon 64 processor is a classical example of an organisation hailed as one of the US's top technology organisations failing to rapidly respond to changes in conditions.

A leading academic from Harvard University, Michael Porter, developed a method for examining the strengths and weaknesses of different economies[9]. He described a nation's competitive position in terms of factors conditions, demand conditions, supporting industries and firm strategy.

Factor conditions include: the quantity, quality and cost of people; the quantity, quality and cost of physical resources such as land, minerals, fish and timber; the science, technical and market knowledge; the customisation and liquidity of capital resources; and type, quality and cost of infrastructure. The United States has large numbers of well-educated people, substantial resources at moderate cost, the science skills and extensive cost-effective infrastructure. The country has large tracts of land and modest population density, with excellent transport links with the rest of the planet.

However, factor disadvantage often leads industries in resource-poor countries to develop knowledge and technologies to overcome the factor disadvantages, while factor plentiful industries tend to consume more of these factors than their foreign equivalents. One example of a factor disadvantage derived from a lack of land is Japan's dense population, which led to the development of miniaturised technologies and thereby a competitive advantage in many industries. The United States, by comparison with many other countries, is poorly structured to operate in an environment where staff and equipment are in short supply, as its industries are inherently based upon plentiful staff and capital resources.

Further, the United States transport links with both Asia and Europe and its land borders both to the north and south exposes the country to a reasonable risk of contamination from a pandemic, which could paralyse the necessary response capability through loss of key people at important parts of US infrastructure. One advantageous factor condition for handling a pandemic is physical isolation, thereby reducing the likelihood or increasing the warning time prior to spread of the pandemic. The United States is particularly exposed to migratory birds breaching the borders while carrying disease, thereby exposing even remote parts of the US, such as Alaska, to a pandemic.

[9] Porter, Michael E. (1990). *The Competitive Advantage of Nations.* New York: The Free Press.

Demand conditions are made up of: segment structure of demand, where some skills are applicable globally while others are applicable only to local conditions; the sophistication of consumers in the local economy; and the demand size locally and internationally. The US economy produces a range of technologies primarily to fit the local market, and these technologies form the basis of products sold around the world. The country has a moderately educated population with an active media that enables adoption of new technologies. However, the scale of the United States often precludes the use of technologies in the integrated fashion achievable in many advanced smaller countries, and the tendency towards specialisation in the US enabled by the large scale of government and commerce has resulted in a lower use of advanced technology than is achieved in smaller scale economies.

Supporting industries are those industries with advantages that can be used to improve the capability in the local economy. The United States has extensive research, communications and computing industries available to meet the pandemic response. However, while impressive, the communications and computing capabilities are no different from any other advanced economy, while the research facilities are only of value in solving the pandemic threat in the long term and not for managing a short-term outbreak.

Further, the CDC is relying on the airline and shipping firms acting as supporting industries in the case of a pandemic. These industries are poorly structured to act in the case of a pandemic crisis, with both industries losing staff, capabilities and institutional knowledge as a pandemic becomes established. The necessary controls on people movements will deprive both industries of personnel when they are required to meet extensive and unprecedented demands.

Finally, the CDC strategy is predicated on the government's duty to provide for the public welfare. The lack of alternative strategies from other parties does expose the United States to the risks associated with a less robust analysis than could be achieved with input from competing sources. The CDC's monopoly in this field suggests a disadvantage could be derived from a limited strategic capacity.

Taking these four elements together, and applying them to the pandemic scenario, the United States does have some disadvantages. Its plentiful human resource, physical resources and extensive infrastructure place it in a position where it is less likely to cope with personnel or material shortages, or to cope with infrastructure failure as a result of a pandemic. The US economy is poorly positioned to provide the required technology and resources compared with many smaller countries. The reliance on supporting industries may further exacerbate a difficult situation, turning it into chaos. The CDC strategy, however, assumes a single scenario event and the CDC's limited strategic capability could expose the US to a disaster if an alternative scenario emerges.

The CDC's and US' weaknesses can be managed by partnering with a PPP partner who can overcome these weaknesses and is based upon different conditions. By the very nature of the requirements, this partner would need to be located in a foreign, advanced and small economy, where large amounts of data integration are well established. The appropriate partner needs expertise and technology in operating systems with few or no personnel, and the systems need to be able to operate in conditions where there are no supporting resources and to provide effective information services for regions with total infrastructure failure.

Such a PPP partner would be a private sector organisation with strong strategic capability and with inherent flexibility in responding to any requirements with new technology and services. Further, the PPP partner should be based in a geographically remote and low risk area where there is reduced chance of pandemic infection. Such a PPP partner would be hard to find, but does exist.

Summary

First, CDC's stated goals and values have been examined to surface the assumptions inherent in the organisation. The stated goals and values are lofty and noble in purpose, but are worryingly limited in failing to include high levels of organisational performance.

Second, the organisation by its nature as a government entity has a perspective of time that could drive the organisation to react too slowly to an evolving pandemic scenario. The political oversight and reliance on using resources from other locations both expose CDC to enhanced risk of failure.

Third, the CDC response plan to a pandemic relies on tracing incoming infected people from overseas and quarantining these people along with all people contacted. There is no reason to expect that this strategy will be successful if a pandemic becomes established in foreign countries. The stockpiling of drugs is likely to be inadequate both in quantity and efficacy to provide protection to the general population.

Fourth, CDC can strengthen its response by forming a partnership with a carefully selected private sector company. The ideal partner would complement CDC by bringing technology, knowledge and rapid response capability into the CDC plan. The nature of the US economy ensures that such a partner would most likely be found in a small, advanced and remote economy with high levels of experience and skills in integrating disparate systems, providing technology which requires little or no human management and the ability to operate in an area where the infrastructure no longer operates.

To conclude, like all organisations, CDC has strengths and weaknesses. By actively acknowledging these realities, CDC can partner with a complementary partner to substantially improve the United States' ability to respond to and control a pandemic.

Such a partnership is an alternative to CDC's current plans, and can be created to improve CDC's capacity to fulfil its mission to protect the American people from disease.

Part 4

A Fix to the Pandemic Problem

Introduction

The modern world has been hit by three pandemics over the past century. The most virulent of these strains was the Spanish Flu pandemic of 1918, that killed some 25-50 million people including 0.5 million Americans, and affected some 20% of the population (28% in the US), leaving them too weak to immediately cope with the demands of the situation.

Two relatively mild pandemics arose in 1957 and 1968, with a less virulent form of the disease. A third potential pandemic, SARS, was successfully contained in 2003 after a relatively small number of deaths mainly in Asia thanks to a combination of exceptionally well-organised medical services, the restricted area of the outbreak and the successful application of international resources.

However, the limited effect of these later three pandemics has been due as much to the low potency of the virus as the countermeasures from public agencies. A virus such as the Spanish flu still has the potential to wreak havoc on the same scale as 1918-1919. The spread of the H5N1 strain of bird flu has raised fears that such a virus may be about to migrate from birds and become established in humans.

The CDC, as the US Government agency involved, has drawn up a plan to track people in case of an outbreak. They have relied upon a pandemic outbreak starting offshore and being able to trace people through air and sea travel. This plan has a number of flaws, in that it assumes that a virus must be imported by air or sea, that it will not arise in the US naturally either by transmission from animals such as migratory birds or by direct means, that other countries will be successful in tracking cases within their borders and that quarantine will be effective in restricting the spread of a virus.

The effectiveness of the CDC's fix to pandemic problem will be examined through three scenarios representing (1) CDC's scenario of low infection levels internationally through rapid identification and effective responses, (2) where delays in identifying and reporting the pandemic results in less effective responses in some foreign countries and (3) where the US border control is ineffective. A further scenario based on the Congressional Budgetary Office analysis is included for comparison.

CDC's own scenarios are scenarios of responses for budgetary purposes, not scenarios of situations for risk management purposes. The scenarios surface different results from the introduction of elements that are reasonable based on available data. Hence, they are a useful method of exploring the problem.

