37 Global Health Security: The WHO Response to Outbreaks Past and Future

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37.1 Introduction

During the first years of the 21st century, concern about the threat of infectious diseases has rapidly escalated after three dramatic events: a bioterrorist attack, the emergence and international spread of a severe new disease, and the looming threat of an influenza pandemic. Concern has progressively mounted: worst-case scenarios for one outbreak have been replaced by the next. While the three events are distinctly different in their origins and epidemiology, each has delivered a vivid warning that the world is now far more vulnerable to the adverse effects of emerging and epidemic-prone diseases. Together, they have challenged the very notion that an outbreak can be considered 'localized' in a highly mobile, economically interdependent, and electronically interconnected world. Although the number of cases and deaths has been comparatively small (table 37.1), the social and economic consequences have been enormous.

Table 37.1: Cases and deaths from recent outbreaks compared with those from persistent infectious disease threats ([a] numbers infected in June 2005). **Source**: WHO Statistics; at; <http://www.who.int/research/en/>.

Disease	Year	Cases	Deaths
Anthrax	2001	22	5
SARS	2003	8098	774
H5N1 avian influenza	2004 – June 2005	108	54
AIDS	2004	39.4 million[a]	3.1 million
Tuberculosis	2004	8.97 million[a]	1.7 million
Malaria	2004	400 million	1 million

The unprecedented volume of international air travel – airlines now carry 1.6 billion passengers each year – has opened opportunities for pathogenic agents to be carried to any part of the world within a few hours. The interdependence of economies and commerce means that the disruption caused by an outbreak in one area can likewise spread quickly around the world. Broad access to electronic communications immediately gives outbreaks a large international audience and amplifies the anxiety they provoke, leading to behaviours – avoidance of travel, drops in consumer consumption of certain foods and goods – that further exacerbate the social and economic consequences. Since the start of the 21st century, public perceptions of the severity of outbreaks have been shaped by striking images of investigative squads in full protective gear, masked faces and empty airports, and the mass culling of millions of animals. Politicians, too, now appreciate that outbreaks can have consequences that extend far beyond the health sector. For all these reasons, the risk of further outbreaks, especially when caused by a new pathogen, is increasingly seen as a direct threat to national and international security.

After a brief introduction of the evolution of the health security concept within the WHO (37.2), three health security issues will be discussed for the three outbreaks – anthrax, SARS and H5N1 avian influenza (37.3 and 37.4) – and the specific ways they have altered perceptions of the infectious disease threat (37.5). These changes are then placed in the context of concerns that had been mounting, albeit far more gradually, during the last decades of the previous century (37.6 to 37.8). Changes in concepts of national and international security are discussed in terms of their increased ability to accommodate infectious disease threats (37.9). The remaining sections explain the operational framework put in place by WHO to defend global health security (37.10).

37.2 Evolution of the Health Security Concept within WHO

UNDP (1994) mentioned health security[1] as one of seven dimensions of its suggested human security concept. The concept of a *health security* has been introduced during a WHO Colloquium on Women's Health Security on 5 September 1995 in Beijing as encompassing:

> all aspects of the basic human right to health. Health security means the guarantee of accessible and affordable health care to all – men, women and children. Its three cornerstones are equity, choice and partnership. In the case of women, this translates into provision and access to information and education; adequate nutrition; freedom from violence; the right to work in safe environments; and access to appropriate health care services. ... Freedom from all forms of violence against women is an essential component of health security. ... WHO calls for governments and health planners to improve their response to the threat to women's physical and mental well-being by regarding violence as an important health issue. ... WHO believes that only through health security, can women have access to quality health care services, and be sure that their health needs will be met from birth to old age.[2]

The WHO Global Commission on Women's Health adopted at the United Nations' Fourth World Conference on Women a Declaration calling for government action to sustain the realization of women's health security.[3] The WHO contributes to *Global Health Security*, and specifically to the concept of *Global Public Health Security*[4]. This is done through WHO Pandemic and Epidemic Alert and Response activities, via a global partnership focusing on three goals: a) contain known risks, b) respond to the unexpected, and c) improve preparedness.[5]

37.3 Anthrax, SARS and an Ominous Influenza Virus

The deliberate use of anthrax to incite terror, which quickly followed the events of 11 September 2001 in the USA, changed the profile of the infectious disease threat in a dramatic and definitive way. Prior to these events, the emergence of new diseases – and most especially, the impact of AIDS on Africa and on economically important nations in Asia – had sharpened concern about the infectious disease threat as a disruptive and destabilizing force, and given it space in national security debates. The reality of bio-terrorism immediately raised the infectious disease threat to the level of a high priority security imperative worthy of attention in defence and intelligence circles. In so doing, it also focused attention on several features of the infectious disease situation that make outbreaks – whatever their cause – an especially ominous threat. As smallpox again became a disease of great concern, both politicians and the public began to comprehend problems, long familiar to public health professionals.

