Emerging infectious diseases: the public's view of the problem and what should be expected from the public health community

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The public's view of major threats to health, as with other contemporary issues, is largely influenced by the media. As new health-related information is released from the clinical and research communities, it is translated for and disseminated to the public through a variety of mechanisms. In the past, healthcare providers served as the primary source of health-related information for patients. Today, however, an unprecedented interest in health issues has led to intense media coverage of medical developments. Moreover, the internet has given interested individuals rapid access to virtually unlimited sources of information. Because of this symbiotic relationship between public interest and media attention, the actual impact or severity of a public health problem can be disproportionate to the amount of media coverage it receives, creating a climate of unnecessary fear and obscuring important health messages [1].

In 1999, the Centers for Disease Control and Prevention (CDC) released a series of reports describing ten great public health achievements in the United States during the 20th century [2]. The topics were chosen based on their impact on reducing death, illness, and disability in the United States, and include advances such as vaccinations, improved maternal and child health, safer and healthier food, fluoridation of drinking water, and safer workplaces. Also among this list is control of infectious diseases, resulting from improvements in sanitation, access to clean water, and the development and use of effective vaccines and antibiotics. So dramatic were these advancements that by the middle of the 20th century infectious diseases were no longer viewed as major public health threats in the United States and in many other developed countries. This false sense of security was short lived, however, as newly recognized and reemerging diseases continued to appear, many of which produced devastating consequences – most notably HIV/AIDS.

Advances against infectious diseases have not been universal. Worldwide, infectious diseases continue to be a leading cause of death, profoundly impacting the developing world. The World Health Organization (WHO) estimates that nearly 15 million (26%) of the approximately 57 million deaths that occurred

throughout the world in 2003 were caused by microbial agents [3] (Table 1). Leading the list are lower respiratory infections, responsible for 3.9 million deaths per year, followed by HIV/AIDS (2.8 million), diarrhea (1.8 million), tuberculosis (1.6 million), and malaria (1.2 million) [3]. The true burden of death from infectious diseases, however, is much higher since underreporting remains a major factor, particularly in the developing world. Moreover, many deaths associated with infections are not categorized as infection related (e.g., deaths from cancers caused by infectious agents). Despite the continued dramatic impact of these global killers, they receive very limited media attention – having become commonplace compared to the new and exotic.

One of the reasons for this disparity has been the actual increase in the number of emerging and reemerging infections that have surfaced during the last 10 years (Box 1). Examples include newly recognized diseases such as hantavirus pulmonary syndrome, new variant Creutzfeldt-Jakob disease, and Nipah and Hendra viral diseases, the introduction and spread of West Nile virus infection in North America, and intermittent outbreaks of Ebola hemorrhagic fever in parts of Africa. Other major concerns include the increasing problems created by antimicrobial resistance and the continued threat of bioterrorism. In 2003 alone, a newly recognized coronavirus spread across five continents sickening more than 8,000 people and causing 774 deaths from a new disease designated severe acute respiratory syndrome (SARS) [4], the exotic animal trade resulted in the first cases of human monkeypox in the Western hemisphere [5], and highly pathogenic strains of avian influenza virus killed humans and devastated the poultry industry in parts of Asia [6] – further heightening fears of pandemic influenza.

This continual onslaught of newly identified and reemerging infectious diseases, along with increased concerns on the part of policymakers, the media, and an interested public, has created a new public health perspective and a heightened sense of vulnerability regarding infectious diseases. Experiences with both naturally occurring and intentionally caused diseases have clearly demonstrated that infectious diseases can have severe consequences beyond public health, impacting national security and the global economy. Local outbreaks are no longer

Table 1. Leading infectious causes of death, 2003

Lower respiratory infections	3.9 million
HIV/AIDS	2.8 million
Diarrhea	1.8 million
Tuberculosis	1.6 million
Malaria	1.2 million

Source: World Health Organization. The World Health Report 2004: Changing history. Geneva: World Health Organization, 2004

Box 1. Selected infectious disease challenges 1993–2004

Hantavirus pulmonary syndrome
Plague
Ebola fever
New variant Creutzfeldt-Jakob disease
H5N1 inuenza
Nipah virus encephalitis
West Nile virus infection
Rift Valley fever
Anthrax
Vancomycin-resistant *Staphylococcus aureus*
SARS
Monkeypox
Community-associated methicillin-resistant *S. aureus*

considered limited threats but rather sentinel events capable of having much wider and potentially catastrophic implications. As a result, rapid and collaborative responses to infectious disease outbreaks have become both essential and expected.