Scenarios

Scenario One

The bird flu virus has spread from birds into a human host and has mutated to enable transmission from human to human in the same fashion as the Spanish flu virus. This mutation has been shown to require a relatively minor genetic change in the virus DNA. Past mutations have been assisted by the infected human having both the bird flu and an ordinary flu virus at the same time, allowing the two virus strains to exchange some genetic material.

The bird flu has an incubation period of some 1-7 days. Adults can become contagious 1-2 days before they develop any symptoms[1], during which time the person may not be aware of any abnormal effects. Further, if the person is already suffering from an ordinary flu virus, then the symptoms of a fever, cough, sore throat, conjunctivitis and muscle aches may be dismissed as effects of the ordinary flu virus or a cold.

The virus would spread to relatives and contacts quickly, transmitted by food and water prepared by the infected person, and on clothing and equipment touched by him or her. Family members, food distribution centres such as shops, public transport facilities such as buses and trains and schools would provide natural paths for transmission. Based on information from the SARS outbreak, it is reasonable to assume that each person could infect a further 26 people.

One person in eight infected would then die from the disease. The chronic weaknesses and then subsequent deaths of the first victims would be the first warnings to the health system that the pandemic has arisen in the human population. If the first victims are near a city, the hospitals could see their first cases within a week. The quality of the diagnosis will vary, and it is likely that the medical staff will fail to realise the severity of the situation until several people with the same symptoms arrive in the same hospital. The first death may well be attributed to other factors, such as age, or other complications arising from the pandemic, such as pneumonia. By this time, a week could have passed since the first infection and 676 could be infected.

The hospital closest to the outbreak records the first deaths and recognises the severity of the situation. The World Health Organisation (WHO) is advised of the outbreak and agencies from around the world would then undoubtedly send teams to the outbreak location to assist in containment and learn more about the disease itself to enable long-term counter-measures. The two or three day delay in reacting to the outbreak results gives the virus the opportunity to infect another round of victims, with a total of 17,576 being infected. The Government agency responsible places quarantine measures into place immediately and the infection rate is contained to a further 17,500 people over the next few weeks (based on the Singapore experience).

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[1] Ministry of Health. (2005). New Zealand Influenza Pandemic Action Plan. Available [online]: http://www.moh.govt.nz/moh.nsf/0/5F5694E4A5736DD2CC256C55000788A3/$File/influenzapandemicactionplan-v14-nhep-appendix3.pdf. [12 December 2005].

However, not all of the infected people will still be in their country of infection. ICAO (International Civil Aviation Organization) reported 649 million passengers flew internationally in 2004[2]. Allowing for a global population of 6,446,131,400 as of July 2005[3] and assuming an average mobility rate for those affected, then at least three infected people can be expected to have caught an international flight during the last three-day period. These people could each infect another twenty-six people whilst en route to their destination (assuming the average infection rate rather than an accelerated infection rate taking into account the shared air and cramped conditions of an aircraft). The US is the destination of 17.7% of international travel, with 134 million[4] out of 649 million global international passengers in 2004[5], and thus it is reasonable to expect that one plane en route to the US in this three-day period will carry an infected person. Further, of the twenty-seven infected people arriving in the US, 12% or 3-4 people will immediately transit onwards to another destination by domestic air travel (based on ERG data), while a further 32 people from the same flight who are uninfected by the pandemic would also travel to other destinations. Therefore, a total of five flights could carry infected people and a total of 36 flights might need to be traced.

Meanwhile, CDC will have put their plan into action. All passengers arriving in the United States from the infected area are traced. The airlines provide requested data within 2 days and CDC systems trace the incoming passengers through hubs and to the locations visited. If one assumes an outbreak in East Asia, an average of 64,208 people crossing the Pacific to the USA each day[6] and if one assumes an average plane size of 301 passengers, based on a Boeing 777-200LR[7] and an average 74 per cent load factor[8], then one could expect 289 planes to arrive in US airports from the Pacific each day.

The CDC has scoped their system for 10-12 requests to the airlines for tracking data. The total of one international and thirty-six domestic flights tracked to identify the first case, subsequent infections and contacted people identified in the US is four times the CDC's expectations. The CDC probably could handle this workload with difficulty.

If one assumes that this event happens twice, based on the total number of people infected in the source country, and the CDC is able to trace all people infected en route to the US before they have completed the 1-7 day incubation period and become

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[2] ICAO. (2005). Annual review of Civil Aviation 2004. Available [online]: http://www.icao.org/cgi/goto_m.pl?icao/en/jr/jr.cfm. [11 December 2005].
[3] CIA. (2005). CIA Factbook 2005. Available [online]: ww.cia.org.
[4] FAA. (2005). US and Foreign Flag carriers: Total Passenger Traffic to/from the United States. Available [online]: http://www.faa.gov/data_statistics/aviation/aerospace_forecasts/2005-2016/media/Table7.PDF. [12 December 2005].
[5] ICAO. (2005). Annual review of Civil Aviation 2004. Available [online]: http://www.icao.org/cgi/goto_m.pl?icao/en/jr/jr.cfm. [11 December 2005].
[6] FAA. (2005). US and Foreign Flag carriers: Total Passenger Traffic to/from the United States. Available [online]: http://www.faa.gov/data_statistics/aviation/aerospace_forecasts/2005-2016/media/Table7.PDF. [12 December 2005].
[7] Boeing. (2005). 777-200LR/-300ER. Available [online]: http://www.boeing.com/assocproducts/aircompat/acaps/777rsec2.pdf. [9 December 2005].
[8] ICAO. (2005). Annual review of Civil Aviation 2004. Available [online]: http://www.icao.org/cgi/goto_m.pl?icao/en/jr/jr.cfm. [11 December 2005].

infectious, and that CDC's quarantine measures are as effective as Singapore with a further person infected for each person already infected, then the number of outbreaks in US would be limited to 108, of which 13-27 would probably result in death. This estimate is similar to ERG's estimate of 37 deaths[9].

This scenario would see the CDC managing the pandemic with minimal loss of life. It is based on the assumptions that the pandemic is identified early, that the relevant government announces the situation immediately and that quarantine measures are successful.

[9] Eastern Research Group. (2005). Regulatory Impact Analysis of Proposed 42 CFR Part 70 and 42 CFR Part 71. Available [online]: http://www.cdc.gov/ncidod/dq/nprm/docs/draft_ria_final.pdf [5 December 2005].

Scenario Two: Delayed Reaction by Hospitals and Governments

Scenario two examines these three assumptions of scenario one and introduces time delays in hospital recognition and government announcements. The quarantine measures are still assumed to be effective.

The bird flu virus has spread from birds into a human host and has mutated to enable transmission from human to human in the same fashion as the Spanish flu virus. This mutation has been shown to require a relatively minor genetic change in the virus DNA. Past mutations have been assisted by the infected human having both the bird flu and an ordinary flu virus at the same time, allowing the two virus strains to exchange some genetic material.

The bird flu has an incubation period of some 1-7days. Adults can become contagious 1-2 days before they develop any symptoms[10], during which time the person may not be aware of any abnormal effects. Further, if the person is already suffering from an ordinary flu virus, then the symptoms of a fever, cough, sore throat, conjunctivitis and muscle aches may be dismissed as effects of the ordinary flu virus or a cold.

The virus would spread to relatives and contacts quickly, transmitted by food and water prepared by the infected person, and on clothing and equipment touched by him or her. Family members, food distribution centres such as shops, public transport facilities such as buses and trains and schools would provide natural paths for transmission. Based on information from the SARS outbreak, it is reasonable to assume that each person could infect a further 26 people.

One person in eight infected would then die from the disease. The chronic weaknesses and then subsequent deaths of the first victims would be the first warnings to the health system that the pandemic has arisen in the human population. If the first victims are near a city, the hospitals could see their first cases within a week. The quality of the diagnosis will vary, and it is likely that the medical staff will fail to realise the severity of the situation until several people with the same symptoms arrive in the same hospital. The first death may well be attributed to other factors, such as age, or other complications arising from the pandemic, such as pneumonia. By this time, a week could have passed since the first infection and 676 could be infected. The disease is still confined to its original country.

