Briefing note on public health security to the L-20 group of countries

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Emerging and epidemic-prone infectious diseases: threats to public health security

The recent emergence of severe acute respiratory syndrome (SARS) in China – and its subsequent spread in humans – first within China, then to neighbouring countries and throughout the world, is a prime example of how newly-emerged infectious diseases can cause human suffering and death, have negative economic impact on robust economies, and easily cross national borders, defying traditional national defences.[1] Though the international outbreak was contained within a period of four months by a coordinated international response, it is estimated that in addition to severe illness and death, the loss to Asian economies was approximately US$30 billion.[2] Airlines with Asian routes lost an estimated US$10 billion.[3] At the peak of the outbreak, SARS cost Toronto an estimated US$30 million each day.[4]

Like SARS, the majority of new and emerging infectious diseases in humans are thought to result from a breach of the species barrier between animals and humans. Microbes carried by animals, often without causing disease, can be severely damaging to health when they infect humans. Once infected, humans can transmit the infection to others and an epidemic ensues. If an epidemic is not contained by the national health system, the potential for international spread is great. In an era of rapid international travel and trade, microbes such as the virus that causes SARS are easily transported around the world in humans if they are not contained when and where they emerge. They can also be transported around the world in insects, food, medicinal products and livestock.

In 1990, cholera is thought to have been carried to Peru by crew members of an international trading ship that pumped its bilge into a Peruvian harbour, causing epidemics throughout Latin America where cholera had only been sporadically reported during the preceding hundred years. By the end of the first year after importation, cholera had spread throughout Latin America and caused over 400,000 infections and 4,000 deaths.[5] The estimated economic loss in Peru during the first year after introduction of cholera was US $770 million, mainly due to decreases in travel and trade. Similar losses occurred in other Latin American countries to which cholera spread.[6]

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In August and September 2000, 33 international athletes from the Americas, Africa and the Pacific Rim who participated in the *Eco Challenge* (a triathlon in the jungles of Malaysia) returned home while still in the incubation period of leptospirosis, an infection carried in rodents and transmitted to humans in contaminated water. Once home and sick, their uncommon infection proved difficult to diagnose. Of the 109 athletes affected, 29 became severely ill, requiring prolonged hospitalization.[7]

Each year airport malaria – malaria in persons working in airports or living nearby who have never travelled to tropical countries – is identified somewhere in North America, Europe and other geographic areas that do not have endogenous malaria.[8] Airport malaria is caused by the bite of malaria-infected mosquitoes that travel in passenger compartments or holds of aeroplanes that fly international routes. Once bitten and sick, unsuspecting humans, who have no history of travel to parts of the world where malaria is present, prove to be a diagnostic challenge to health workers. Airport malaria is thus associated with high death rates because of delayed diagnosis and treatment.

If domestic mosquitoes that are able to carry malaria live in the vicinity of the airport and bite those persons who have airport malaria, malaria can then be transmitted to other humans in and around the airport. Such a series of events has recently occurred in the United States of America (USA), where a local outbreak of malaria required greatly increased investment in mosquito control to prevent malaria from becoming a permanent health threat.[9]

The virus that causes West Nile Fever was imported into the USA, by either an infected human, insect or bird, and it has become an endemic disease in North America and Mexico causing sickness and death, especially among elderly populations.[10] It is now spreading to new areas and unsuspecting populations in Europe and Asia.

Laboratory analysis of the West Nile virus in the USA suggests that its introduction to North America was a one time event sometime during the 1990s, and that it is later generations of this same virus that are now spreading to other industrialized countries. The US Centers for Disease Control and Prevention estimates that West Nile fever cost the country, during 2002 alone, at least US$20.1 million in costs of illness and almost US$140 million attributed to the public health response. .

The recent emergence in the United Kingdom of Bovine Spongiform Encephalopathy (BSE) – commonly known as "mad cow disease" – and its subsequent spread to humans as a new variant of Creutzfeld-Jakob Disease (vCJD), provides an example of how microbes can also cross national borders in food and related products.[11,12] In this case beef and beef products, biologicals produced in bovine serum, bone meal used to feed other cattle, and live cattle from the United Kingdom had all been traded widely throughout the world for up to six years before BSE was recognized as a new infectious disease in cattle. By mid-2004 over 150 persons had been diagnosed with vCJD in the United Kingdom, and other geographic areas including France Hong Kong and Ireland.