In 2003, the Institute of Medicine published a report highlighting the increasing risks to public health posed by emerging microbial threats [7]. The report, *Microbial Threats to Health: Emergence, Detection, and Response*, serves as an update to the Institute's 1992 landmark report on emerging infections [8], which issued a strong caution against complacency toward infectious diseases and called for a rebuilding of the nation's public health system. The new report categorizes the spectrum of microbial threats into five areas: the global burden of AIDS, tuberculosis, and malaria; antimicrobial-resistant infections; vectorborne and zoonotic diseases; chronic diseases with infectious etiology; and microbes intentionally used for harm. The report also describes more than a dozen factors – human, biological, social, and environmental – that can work alone or in combination to produce a global microbial threat. Examples of these factors include human demographics, behavior, and susceptibility to infection; changes in technology, industry, travel, and commerce; changing ecosystems and microbial hosts; and social and political factors such as poverty and other inequities, lack of political will, and the consequences of war and terrorism.

As if a portent, the release of the IOM report in March 2003 coincided with the outbreak of SARS. The disease would prove to be an archetype of a global microbial threat, spreading rapidly as a result of international travel and requiring an international response to stop its spread. Although the earliest notification about the illness came on February 10, 2003, through a report posted on the Program for Monitoring Emerging Diseases, or "ProMed" [9], the disease had been occurring in southern China since November 2002 – spreading largely to hospital workers who had treated affected patients. The global outbreak began on February 21, 2003, when a Guangdong physician, traveling while ill, spent one night in a Hong Kong hotel. Although the exact modes of transmission are unknown, this individual would infect more than a dozen other hotel guests and visitors, many of whom served as index patients for major outbreaks in Hong Kong, Singapore, Vietnam, and Canada [10] (Fig. 1). In Singapore, more than 170 of the country's 238 SARS cases were linked to a single individual who became infected at the Hong Kong hotel [11].

Much has been learned from these recent outbreaks of emerging infectious diseases, especially SARS (Box 2). Despite its tragic health consequences and strong social, economic, and political impact, SARS was fortunately not the feared "Big One," appearing to spread primarily by droplets during close contact. The SARS outbreak uncovered both strengths and weaknesses in global disease detection and response efforts and can therefore serve as a strong warning as well as an opportunity to prepare for future threats [12]. SARS clearly showed the unpredictability of emerging infectious threats and the vulnerability of even the most developed nations. The virus did not respond to treatment, and no vaccine was available. The use of strict isolation and quarantine precautions – some involving tens of thousands of individuals – proved the best means of stopping the epidemic.