The hospitals would not process their data into national health registries until the cases are fully processed. In some countries where the hospital system is operated by private institutions, the notification of disease may be delayed by the billing cycle of the hospital. In other countries, fragmentation within a public health service may delay recognition of a trend emerging from a number of different hospitals. These delays could cost a week and the infection level could have risen to 457,000 people.

[10] Ministry of Health. (2005). New Zealand Influenza Pandemic Action Plan. Available [online]: http://www.moh.govt.nz/moh.nsf/0/5F5694E4A5736DD2CC256C55000788A3/$File/influenzapandemicactionplan-v14-nhep-appendix3.pdf. [12 December 2005].

The virus has now spread, as 67 infected people have now flown internationally, including 12 to the US, and the pandemic has spread to other countries.

By the time four deaths have been recorded in the first hospital, medical staff will have undoubtedly recognised that they are facing an unusual situation. The WHO and national health warnings will likely trigger the hospital to alert the responsible government agency. The Government responsible may attempt to handle the outbreak themselves and not advise the international community of the situation. Concerns over potential terrorism may also delay the Government response. This politically induced delay may cost another week, with the infection level rising to 12 million. Over 1800 infected people have now flown internationally, with 319 going to the US, and the first deaths are appearing in other countries.

The World Health Organisation (WHO) is advised of the outbreak. Leading agencies from around the world would then undoubtedly send teams to the outbreak locations to assist in containment and learn more about the disease itself to enable long-term counter-measures. However, the spread of the pandemic to other nations will complicate their mission. Further, by this time the virus has passed through up to seven different generations and may have mutated further in the process. A total of 309 million people could now be infected, and even if further international air travel is suspended, some 47,000 infected people have now spread the disease across the planet. The situation would be beyond control in the original location.

Meanwhile, CDC will have put their plan into action. All passengers arriving in the United States from the infected area are traced. All international flights would probably be cancelled in an attempt to deal with the emergency. However, even if the borders are closed, 17.7% of total international air travellers have crossed into the US, and thus some 8,281 cases would have entered the US before CDC can effectively respond. Over two thousand of those cases would have continued to travel in the US beyond their original destination, spreading the pandemic across the country.

CDC would need to trace at least every flight from the location area and every passenger travelling onwards. This situation would be complicated by infected people arriving in the US from other regions as well. Based on the scenario of the pandemic arising in East Asia, CDC could be tracing some seventeen hundred international and seven thousand flights to trace the people. CDC would need to complete the tracing of these people within two days, or the infection n the US would escalate from two thousand people to twenty-six thousand.

CDC has planned on the basis of 10-12 data requests. It is highly unlikely that CDC could analyse over four thousand flights per day, trace all infected people and place them in quarantine immediately before infecting more people. The likely scenario is a less effective quarantine. Using ERG's estimate that a 50% effective quarantine would result in 24 times the death rate of an effective quarantine, and assuming that CDC requires more than two but less than five days to begin effective tracing of the travellers, then the pandemic could infect 2.4 million people and cause 300,000 deaths in the US before being brought under control. The US economy would probably be temporarily disrupted through panic and measures to isolate infected regions, with some infrastructure problems, and possibly resulting in further death from civil unrest and other causes. Lost production from the sick would cost some three weeks per sick

person, valued at $13 billion based on the Congressional Budgetary Office estimates[11], while the value of statistical life of the victims would contribute a further $2070 billion in losses to the economy.

Thus, the introduction of delays by hospital recognition and foreign government reluctance to pass on information could escalate the US death rate from around 27 to 159,000.

However, CDC will have succeeded in preventing a worse disaster with a higher cost, as illustrated in scenario three, and would be justified in being credited with defending the US against a serious threat.

[11] Arnold, Robert, De Sa, Jeanne & Gronniger, Tim. (2005). A Potential Flu Epidemic: Possible Macroeconomic Effects and Policy Issues. Available [online]: http://www.cbo.gov/ftpdocs/69xx/doc6946/12-08-BirdFlu.pdf. [12 December 2005].

Scenario Three

Both scenarios one and two are based on the assumption that the United States can effectively control its borders and that quarantine measures are effective. Scenario three instead assumes that the pandemic also spreads by non-human carrier, such as migrating birds.

In this case, CDC's responses would be largely ineffective. Quarantining infected travellers would fail to isolate the population, as birds spread the disease through water supplies and other means. The number of outbreaks in the United States would spread without requiring air or sea travel, as people move about by private land transport and contact other people in their normal life. CDC has no ability to track large numbers of movements inside the United States and hence CDC's tracking capability would fail.

The consequence would be a scenario similar to the Spanish Flu, with some 82 million people infected and over ten million dead over a period of 6 months. Hospitals would be rapidly overwhelmed, anti-viral supplies exhausted with 3.9 million (1.3%) Americans[12] inoculated and panic would set in the population and quarantine stations would become saturated.

CDC would instead be faced with the need of separating the inoculated and unaffected population from the carriers and infected until a nation-wide inoculation programme was completed or the disease ran its course. Land, sea and air movements would need to be restricted and essential supplies delivered to infected areas, to prevent the population staging a mass break-out. Some cities may need to be isolated from the rest of the country to prevent infection of rural areas.

Further, infrastructure such as telecommunications, power supplies, transport networks, water and sewage systems would progressively fail due to lack of maintenance and operators being unable to attend to their duties. Essential services may be locked down to prevent infection and to provide protection for essential personnel and resources from civil unrest.

This scenario is assisted by CDC's lack of resources and preparation for the control of a pandemic once it has become established in the US. CDC would most likely lose control of the situation to the Departments of Homeland Security and Defense, as the Government tries to grapple with the emergency and places key security and infrastructure under secure control. The disease would run its course, though the security measures may prevent some areas from being infected.

The infrastructure, data collection requirements, privacy and risk management ramifications are considered in the following sections, focussing on the problems that CDC faces, the consequences of failure to solve these problems and proposed fixes that could be implemented to minimise the impact of the problems.

[12] CNN. (2005). Bird flu vaccine eggs all in one basket. Available [online]: http://www.cnn.com/2005/HEALTH/conditions/12/08/pdg.bird.flu.vaccine/. [12December 2005].

However, first, separate from CDC, Congress has also been considering the impact of a bird flue epidemic on the US. A discussion of the Congress' perspective is considered as a comparison with the above scenarios, which are all based on the assumption that the US Government will use its powers to minimise the impact of the pandemic on the lives of US citizens and to protect the economy in general.

CBO Serious Pandemic Scenario

The Congressional Budgetary Office (CBO) has released a report into the economic effects of a pandemic[13]. They have examined the costs of a serious pandemic on the scale of the Spanish influenza pandemic from an independent perspective, based on the assumption that a quarantine is ineffective at stopping or limiting the pandemic.

Further, the CBO assumes that the government's actions to limit the effects of the pandemic will be restricted to providing available medication to high priority people and facilitating the response of state-based medical efforts. There is no suggestion of attempts to isolate infected areas from the rest of the country, or to limit freedom of movement to resolve the situation. Instead, it is assumed that people will refrain from unnecessary association with others and many will stay at home to look after children as schools are closed and after sick relatives unable to go to overcrowded hospitals. The level of economic damage is restricted to people taking three weeks off work when sick and the cost of replacing the dead with new workers from, presumably, the unemployed labour force.

CBO also assumes that the pandemic will not cause any serious economic dislocation. It is assumed that transport services will continue to operate, supplies will be delivered and infrastructure maintained and operated. The CBO model reduces economic performance of some industry sectors as a result of decline in demand, but there is no suggestion of failed services.