1 This brief section was added by Hans Günter Brauch with the consent of the authors. The new sectoral 'health security' concept is closely related with all five security dimensions: the economic, societal, environmental but also with the political and military. Within the *environmental* dimension of security (ecological security) it is closely linked with 'water security' (referring to the health problems that are generated by *water scarcity* (drought, heat waves), *abundance* (flash floods and inundation) and by *degradation* and *pollution* (water related diseases). In the *societal* and *economic* dimension of security health security refers to totally different discourses in the North (health reform, affordability of public health services for aging societies partly based on solidarity principles) and in the South (bring basic health services to the poor and most vulnerable to both diseases and water related hazards). The health security debate has also acquired a *political* dimension, e.g. due to the use of economic sanctions (e.g. on the health of children in Iraq), and the prevention of scientific assessments of the impact of enriched uranium projectiles during the second Persian Gulf war in 1991 (Haavisto 2003; UNEP 2003, 2003a, 2005, 2007) and a *military* dimension with regard to the impacts of wars (war and post-war periods) but also on the health of combatants and the civilian population (also by the use of both conventional and mass destruction weapons that do not discriminate between both) and more recently primarily of the fear that terrorists may use biological and chemical weapons indiscriminately thus threatening the survival of whole civilian populations in the urban centres of the economically developed world. In the conceptualization of health security differences exist also within the UN system with regard to the referent object. While many have used the state (national security) as the major referent of health security, UNDP (1994) referred to the individual human being, the people or to humankind (human security) as the key referent object.

2 See: Press Release WHO/53, 12 July 1995: "WHO calls for better Women's health security", at: <http://www.who.int/archives/inf-pr-1995/pr95-53.html>.

3 See: Press Release WHO/65, 5 September 1995, at: <http://www.who.int/archives/inf-pr-1995/pr95-65.html>.

4 The World Health Report 2007. A Safer Future – Global Public Health Security in the 21st Century. World Health Organization. http://www.who.int/whr/2007/en/index.html.

These have ranged from silent incubation periods that allow pathogens to cross borders undetected and undeterred, through the finite nature of vaccine manufacturing capacity, to the simple fact that outbreaks have a potential for international spread that transcends the defences of any single country.

Speculations about the consequences of a biological attack with the smallpox virus produced many scenarios about how a new or unfamiliar pathogen might behave in the 21st century. Even in the most advanced countries, the non-specific symptoms of a flu-like illness would create diagnostic confusion. Clinicians, unfamiliar with the disease, would initially miss cases, thus delaying the first alert. Inadequate supplies of vaccines and antiviral drugs would fuel social upheaval. Lacking adequate surge capacity, hospitals and health care systems would be overwhelmed. Authorities would resort to enforced isolation and quarantine. The silent incubation period would facilitate rapid international spread by air travellers. Given broad access to electronic communications, rumours would spread with equal speed. Travel and tourism to affected areas would come to a virtual standstill.

When SARS began to spread internationally in late February 2003, many of these scenarios were played out in reality. Others would take on concrete meaning in 2004, when a highly lethal avian virus began moving the world to the brink of another influenza pandemic. SARS – the first severe new disease of the 21st century – spread rapidly along the routes of international air travel. The disease placed every country with an international airport at risk of an imported case. SARS spread from person to person, required no vector, displayed no particular geographical affinity, mimicked the symptoms of many other diseases, took its heaviest toll on hospital staff, and killed around 10 per centt of those infected. In the absence of a vaccine or cure, isolation and quarantine became the principal control measures. SARS caused great social disruption and economic losses far out of proportion to the number of cases and deaths and well beyond the outbreak sites. News on the disease jolted stock markets. Projections for economic growth were revised downwards. Commerce in distant countries dependent on Asian goods and manufacturing capacity suffered. Schools, hospitals, businesses, and some borders were closed. Broad access to electronic communications and extensive media coverage made the public deeply aware of SARS and worries about it spread. Travel to affected areas plummeted, causing airlines with Asian routes to lose an estimated US $ 10 billion. Fortunately, these consequences, apparent early on, brought political support at the highest level and increased pressure to contain the outbreak as the only way to regain economic health (WHO 2003a).