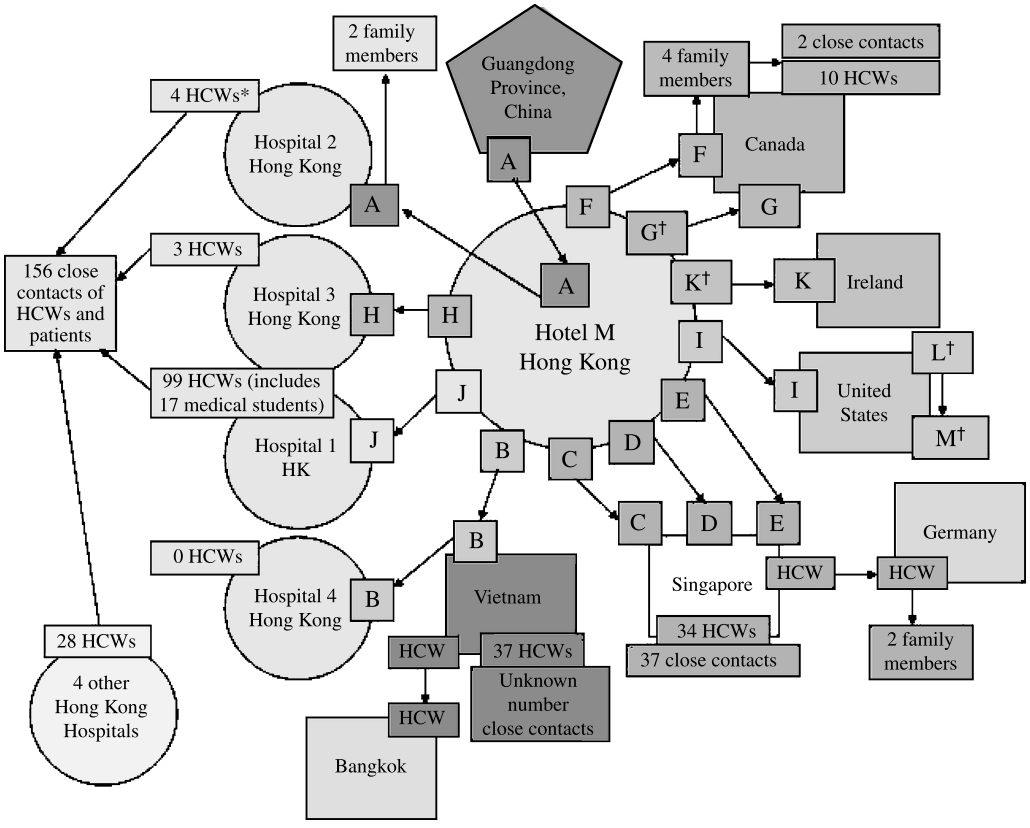

Fig. 1. Chain of transmission among guests at Hotel M – Hong Kong (2003): *Health-care workers; †Guests L and M (spouses) were not at Hotel M during the same time as index Guest A but were at the hotel during the same times as Guests G, H, and I, who were ill during this period. Data as of March 28, 2003

Box 2. Improving preparedness and response: *lessons learned from recent outbreaks*

– Strengthening existing and developing new national and international partnerships
– Training and educating a multidisciplinary workforce
– Ensuring "full use" of investments
– Encouraging transparency and political will
– Fostering a global commitment to address inequities
– Developing and implementing preparedness plans and research agendas
– Proactively communicating with health professionals, the media, and the public

While the first line of defense in controlling an outbreak remains strong national surveillance systems that can readily detect outbreaks, the SARS experience highlighted the importance of global disease detection efforts [13]. The same interconnected world that enables microbes to rapidly cross borders can also work to effectively stop their spread, providing an opportunity for establishing surveillance systems that can approach real time. For SARS, the internationally coordinated response led by WHO allowed clinical, research, and public health

experts around the world to exchange information on the new disease as quickly as it evolved. Part of this effort included the WHO Collaborative Multi-center Research Project on SARS Diagnosis, a network involving more than a dozen laboratories and 10 countries. In less than a month, three of these laboratories determined the cause of the illness – a previously unrecognized coronavirus. Also playing a major role in the response was WHO's Global Outbreak and Response Network (GOARN), a surveillance and response system of more than 120 organizations worldwide. Although GOARN responds to dozens of outbreaks in developing countries each year, the SARS outbreak represented its first response to an internationally spreading illness [13]. Among GOARN's most visible partners are the National Influenza Centers (http://www.who.int/csr/disease/influenza/centres2004/en/). Established in the 1950s, this expansive network of more than 100 institutions in over 80 countries is responsible for tracking influenza viruses to guide vaccine development and to recognize variants that may be capable of producing a pandemic.

Another message clearly indicated from recent emerging and reemerging infectious diseases is the need to strengthen existing and establish new linkages between the human and animal health communities. The majority of pathogens implicated in recent outbreaks, as well as most of those identified as potential bioterrorism agents, are vector-borne or zoonotic microbes, many of which have crossed the species barrier from animals to humans [4, 14] (Box 1). Continued urbanization and other environmental and human demographic changes suggest that this emergence of new zoonotic diseases will likely continue, requiring a corresponding convergence of highly trained human and animal health experts to effectively address them.