In the CBO scenario, the disease is left to run its course. The CBO placed the cost of the epidemic at some $690 billion in lost productivity. However, there is no allowance for the social cost of the 2.5% expected cases that are expected to die from the pandemic. If one adds the value of statistical life used by the ERG report, $6.9 million per person, for each of the 2 million people CBO expects to die in their severe pandemic scenario, the total cost of the pandemic to the US would be $14.49 trillion rather than $690 billion, or 21 times greater than estimated by the CBO.

A second variation of costs would be to change the pandemic death rate from the 2.5% of cases assumed by the CBO to 12.5%-25% experienced internally during the Spanish flu. In this case, the costs of lost life would increase by some five- to ten-fold.

Further, the CBO assumes that the US will return to trend-line growth from the following year. The assumption is that all of the people killed in a pandemic are replaceable from unemployed labour. That assumption may have been valid for traditional smokestack industries, but many industries are highly dependent on some numbers of highly knowledgeable people. It is extremely unlikely that the medical industry could find 2.5% more doctors in the ranks of the unemployed, or the research fields have such spare capacity, or any high technology field has spare staff. The

[13] Arnold, Robert, De Sa, Jeanne & Gronniger, Tim. (2005). A Potential Flu Epidemic: Possible Macroeconomic Effects and Policy Issues. Available [online]: http://www.cbo.gov/ftpdocs/69xx/doc6946/12-08-BirdFlu.pdf. [12 December 2005].

nature of the modern economy would more likely result in a long-term loss of human resource capacity that would require many years to replace.

Thus, the CBO approach essentially removes CDC from any role in protecting the US, as the pandemic will arrive in any case.

Infrastructure Failure

The Problem

Infrastructure Failure is one of the most serious outcomes identified in scenarios two and three. CDC has made no account in their planning for this problem, and as a result, could easily find itself unable to fulfil its basic mission.

First, if a pandemic becomes a significant problem, CDC may be forced to quarantine whole areas to protect the general population. At that point, some people will be prevented from carrying out their jobs in maintaining various aspects of the economy's infrastructure. Problems will emerge in areas like:

- Postal Services – the post will not be able to be delivered, as the postal people will not have access to some locations.
- Rubbish collection – rubbish piling up on the streets can help the spread of disease.
- Water Services – burst pipes would not be repaired and urban areas could lose sufficient water pressure, forcing people to collect water from public areas.
- Electricity Supplies – Network failures would not be repaired. Utilities unable to read meters may start turning off power to residents who cannot pay bills they cannot receive due to a lack of postal service.
- Telephone Lines – Network failures would not be able to be repaired. Again, utilities may elect to cut off subscribers who have not paid accounts that have not been delivered.
- Roads – road repair staff would not be able to access the roads requiring repairs.
- Railroads – Any railroad running through a quarantined area would be effectively cut, preventing freight and passenger services through that line.

A second problem will emerge as some organisations will go into lock-down mode to ensure that they can continue operations throughout the pandemic. Their staff will be unable to return to their homes, and the burden of looking after any dependents will fall on their spouses, family or friends – thereby taking more people out of the workforce.

Third, those places where people crowd together would be considered too hazardous for health and would be avoided as much as possible, by customers and by staff. Schools would be shut and students sent home, requiring parents to stay home to look after them. Supermarkets could become dangerous places, as people avoid each other, and lead to looting as people are unable to buy products due to a lack of sales staff. Large office blocks could be emptied, as people fear to breathe in the same air as their colleagues, grinding commerce and government to a halt. Information would become hard to access, as local television, radio and newspapers fail due to staff absenteeism.

The Consequences

The first consequence of a pandemic will be fear. Assurances from the Federal Government that everything is under control will fail once people start seeing bodies decomposing in the street.

Second, people will feel cut off from information. The only reliable information sources will be long-distance broadcasts from television and radio in unaffected areas and from the Internet, so long as local telecommunications and power remain operating.

Third, starvation and thirst will drive people to take extreme risks. Recent years have seen people acting desperately in Sarajevo risking snipers, New Orleans with the flooding and Baghdad with the bombings. People in such straits will develop a siege mentality and tend to barricade themselves in their homes as much as possible.

Fourth, some people will attempt to escape the situation. There will be risks to CDC, Homeland Security and other security staff from desperate people trying to reach safety. Quarantines may need to be maintained by armed forces and it may prove necessary to shoot people to prevent quarantines being broken. States may well mobilise their militia forces to maintain order, and there is a potential for conflict between state and federal authorities as each follows different priorities.

Fifth, without infrastructure, CDC will have problems communicating with personnel and maintaining control of the situation. A failing telecommunications infrastructure may lead to whole areas being cut off from CDC's network. Road and rail problems may frustrate attempts to move food, fuel and other supplies as required. A lack of electricity could result in much medical equipment being unavailable.

Finally, CDC needs an information infrastructure to monitor people movements, enforce a quarantine and to protect the remaining unaffected population. This loss of supporting infrastructure threatens the security of CDC's information infrastructure from the effects of a pandemic, as it needs access to incoming data from data sources, to sustain its personnel and to deliver information to areas with total infrastructure failure, while being sufficiently capable to ensure that operational requirements can be met through innovation and adjustments to changing circumstances.

The Fix

CDC cannot rely on existing infrastructure in its pandemic planning. A complete independent information and communication infrastructure is required that does not depend upon local maintenance. The whole system needs to be operable from a remote location that can be protected from the pandemic, has access to sufficient anti-pandemic drugs to provide protection to core personnel and sufficient capability if required to modify the systems to meet rapidly changing circumstances.

Remote Data Collection and Retrieval

The Problem

The United States does not have a reliable method of identifying people within its boundaries. The large numbers of identity thefts each year highlight the difficulties faced by any federal agency in identifying and categorising individuals.

However, in the case of a pandemic, CDC will need to be able to reliably identify individuals and determine their disease status: unaffected, infected, carrier, inoculated, etc. Some people, including CDC people, will need to be able to move about to carry out critical functions, while others need to be contained in quarantined zones for the protection of others, or outside quarantined zones for their own protection.

CDC and CDC-led people are going to need to be able to access this data in a timely fashion in the field in a situation where there may be no operating infrastructure. The equipment used needs to be powered from locally available sources, such as solar or batteries, and be able to pass collected information to CDC and receive information as required. A typical example will be a checkpoint where a security officer is checking the identity of somebody to determine whether they will be allowed to cross to the other side. Photographs, biometric data and disease status will need to be available within a few seconds to avoid potential confrontation from frustrated citizens and a dangerous situation arising.

Further, this data will need to be drawn from large numbers of sources not previously integrated. The data management exercise is of large scale and of high complexity.

The Consequences

An effective information system would enable CDC people to manage population movements and enforce a quarantine.

Failing to create such a system would result in CDC people not being able to identify people, and thus being forced to either quarantine people who need not be quarantined to err on the side of caution and expose these people to unnecessary personal risk, or to jeopardise the effectiveness of the quarantine system and place everyone at risk.

The Fix

CDC should examine the global market for suitable technology that can enable the integration of data necessary and the delivery of information services to areas with no infrastructure. Equipment can be pre-positioned at strategic locations to ensure availability in times of a pandemic and to provide essential training tools to CDC teams.

Privacy

The Problem

CDC's primary concern with privacy, as signalled in the ERG report, is with the cost of providing privacy measures rather than in protecting the American people and citizens of other countries from abuse of privacy as a result of actions sanctioned by CDC.

While it acknowledged that CDC is required by law to comply with the Federal Information Security Management Act of 2002 (FISMA), and that it is funded to do so, that in itself is an insufficient safeguard to justify entrusting CDC with personal information that could be misused for purposes other than required to manage a pandemic.

First, consider CDC's performance under the FISMA. CDC, as part of the Department of Health and Human Services, has received an F grade for both 2004 and 2003 years[14]. That is the lowest grade achieved by any government agency and equalled by another agency essential to meeting the demands of a pandemic, namely the Department of Homeland Security.

CDC's ability to manage secure information is seen by Congress to be a complete failure. That does not inspire confidence in its ability to, in ERG's words, protect personal data collected for the purposes of mitigating health impacts.