Because of measures to stop the spread of BSE among livestock, including culling of entire herds of cattle where infection had been detected and bans on trade of British beef, the estimated loss to the UK economy was estimated at over US$ 9 billion during the first eight years after its recognition.[13] As comparison, the culling of chickens and ducks to stop the 1997 outbreak of avian influenza cost the Hong Kong economy an estimated US$22 million, while the cost of culling chickens and lost trade during the present avian influenza outbreak in Thailand has been estimated to date at US$2.6 billion.[14]

Animals were also implicated in an outbreak of Rift Valley fever on the Arabian Peninsula when, in 2000, Rift Valley fever is thought to have crossed the Red Sea in livestock from eastern Africa destined for trade in Saudi Arabia and Yemen.[15,16] Eastern Africa had an epidemic of Rift Valley fever in cattle and humans in the late 1990s as a result of several important factors that occurred simultaneously – discontinuation of cattle vaccination programmes, flooding associated with the el niño phenomenon that resulted in increased mosquito vectors to carry the Rift Valley Fever Virus, and forced co-habitation of small parcels of dry land by humans and cattle. The Rift Valley virus is now positioned to regularly infect humans in the Arabian Peninsula through the bite of local mosquitoes unless animals that carry the virus are regularly vaccinated. The impact of Rift Valley Fever on the economies in Saudi Arabia and Yemen is still being assessed.

Finally, in 2003 and 2004 the polio virus spread from Nigeria to 12 polio-free countries in West, Central and Southern Africa. In four of these countries polio outbreaks occurred and spread polio widely, while in the other eight localized outbreaks occurred without widespread transmission. The immunization campaigns to stop polio transmission in these countries are projected to have cost over 100 million dollars by the end of 2005.[17]

Bioterrorism: an additional threat to public health security

In October 2001, several letters containing *Bacillus anthracis* spores were sent through the US postal service to private sector and government buildings. Between 2 October and 19 November, investigators identified a total of 22 cases of bioterrorism-related anthrax: 11 were confirmed as inhalational anthrax, causing severe pneumonia, and 11 (seven confirmed and four suspected) were cutaneous anthrax, appearing as ulcers of the skin. Five of the 11 inhalational infections were fatal.[18] Post-exposure prophylaxis to prevent the development of inhalational anthrax was given to over 10,000 persons who were exposed to environments contaminated with *B. anthracis* spores, and permanent and costly measures to detect further contaminated letters were put in place in the US postal system..

Following this deliberate and malicious use of anthrax in the US in 2001, the perception of the infectious disease threat quickly broadened. Now, just three years later, preparedness for a possible deliberately caused infectious disease outbreak, bioterrorism has become a great concern in many countries. It has raised many questions about the capacity of public health infrastructures to respond to outbreaks of massive proportions, the best strategies for protecting populations, and the extent to which resources should be devoted to preparation for an event considered by many countries to be of low probability yet potentially catastrophic consequences.

Diagnosis and treatment of persons with deliberately-caused anthrax infections in the USA was assured by first responder health workers followed by a public health response in the affected states, supported by the Centers for Disease Control and Prevention (CDC), the federal agency with national responsibility for detection and containment of infectious disease outbreaks. Soon afterwards, domestic and international intelligence and criminal forces were brought to bear, which necessitated new ways of working and collaboration between these varying agencies, each with its own comparative advantage.

Just as the public health system was the first to detect cases and raise the alarm when deliberate use of anthrax occurred, it remained at the front line throughout the public health response, alongside the criminal and other elements of the response. The economic implications of deliberate use of microbes have added increased costs to security in many countries where risk analysis has suggested that such events are possible, in the form of investments in stockpiles of existing vaccines and medicines, and increased resources for research and development of new vaccines.[19]

National disease detection and containment: the cornerstone of public health security

Infectious diseases are therefore a volatile danger from which countries need to be shielded. Most times they occur naturally, but at times they can be deliberately caused. No matter what their origin, they must be detected and contained rapidly. If not, they have the potential to cause high levels of human sickness and death, to spread throughout our globalized world by humans, insects, livestock and food; and to cause severe economic loss.

Strong national surveillance systems for naturally occurring epidemic-prone and emerging infectious diseases result in rapid identification and containment of infectious disease outbreaks. They also enhance the capacity of countries to detect and investigate deliberately caused outbreaks, because they often have the same epidemiological and laboratory characteristics.

Not surprisingly, outbreaks of naturally occurring emerging infectious diseases occur most frequently in countries that lack the public health capacity to rapidly detect and quickly contain their spread. For this reason, it is in the interest of both developing and industrialized countries to strengthen developing country public health systems. Strengthened laboratories, up-to-date health personnel and reinvigorated public health institutions benefit developing countries by ensuring early identification and containment of infectious disease outbreaks, thereby decreasing the human suffering, death and economic impact they cause. At the same time, industrialized countries benefit from the decreasing risk that these diseases will spread internationally.