Ensuring that these experts have the capacity to respond to a broad range of infectious threats requires recruitment efforts and training programs across a variety of disciplines including clinical, laboratory, epidemiologic, and behavioral research. National and international collaborations among a skilled workforce are critical for improving global disease detection and ensuring an effective response. Such investments in human resources must also be met with improvements in research facilities and capacities. The benefits of such efforts can be substantial, extending beyond national borders and allowing for a "dual" or "full" use of resources. In the United States, investments made to strengthen national bioterrorism preparedness and response efforts over the past several years have improved overall preparedness for public health threats. An example is the Laboratory Response Network (LRN), a network of public and private laboratories established in 1999 by the Centers for Disease Control and Prevention (CDC) to respond quickly to acts of chemical and biological terrorism, emerging infectious diseases, and other emergencies. In 2003, the LRN provided valuable diagnostic services for SARS, monkeypox, and avian influenza, in addition to daily monitoring of potential bioterrorist agents.

The critical importance of transparency and political will in controlling infectious diseases was also evident during the SARS outbreak. China's months-long delay in reporting the outbreak not only prevented efforts to contain the epidemic locally but also proved most costly for its own region. In contrast was Vietnam, one

of the earliest countries affected by the outbreak and the first to contain it [15]. Dr. Carlo Urbani, an infectious disease physician working in Hanoi for WHO, recognized the unusual severity of the disease and quickly instituted infection control precautions, sadly too late to prevent his exposure to the infection that would cause his death. Dr. Urbani's prompt recognition along with Vietnam's commitment and global cooperation effectively limited the spread of SARS in Vietnam. China ultimately demonstrated one of the most extraordinary acts of political will in addressing the epidemic when more than 4,000 construction workers built a 1000-bed hospital in approximately one week. The importance of political will in addressing infectious diseases continues to be demonstrated most directly by its absence – an all too frequent obstacle to eradication efforts for vaccine-preventable diseases such as polio and measles.

Closely tied to political will is a commitment on the part of high income countries to help address inequities – the social, economic, and health disparities that contribute to the spread of infectious diseases [7, 16]. In 2000, at the United Nations Millennium Summit, representatives from nearly 200 U.N. member states resolved to help end human poverty and its ramifications. Termed the "Millennium Development Goals," this agreement requires countries to increase their efforts to address inadequate income; lack of food, clean water, and health care; substandard education; gender inequality; and environmental degradation. The goals also call for renewed commitment in addressing the disproportionate impact of infectious diseases on many of the world's poorest regions. A more recent undertaking is "The Grand Challenges in Global Health" initiative, funded by the Bill and Melinda Gates Foundation and administered by the Foundation for the National Institutes of Health. This initiative was established in 2003 to help develop solutions to critical problems that perpetuate the spread of disease in the developing world. Such international undertakings directed toward the diseases causing the greatest morbidity and mortality in the developing world should be priorities for wealthier countries. In addition to meeting enormous humanitarian needs, efforts to address these daunting global killers can help remove major obstacles to economic growth and development, thereby strengthening public health infrastructures and disease detection capacities worldwide.

Perhaps most evident during the SARS outbreak was the crucial need for rapid dissemination of accurate information – both for the medical and scientific experts confronting the epidemic and for a concerned public. During the SARS epidemic, the availability of electronic communications enabled networks of laboratory scientists, clinicians, and public health experts to share information and rapidly generate a scientific basis for public health action against a novel disease [17] – a major step toward lessening the health consequences of the outbreak. These extraordinary efforts and swift actions, however, did not prevent the severe social and economic ramifications that resulted from SARS. These consequences, largely generated by the fears and perceptions of a vulnerable public, highlight the critical need to communicate timely and accurate information in the face of scientific uncertainty. Proactive communications directed at health professionals can enhance the ability of those on the front lines to detect the

unusual – e.g., test results or patient symptoms that could signal the occurrence of a new health threat. Similarly, proactive and open communication between public health officials and policymakers is essential for sound public health action. Finally, proactive communications through public health websites and with the media can help ensure broad dissemination of timely and accurate risk information to members of the public that can enable them to make important decisions in protecting their health.

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