The purpose of FISMA, as stated in the preamble to the Act[15], is to:

> ''(1) provide a comprehensive framework for ensuring the effectiveness of information security controls over information resources that support Federal operations and assets;
> ''(2) recognize the highly networked nature of the current Federal computing environment and provide effective governmentwide management and oversight of the related information security risks, including coordination of information security efforts throughout the civilian, national security, and law enforcement communities;
> ''(3) provide for development and maintenance of minimum controls required to protect Federal information and information systems;
> ''(4) provide a mechanism for improved oversight of Federal agency information security programs;
> ''(5) acknowledge that commercially developed information security products offer advanced, dynamic, robust, and effective information security solutions, reflecting market solutions for the protection of critical information infrastructures important to the national defense and economic security of the nation that are designed, built, and operated by the private sector; and
> ''(6) recognize that the selection of specific technical hardware and software information security solutions should be left to individual agencies from among commercially developed products.

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[14] Government Reform Committee. (2005). Federal Computer Security Report Card. Available [online]: http://reform.house.gov/UploadedFiles/2004%20Computer%20Security%20Report%20card%202%20years.pdf. [9 December 2005].

[15] 107th Congress. (2002). Public Law 107-347. Available [online]: http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=107_cong_public_laws&docid=f:publ347.107.pdf. [9 December 2005].

Second CDC is also bound by the so-called Privacy Act, s552a of title 5 of the US Code. However, this law does not prevent information collected for the purpose of combating a pandemic being shared with other government agencies.

Further, CDC's tracing system is designed to track people entering the United States from foreign locations. A substantial number of the passengers on these flights and ships will not be a US citizen or permanent resident, and hence have no protection of privacy under s552a. Their information can be shared and used by US authorities without restraint or regard to the effects on the individual.

It is difficult to see how CDC can gain the support and confidence of travellers when a large percentage of travellers have no privacy protection from information abuse under US law. If CDC is not prepared to protect all travellers equally, then how can they expect total cooperation?

The Consequences

The preamble to the Act makes clear that the purpose of this law is to protect the Federal government against the actions of others, rather than to protect the people against abuse of information *by* the Federal Government or those parties to whom it may release information or those parties acting in concert with the Federal Government.

Thus, CDC's statements in the ERG's report allaying privacy concerns have no relevance to the basic problem at hand.

The success or failure of an effort to contain a pandemic will depend utterly on the reliability of the data available, to enable people to be tracked for pandemic management purposes. If this information could be used for other purposes, such as tax collecting, immigration control, serving of warrants, capturing of fugitives or for commercial gain, such as product marketing or profiling, then people will be encouraged to provide false information.

CDC's inability to guarantee total privacy of information could result in small numbers of infected people being missed in a quarantine effort, with the result of widespread death and economic loss completely out of proportion to the gains made by the abuse of the collected information.

Further, large numbers of Americans distrust the Federal Government. The cooperation of citizens in the event of a serious emergency will likely hinge on their willingness to provide data on their movements and the people contacted. These people need the reassurance of anonymity from other government agencies before one can expect trust and cooperation.

The Fix

First, the solution is to ensure that information is placed beyond the reach of other agencies of the Federal Government and business interests. One answer used in some countries is to shift the data offshore to a jurisdiction which has the legal mechanisms in place to protect privacy and with sufficient physical security to prevent theft.

Second, a private organisation can be bound by contract to observe strict protection of individual's data. A private organisation can also create trust with the American people through appropriate contractual commitments, honesty and superior performance.

Third, the technology selected to store the data fragments individual data elements to frustrate unauthorised access. Such a data storage mechanism can reconstitute the data as required to fulfil individual CDC information requests from the field, while restricting access to information requests outside the purpose of the system.

Risk Management

The Problem

CDC is an agency tasked with disease control. It is facing a situation unprecedented in its history where its failure could jeopardise the country's security and position in the world. For the first time a failure by CDC may not be recoverable at a later date by court action against parties who have failed to provide contracted services, or by political positioning to win political support. In this case, failure could be *permanent.*

The Consequences

The response by CDC to the situation is to ensure that it meets its obligations under law and carries out the role allocated to it. What CDC has not done is take an overall perspective of the risks facing the US from the pandemic and attempt to manage those risks.

However, there is no other US Government agency better placed than CDC to carry out this task, Homeland Security might play a useful role, but they are distracted by the threat of terrorism and do not have sufficient knowledge to fully understand the risks to the same depth as CDC.

Hence, the buck stops with CDC.

The Fix

CDC could start by recognising internally at least the gravity of the threat and carry out a full risk assessment. The risks being faced need a full evaluation from financial, legal, reputational, behavioural and hazard perspectives.

A more holistic view of the threat can enable CDC to develop a plan that can reduce the real impact of a pandemic, and to do the right thing, rather than to be merely seen to have done the right thing.

The Fix

The pandemic threat is manageable. There are effective options to reduce the damage and save lives.

CDC can recast its strategies to deal with infrastructure failure, remote data collection and retrieval requirements, and to maintain privacy of information collected to manage the pandemic. A complete risk management approach can reduce the real costs, while enabling CDC to carry out its goal of protecting American citizens and optimising lifespans.

Further, CDC is uniquely placed to take and retain leadership of US government agencies throughout the pandemic crisis. The organisation can provide coordination and purpose to ensure that state resources, the Departments of Homeland Security and Defense and private sector resources are aligned to deal with the real threat of a pandemic to the US.

The future is in CDC's hands

Part 5

An International Fix to an International Problem

The Human Problem

Our close contact and dependence on domesticated animal species for food, clothing and raw materials has exposed humans to waves of viruses passing from an animal host to humans. It is an historic fact that practically every disease that currently plagues our species originated in a domesticated species.

The bird flu is the latest virus to threaten the human race. The H5N1 virus has infected bird stocks from Eastern Europe to East Asia. The virus bears marked similarity to the Spanish flu virus that swept across the world during 1918-1919 and there are fears that a simple mutation by the H5N1 virus will result in a new strain that will have similar virulence to the Spanish flu virus.

What makes the H5N1 virus different from the viruses responsible for the two most recent pandemics is the mortality rate of its victims. The 1957 and 1968 viruses killed only 0.1% of cases, leaving a death toll much worse than a normal flu season. However, the Spanish flu virus killed some 12.5% to 25% of cases, leaving a death toll substantially higher than the human population's normal attrition rate.

Even earlier cases of flu viruses have killed larger numbers. The mixture of viruses released by the Spanish when Columbus discovered the Americas killed some 95% of the North American Native Indian population. The native Indians were particularly susceptible to viruses as they had not developed natural resistance as a consequence of generations in close contact with the domesticated animals prevalent in Europe and Asia.

If a new virus emerged that had characteristics of bypassing our natural immune systems, then a 95% mortality rate similar to the North American Indians could be repeated.

Further, the human species is more prone to widespread infection of a pandemic. Our global air travel carried the equivalent of ten per cent of the human population between countries during 2004. Our economies are becoming more integrated with strengthening international trade patterns. We are seeing increased specialisation in many economies, as some countries develop or exploit competitive advantages in various commodities and products. A pandemic with even low mortality rates can disrupt trade patterns to some extent, such as was demonstrated during the relatively minor 2003 SARS outbreak in East Asia and Canada.

The problem we humans face from a pandemic is larger than a national issue. A pandemic has implications for humans everywhere and of every type. It is an issue beyond the control of any individual nation state. A management failure anywhere would affect everyone everywhere.

A threatening global pandemic is one issue that requires the coordination of all governments, industry agencies, companies and the general public. It is a human problem upon which united we stand, or divided we fall.

The International Problem

A pandemic does not recognise national borders. It would move from country to country carried by aircraft, ships and land transport. Infected wild life may also act as carriers, bypassing local attempts to track infected people.