Global surveillance and response: a safety net to increase public health security

Concern about the international spread of infectious diseases is not new. In the 14th century, ships that were potential carriers of plague-infected rats were forcibly quarantined in the harbour of the city-state of Venice to prevent importation of plague, and then in other seaports around the world.[20] By the 19th century, there was a series of international agreements between the newly-industrialized countries that culminated in the mid-20th century with the International Health Regulations (IHR).[21] Accepted by all Member States of the World Health Organization (WHO) in 1969, the objective of the IHR is to maximize public health security against the international spread of infectious diseases while ensuring minimum impact on trade and travel. The IHR are the only international regulations that require reporting of infectious diseases. At the same time, they provide norms and standards for air and sea ports designed to prevent the spread from public conveyances of rodents or insects that may be carrying infectious diseases. The IHR also describe best practices to be used to prevent the spread of these diseases internationally

To broaden the disease coverage of the IHR as new infectious diseases continue to be identified (over 30 during the past twenty five years); to increase their sensitivity for outbreak detection; and to provide guidance on more effective control measures for air and sea ports, the IHR are currently being revised to serve as an up-to-date framework for 21st century global surveillance for, and response to, infectious diseases .

The revised IHR will thus provide the framework for a global safety net to rapidly detect and coordinate international responses to infectious diseases that have not been effectively detected and responded to nationally. This safety net has been under development since 1997 as the WHO Global Outbreak Alert and Response Network [22]. This overarching network presently interlinks, in real time, over 100 existing laboratory and disease reporting networks that together possess much of the data, expertise, and skills needed to keep the international community constantly alert and ready to respond to infectious diseases that threaten to spread internationally.[23] The network ensures that the necessary laboratory and epidemiological skills are kept sharp, since the call-out for natural outbreaks at the global level is frequent. It also provides the mechanisms for sharing expertise, facilities, and staff, a point that is considered of prime importance to global public health security since most outbreaks of naturally occurring emerging infectious diseases occur in countries that lack the public health capacity to detect and then quickly contain their spread.

The network is supported by several new mechanisms and a computer-driven tool for real-time gathering of disease intelligence. This tool, the Global Public Health Intelligence Network maintained by Health Canada, heightens vigilance by continuously and systematically crawling web sites, news wires, local online newspapers, public health email services, and electronic discussion groups for rumours of outbreaks [24]. In this way, the network is able to scan the world for informal news that gives cause for suspecting an unusual event.

Other sources of information linked together in the network include government and university centres, ministries of health, academic institutions, other UN agencies, networks of overseas military laboratories, and nongovernmental organizations with a strong presence in epidemic-prone countries. Information from all these sources is assessed and verified on a daily basis. Validated information is made public on the WHO web site, and a coordinated international response is mounted. It was this network that detected and coordinated, in real time, the response to the SARS outbreak in 2003..

Protecting our future: the case for L-20 involvement in global activities to prevent and control emerging and epidemic-prone infectious disease threats to public health security

National and global surveillance and response mechanisms are key (global) public goods for public health security. They minimize the human suffering and death associated with naturally occurring or deliberately caused infectious disease outbreaks; they prevent their international spread; and they mitigate their negative economic impact. They can be supported by contributing to developing country capacity building in disease surveillance and response, and by strengthening the global alert and response network that ensures robust global safety net against the international spread of infectious diseases.

Investments in these public goods are beyond the means or incentives of any single government, and are undersupplied and underfinanced, requiring collective action. The L-20 is an appropriate group to help drive this initiative both through its political leadership and potential influence in insuring that resources are mobilised. The essential elements for effective L-20 action are already in place: national infectious diseases detection and response systems are being strengthened in developing countries both bilaterally and through multinational efforts at WHO and elsewhere; the IHR revision is scheduled for completion during the next twelve months and will provide a consensus framework for global alert and response; and guiding principles for international outbreak alert and response are being agreed upon internationally, based on the lessons learned from the recent SARS outbreak and the current threat of a major outbreak of avian influenza.

It therefore makes good business sense for L-20 leaders to invest in and advocate for public health security in three areas:

- strengthening capacity for outbreak detection and response nationally, and in developing countries bilaterally or through multinational mechanisms,
- increasing robustness of the WHO-coordinated international system for outbreak alert and response as a safety net if national capacity fails to detect and contain, and
- establishing some type of risk management/insurance fund to provide incentives for countries to comply with the IHR and take steps to protect themselves and [†]others from potential high short term economic losses.

With strong advocacy and adequate resources, a fully operational system - functioning national surveillance and response capacities linked to a strong and responsive international alert and response system - can be in place within five years or less.

The estimated cost is 300 million Canadian dollars per year for 5 years. Potential funding sources, in addition to traditional development cooperation funds and funding from the Ministries of Health (contributing to this global public good is in their direct interest), are private sector investment banks, insurance and other risk management companies, and airlines that have already expressed interest in contributing to some type of fund that would help lower the risk of global epidemics and their potential economic costs by strengthening national and global alert and response.

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