National strategies to cope with bird flu would undoubtedly rely on prioritising local vaccine production for domestic use, suspending travel and trade with infected countries and putting security measures into place to prevent travel and looting.

However, these measures are hardly likely to succeed.

A pandemic out of control in a neighbouring country would increasingly spill over the borders until it became uncontrollable. It does not matter how well a country like the United States or a European country manages its borders, sooner or later an epidemic elsewhere in the world would arrive locally.

The only real hope is to manage the situation as the single human problem that it is. This problem is beyond the capability of any single government to resolve on its own.

The answer to the problem is an integrated human approach to the threat – including effective surveillance, protection and response. These three elements need to be completely successful. A 99% success in surveillance, protection or response is still failure.

The international problem is essentially the fragmentation of government, industry agency, company and public responses. The human race needs more to escape the consequences of a pandemic. It needs something unprecedented in human history.

The human race requires cooperation of all governments, industry agencies, companies and general public to handle this threat. The alternative could be a plague of biblical proportions.

The Local Problem

The consequences of a pandemic are potentially dreadful. Once the virus has established itself in local populations, there are only two options available: live with it and treat the sick; or isolate the community from the unaffected.

The key variable is the percentage of infected people who die from the disease. If the percentage is low, such as 1957 and 1968, the best course of action is to let the virus run its course. Some 20-30% of the population would probably become infected, and some 0.1% of these people would die. However, the actual death levels, while deplorable, would be not much worse from an average year and the economy would weather the effects and carry on largely business as usual. The main economic cost would be the three or so weeks of lost productivity of sick workers and the people required to look after the sick.

A second comparison is the Spanish flu virus. This virus killed between one in four and one in eight people infected, and left the survivors sufficiently weakened that they were unable to look after the sick or dead. However, the virus did affect some communities with greater intensity, with some local populations wiped out. A virus of this lethality today would disrupt commerce, as large numbers of people would avoid crowded areas, leading to widespread absenteeism. There is the possibility of infrastructure failure, as people responsible for maintaining or providing services fail to carry out their tasks. Looting could become reasonably common, as people search for essential supplies to survive.

The question authorities would need to consider is whether to quarantine infected areas to protect other areas and delay the spread of the virus, or to accept the human cost and use resources to keep the economy operating to supply essential resources to city populations and to industry. The existing stocks of vaccines would be quickly exhausted and new supplies would be contingent on availability.

The main problem is that the H5N1 virus appears to have a higher mortality rate than the 1958 and 1967 strains. The World Health Organisation has to date reported 137 cases and 70 deaths. This is a mortality rate of around 50% of cases. If this mortality rate was experienced across the whole infected population, then the question could become one of saving the economy from total permanent collapse. The loss of 50% of the infected population, even assuming that only 20-30% became infected, would mean 10-15% of all people. The lost human skills could destabilise whole sectors of the economies and there is the possibility of widespread environmental damage from neglected facilities that could result in larger numbers of consequential deaths. Further, the disruption of commerce could also result in mass starvation after a few months, as essential food supplies are not harvested or delivered. In this scenario, those countries that fail to adequately manage the situation may find themselves in a very different position post-epidemic than before.

Our Answer

We need to combine our skills, determination and resources to meet the pandemic threat. This is not just a government policy issue, but a threat to all humans, both in terms of life and economic conditions. We need to take a holistic view of fixing this problem while there is still time.

The Goal

We do not accept that 2.5% of humans could die in the six month period following a bird flu virus mutating to allow human to human transmission.

We know that this virus can be contained and the threat can be managed with existing resources.

We know that the cost of meeting this challenge is less than the expected cost of the damage caused by the virus.

We intend to fix this issue to reduce the casualties to the lowest possible level. We do not accept that millions should die.

The goal: to put in place the tracing and response systems required to meet the goal of no more than 0.1% casualties from a H5N1 pandemic.

Cooperation

We need cooperation to achieve the goal. The European Union and the United States both have leadership positions in the world of international air travel and trade, and we need these parties to cooperate with each other and everyone else. We need small countries to cooperate with big countries. We need industry associations to cooperate with the pandemic effort. We need companies to treat the pandemic as a major threat to their ongoing business. We need the public to be aware of the situation to cooperate with authorities.

The tracing of infected people and their movements requires the cooperation of all airlines. The current national efforts of the United States and the European Union, amongst others, are fragmented when the basic requirements are the same. This is not a situation where international rivals can achieve the goals of fighting a pandemic separately. We sink or swim together.

Further, the United States and the European Union together or separately do not have the capability of tracking people movements around the world. Whether the US or European governments like it or not, they and everybody else depends on the cooperation of all national governments in the world.

All airlines have a national office in a country. These airlines are all responsive to their national government priorities. They all manage their affairs in accordance with the rules of their home countries first and foremost. If the US or any other government wants data, then it needs to work cooperatively. If one power starts trying to seize data or requires information in contravention to home country laws, then the consequence could be a major diplomatic crisis right at the time a pandemic becomes established across the world. Such a failure of government leadership would almost certainly result in disaster everywhere. There is simply not the time for this type of squabbling in the time of crisis.

In addition, small countries including the third-world need protection too. It is not sufficient for the OECD members to save themselves while allowing the rest of the planet to suffer a pandemic. If the H5N1 virus becomes established in Africa, South America, the Middle East or Asia, then it will eventually infect the OECD countries as well.

The only chance to beat the pandemic is to trace all infected people and treat them at an early stage of the outbreak, while numbers are still relatively small. This requirement means cooperation of all parties from the beginning.

Alignment to meet threat

Next, we need to treat this threat seriously. This is a threat to our lives and our whole way of life.

First, we need to align our ways of thinking to the posed threat. The virus will not adjust its schedule or way of doing things to fit in with our schedules, management styles or preconceptions. We need to accept that stopping a pandemic is a viable strategy and that we are going to do exactly that. If we cannot agree on our goal, then the pandemic will spread and run its course.

Second, we need to adjust our view of time to the threat. The flu virus can incubate in 1-7 days, with symptoms appearing from the fifth day. An adult person can become contagious 1-2 days before they develop the symptoms. Hence, we have a three-day period from infection to the contagious stage.

These realities dictate our required view of time. We must think in terms of three-day cycles. Our tracing capability must be able to identify people's movements for the previous three days and the people contacted. Further, we need to be able to trace the sources of infection for further three-day periods, and so on, until a single source of infection is identified.

The three-day time cycle dictates the length of time available. We have three days to trace the infection and put responses in place. The alternative is that another round of infection will occur and the disease will spread faster than responses can manage.

Third, we need cooperation from a wide variety of organisations. There is enormous variety in national cultures, between government, commercial and research organisations, and between types of roles within organisations. There is the potential for miscommunication, mistakes and failure. This misalignment needs to be eliminated from the equation, or human issues could lead to failure to contain the pandemic.

The only practical solution is to eliminate human involvement with the tracing and response requirement to the greatest possible extent. The automation of roles can solve both the problems of people management and can assist in the timely execution of the tracing and response requirements.

Independence of other interests

The outbreak of a pandemic would change the international landscape. The power to withhold data from local sources would become viable tactic to extract value from other parties.

In particular, countries without access to drugs may attempt to withhold information to leverage better access to medicines, or other benefits, from countries with local production. This type of blackmail could spell disaster, as a single missed infected person could lead to massive outbreak and large numbers of dead.

Any international tracing system needs to be positioned to remove the incentive for any party to use the system for benefits other than fighting the pandemic.

The most effective response to this threat is to ensure that the operation of an international tracing system is separated from any one government, thereby eliminating the effectiveness of the threat to withhold data.

Further, the data system needs to be placed in a jurisdiction without any international influence on other jurisdictions. In that manner, it would become well-known that threatening the integrity of the data will not result in direct leverage against a government or organisation with the power to meet demands.

Neutrality

Further to the requirement for independence from other interests is the requirement for a neutral location.

International politics are such that many countries do not trust either the US or the EU to hold a world database on the movements of their citizens. Such concerns could easily lead to international refusal to sanction such a system.

However, a tracing system needs a database to be effective. The solution is to place such a database in a location judged neutral by all other parties, reliable in the safety of the repository from damage or abuse, and protected from parties interested in the data for reasons other than fighting a pandemic. The local government of such a location needs to be trusted by all parties to be acceptable.

There are few governments in the world that fit into this category.

Requirement for Effective Technology

Automated Service

The required information service is to support the management of the pandemic. The nature of a pandemic is that it is unsafe to assume that operators will be immune to the effects of the pandemic. Therefore, such a systems needs to be a fully automated system.

It is a basic requirement that the system must be able to operate without human operators, in order to ensure that such a database would continue to function and provide effective services during a pandemic outbreak.

Information Capture

The quality of the information captured will to a large extent determine the effectiveness of any tracing system. The only practical response is to capture data from existing systems without disrupting those systems.

The airlines, shipping companies, travel agents and other organisations already have their own information systems for automating their logistics. Other organisations of interest, including railroads, bus companies, taxi companies, tolling systems, medical records and emergency services, have logistical systems with valuable information on people and their movements. Existing government systems, including tax systems, social services, pension systems, births deaths and marriage records, driver licensing systems and immigration systems all contain details that can add important details that aid in person identification.

First, the data should be captured as it passes through each of these data sources without requiring any changes to the existing system. The information needs to be captured online to ensure timely availability for all other purposes. The information must then be able to be extracted immediately as required, to ensure complete reliability of information on each person.

Second, changes to requirements will undoubtedly occur. The original system needs to be able to be enhanced to extract additional value from the collated data and provide enhancements in response to changing circumstances. These enhancements need to be able to be implemented across the entire system within hours. The updating process needs to be automated to remove the need for skilled local technical support and to ensure that the most reliable and best verified information is available when required.

Third, the same interface is needed to insert data into existing systems as required to enable record updates. The capture of information at its point of creation and insertion into other systems would avoid duplication of effort and the scope for errors.

Fourth, the data from these systems needs to be stored in a secure database with measures to prevent unauthorised physical or remote access. Any party with access rights needs to be able to access individual items of information pages from the database system through any communications infrastructure, including the Internet infrastructure by a web-browser or handheld devices.

Data storage

The database required to meet a pandemic threat is without precedent.

The basic transaction requirement is to collate and store all people movements as they occur. This requirement is many orders of magnitude beyond the computational ability of any one commercially released computer.

Further, the data needs to be extracted in manners that are not wholly predictable. The development of a pandemic will undoubtedly create unexpected situations and require information to be collated and used in unexpected ways. The traditional relational database concept of organising data as it is stored is ineffective in this situation, as the data needs to be re-organised to meet new needs and there is no period during a pandemic when the system can be taken down for reorganisation.

Instead, a new concept of data storage is required to move beyond the inherent limitations of currently available technology. A database technology is required that is inherently capable of capturing vast amounts of data simultaneously, storing it immediately and making that data available again in time for the next data request.

Ideally, such a database should store raw data rather than compiled information as per a relational database, where data is stored in tables using associations that are pre-determined. Ideally the data associations should be made at the time of data extraction, allowing the creation of enhanced data reports from greater information over time and thus providing much greater flexibility in the application of information to meet specific requirements.

Information Retrieval

The decentralised database needs to provide information to users upon request. The matching of data elements from many different sources creates an exponentially increasing processing load for data extraction.

The technology supporting all data requests is required to be completely scalable to provide an effectively unlimited computing power upon demand. Ideally a network of processors should respond to data requests and provide individual elements back to the requesting service. This approach would harness the power of maximum computational power at each stage of the request, thereby ensuring rapid processing of the response in a time that fits the requirements of the information requestor.

The technology should cross link multiple source information to resolve individual data requests, to enable information to be pulled together as required. In cases where information conflicts exist, the information requestor can be presented with the alternative information, allowing them to amend the data for more reliable requesting at later occasions.

This approach can be contrasted with traditional database platforms, where an increasingly complex array of tables would be required to contain the multiple sources of data. A single system would then respond to a request by request basis, but with an exponentially increasing complexity, either the number of transactions able to be handled in a given period of time would rapidly drop or response times would soon become unreasonable from the information requestor's perspective.

Secure Data

The database technology is required to be secure from any interference.

Current technology systems are plagued with insecurities. The operating systems of the computers are prone to viruses that can cripple a computer network. The databases themselves can be hacked into by people wishing to alter records or to play a prank. The networks connecting these systems can be crippled by hackers bombarding nodes until they fail under the load, or by changing address tables on nodes to disable whole sections of a network.

Therefore, to ensure privacy and maintain public confidence, the data must be accessible only by registered access with authority for the individual data elements. The restriction of access combined with collation of information upon extraction would prevent people using the data for purposes other than authorised. Further, tracking usage of the system by individuals can expose misuse of an individual's authority for investigation by a watchdog group.

Further, it is a requirement that each person can check and verify the accuracy of their own data on the database, and to add missing details.. The reliability of the data is an essential requirement in ensuring the usefulness of an information tool in managing a pandemic. The data checking needs to accurately identify each person before the updates can be authorised, to eliminate the potential for identity theft.

This level of data security provides real privacy to individuals while still enabling the access of information required to achieve the public good. The data structure provides security against unauthorised tampering with data by third-parties, and thereby provides comfort to individuals that their contribution towards meeting the pandemic threat will not be abused.

Decentralised Data

The database is required to be decentralised to avoid the risk that either (1) a single failure could disable the service and (2) any network infrastructure failure would not prevent access by sections of database users.

Decentralised database technology provides greater reliability, as the loss of any one piece of equipment or location does not jeopardise the delivery of the services. Decentralisation also reduces the reliance on any one secure location, thereby avoiding the need for expensive dedicated facilities and improving security through rendering attacks on any one item ineffective.

Repository

The maintaining of a copy of all data in a remote and secure location would provide an additional fallback position in case of an emergency. The repository location should be physically isolated from other nearby regions, have a well developed infrastructure and be self-sustainable. In case of a pandemic, this system would be locked-down to prevent contamination and to ensure continuing support of the world's pandemic management efforts.

The Repository would then need to be connected to the remainder of the network through high performance data communications, including a mixture of fibre-optic cables and satellite services.

In case of a network infrastructure failure and inability to connect to the rest of the network, then the requestors need to be able to access the repository directly to upload data and download information. In this case, even if other systems become inoperative due to telecommunications or electricity failure, or from physical damage, then the service can continue to operate and provide essential information services to the surviving groups.

Information Access Location

A management of a pandemic will require quarantine staff to access and input information at many different types of locations. Information will be required by quarantine enforcement officers mounting checkpoints to manage people and vehicle flows at important locations, such as bridge crossings, state boundaries and county limits. Other officers may require access for people identification in crowded city areas without operating telecommunications or electricity infrastructure. Yet other officers may require information access from moving vehicles, as they pass through streets checking on local situations. Or in quarantine camps to identify people's case history to determine their quarantine status.

In each of these cases, it cannot be assumed that information can be accessed through networks that existed prior to a pandemic. Some networks may no longer function, while others, such as the Department of Defense, would most likely be overloaded with communications required to maintain other services. It must be assumed that the existing infrastructure may not be available.

Therefore, it is essential that information can be accessed and updated using a mixture of different network systems. Mobile devices are required to establish temporary wireless network nodes and to support handheld devices carried by quarantine management staff. The nodes need to be linked either to other nodes or to long haul communications, possibly using satellites.

In this way, networks can be changed in an environment with rapidly changing safe zones, as the pandemic spreads and the general population reacts to the changing situation. Quarantine management staff can have effective communications and information support, allowing them to concentrate on the containment and elimination of the pandemic.

Flexible Response

There needs to be more than just a Plan A. A threat like a pandemic can evolve in ways that are difficult to predict. The response of the population is a key factor in the success or otherwise of any plan to manage a pandemic.

It must be recognised that planning cannot foresee the unprecedented. Any good General would admit that a plan rarely survives first contact with an enemy.

Hence, we need strategic thinking capability, not strategic planning. We need flexibility in approach. We need novel ideas to solve a real crisis as it unfolds. We need resources to bring new directions into reality within the virus time horizon.

These considerations dictate the form of the response. A form that requires creativity, skill, flexibility and rapid response. A form more suited to the small, nimble and focused organisation than the large, structured, specialised hierarchy.

This recognition frames the method of response.

Public Private Partnership

A public private partnership (PPP) is a collaboration between a public body and a private company to perform a goal. PPPs have become more popular in many countries in recent years as a method of bringing together the strengths of both the public and private sectors to create a more successful response to a need. The PPP model provides a method by which governments can access the flexibility and capability required to address the pandemic threat.

The ideal partner for such a PPP would be a network organisation with the technological skills and with the structure to replicate cells to rapidly scale to operation needs. Such an organisation can add flexibility, fast decision-making capacity and decentralised operations to government's statutory capabilities and public leadership. A network organisation can respond as necessary to new conditions by adding new cells, and bring new technologies into existence rapidly to threats or exploit opportunities.

Further, the inner core of a network organisation can be highly aligned with ownership and governance structures. The result is greater ability to respond to changing circumstances within hours rather than the days and weeks of other organisations. Online communications technology is usually used to bind such an organisation together and operate from dispersed locations while providing flexibility in approach.

The right network organisation in PPP with governments can build and operate a pandemic management system that can work with the required time horizons, with the trust of all parties and in conditions of rapid change.

Trusted Operator

The operator of the pandemic management system needs to be trusted by all parties. A lack of trust threatens access to data, and either a delay or reduced quality of data could spell disaster.

One consequence for trust is that the pandemic threat management organisation should not benefit any one government or people. It needs to be seen to be above local economic interests and aligned solely with the gaol of managing a pandemic. The alternative would be vested interests trying to gain benefit from the facility, and a corruption of its purpose from the original purpose of managing a pandemic threat.

Second, the organisation needs to be completely aligned with the management of the pandemic. Any conflict or competition with other interests could result in a loss of focus and an error. The ideal organisation should be dedicated to the pandemic threat management.

Third the organisation needs to be multi-disciplinary. It needs access to all of the skills required to manage the threat. The use of these skills would enable an effective response.

Finally, the organisation needs the trust of the people of all parts of the planet. It needs to be seen to be acting for their benefit and to provide an essential protection against a real threat. Transparency and accountability to the people can generate the trust required to meet the goal.

Aligned Law

The pandemic management system requires some alignment of laws from various countries. The legal hurdles are not substantial and can be worked through with cooperation.

The guiding principle in legal changes should be that the changes are not seen to be assisting one nation at the expense of another. The principle of security for all depends upon treating all equally.

Further, it is recognised that the legal changes and the enabled service would also provide the framework for tackling terrorism without the loss of civil liberties currently threatened by current anti-terrorist proposals and programmes.

New Zealand

New Zealand is an OECD member located in an isolated part of the South Pacific Ocean. The nearest significant landmass is Australia, itself at the end of an island chain stretching back to Asia, and the equivalent of half the width of the Atlantic Ocean away.

New Zealand is well-respected internationally, being a founding member of the United Nations, a member of ASEAN and the Cairns group. The country has been effectively unaligned for twenty years, following 1985 break-up of the ANZUS treaty with the United States over New Zealand's anti-nuclear stance.

A Safe Haven

The three main gateways into New Zealand are Sydney, Singapore and Los Angeles. The majority of flights into the country depart from these destinations, though a number of other flights link cities on both sides of the Tasman Sea separating New Zealand and Australia and a small number of flights connect New Zealand with other cities around the Pacific Ocean.

The restricted access to New Zealand, and its position at the end of the international airline networks, provides the country with an advantage during a pandemic. Singapore, Australia and the United States all provide New Zealand with a buffer against infection, as all of these countries have advanced medical facilities that have a reasonable chance of recognising an emerging bird flu outbreak.

This buffer combined with the time required to fly the long distance flights to New Zealand gives the New Zealand government the opportunity to close the borders at the first sign of outbreak and contain any incoming infection.

In many ways, New Zealand is the closest country to having a human population on a different planet.

Low Population Density

The country is split into two main islands. Both islands have relatively low population density, and high density urban living is only seen in small numbers in the centre of Auckland, the country's largest city.

In the event of a pandemic, New Zealand can easily move significant numbers of people into a sparsely populated countryside. The country is a major food exporter and there would be a massive surplus of food stocks if the borders were closed.

This low population density reduces the country's vulnerability to disease.

Pandemic Preparedness

The New Zealand Government is one of the few governments that has decided to stockpile vaccines for the general population. By the end of 2005 there will be sufficient doses for 21% of the population.

This vaccine stock, combined with the limited access to New Zealand by other people, the time delay required to reach New Zealand providing a buffer zone forewarning of an approaching problem, the low population density and the country's relative isolation from migratory wildlife, creates the prospect that New Zealand could isolate, contain, treat and eradicate a bird flu outbreak before it became widespread.

Thus, New Zealand is probably the least likely location to be directly disrupted as a result of a bird flu epidemic.

Skilled Technological Base

New Zealand has a substantial technological base. The country has many advanced light engineering and other enterprises, with world-leading skills. New Zealand organisations and staff are often sought for their original and capable approach to niche problems, and the country has a reputation of innovation.

Further, New Zealanders are original people with a passion for technology. The country displays a unique fusion of creativity with realism that can be tapped to solve particular requirements. New Zealand organisations often succeed where others flounder from not acknowledging the boundaries that inhibit others.

In general, New Zealanders are the people you rely on when you want to get something done.

The People

The country has a mixture of an Anglo-Saxon heritage derived from its British colonial past, fused with a Polynesian outlook and inputs from other minority cultures. The dominant language is English, which assists New Zealand in participating in the international scene. Indeed, the country is strongly international in outlook, and incorporates the best available from the US, Europe and Asia.

One key feature of the New Zealand people is that they do not accept failure.

The Development Group

The Development Group is a network of associated companies established to enable large scale information networks. The foundation of the group was laid with original research in the mid-1980s, leading to the formation of the core research and development company Development Systems Limited in 1996. We predicted the need for massive information repositories collecting data as generated and the need for an online trusted provider prepared to guarantee the integrity of data and the availability of information, and have been developing the core technologies to realise that vision since.

The Development Group has now developed novel solutions to problems in the security, airlines, online market and online database markets. We have established links with the European Union and IATA in preparation for introducing novel security services for international airports. Our camera detection technology is being prepared for trials in places as diverse as the Middle East, Asia and the United States, and for purposes as widespread as anti-terrorism, police, theatre protection and gymnasiums. Our wide range of capabilities enables us to combine unique answers to individual problems, in ways not foreseen by traditional perspectives.

Our development core is located in New Zealand. This country provides us with the advantages of a high technology base, skilled human resource, an extensive communications infrastructure and an environment suited for trialling advanced concepts and technologies. In addition, New Zealand's relative isolation and stability provides an enhanced degree of security for our operations.

We have created a network organisation able to scale up to meet any challenge. Our core jobbing and tasking systems allows us to take on and train hundreds of thousands of people in a few months. Our core logistics systems are highly scalable and can handle the largest of tasks. We have developed a conclusive competitive advantage in the economies and scalability of our network technologies that we intend to use to deploy widespread online systems. We will use these capabilities to support our ability to take a holistic view of the real problems and providing a real fix - rather than the usual 'bandaid' and 'blame transfer' that is so common in both government and business today. We choose to be responsible and to act.

We have positioned ourselves to provide a core component in the introduction of online information systems required to enable the New Economy. We have avoided the entanglements of small scale business to focus on our niche, and to prepare for achieving the economies of scale.

We are now ready to apply capabilities to fixing the real problem in the world and demonstrate our capabilities.