SARS did not change the world, but it did reveal how much the world has changed in terms of increased and universal vulnerability to new disease threats. SARS challenged the assumption that wealthy nations, with their well-equipped hospitals and high standards of living, would be shielded from the amplification of cases seen when new diseases emerged in the developing world. Contrary to expectations, SARS spread most efficiently in sophisticated urban hospitals. SARS redefined national responsibilities for outbreaks in two important ways. *First*, given the international repercussions of outbreaks in an interconnected and mobile world, governments are likely to be held accountable, by the international community as well as by their citizens, for failures in their response to an outbreak. *Second*, broad access to electronic communications – from mobile phones to the internet – has made it increasingly likely that official notification of an unusual disease event will be preempted by rumours, likewise giving national events an immediate international audience. It has also made outbreaks too quickly and highly visible for governments to attempt to conceal them. China's initial denial of its SARS outbreak and prohibition of press reports could not stop mobile phone users from sending a text message about a 'fatal flu' in Guangdong Province more than 45 million times on a single day in early February 2003.[5]

SARS stimulated an emergency response, and a level of media attention, on a scale that may have changed public and political perceptions of the risks associated with emerging and epidemic-prone diseases. Reports in scientific publications and the media and from governmental agencies in several countries generally agree that SARS raised the profile of public health to new heights by demonstrating the severity of adverse effects that a health problem can have on economies, social stability and political careers (National Intelligence Council 2003).

At the peak of the SARS outbreak, many infectious disease experts, asked to comment on the significance of the new disease, used the example of pandemic influenza for comparative purposes. While SARS was certainly a matter for grave concern, the true potential of an infectious disease to wreak havoc in a glo-

5 John Pomfret: "Outbreak gave China's Hu an opening; President responded to pressure inside and outside country on SARS", in: *Washington Post*, 13 May 2003.

balized society would be seen with the arrival of the next influenza pandemic, which would be impossible to stop. Far more contagious, and transmitted during a short incubation period, pandemic influenza would extend the devastating consequences seen with SARS in Asia and Toronto, Canada to the entire world within a matter of months. While SARS infected just under 8,000 people, killing almost 800, many millions of people would unquestionably perish during the next influenza pandemic.

In January 2004, six months after WHO declared the SARS outbreak over, intensified surveillance for a recurrence of cases detected a cluster of patients with severe respiratory disease at a paediatric hospital in Hanoi, Viet Nam (WHO 2005). That event marked the start of an outbreak of human cases of avian influenza, caused by the H5N1 strain of the virus, that has brought the world closer to an influenza pandemic than at any time since 1968. The scenarios of how a highly contagious and lethal virus will behave under the unique conditions of the 21st century have begun again, but this time with greater urgency in the face of an imminent catastrophe. No one would question the directness of the threat that pandemic influenza poses to national and international security. Should the case fatality rate be as low as 1 per cent, the highly contagious nature of influenza and the size of the world's population could translate into 30 million deaths, concentrated over a short period of time, if less than half of today's 6.5 billion people were infected. Moreover, the concern with national security is so great that international sharing of limited supplies of vaccines and antiviral drugs is considered exceedingly unlikely; in past pandemics, countries have consistently nationalized manufacturing capacity, allowing exportation of vaccines and drugs only after all national needs had been met. Perhaps most important, differences in the capacity of industrialized and developing countries to respond to outbreaks is now much greater than at the start of the previous century. With health services in many developing countries already overburdened by AIDS, tuberculosis, and malaria, an event such as a pandemic influenza is likely to strain fragile health systems to the point of collapse, further increasing the world's present imbalance.

37.4 Microscopic Adversaries: Well-equipped to Invade, Evade, and Surprise

The source of the evolving infectious disease threat resides in microscopic adversaries that change and adapt with great speed and have the advantages of surprise on their side. During the past 30 years, the infectious disease threat has diverged considerably from previous patterns of epidemiology, drug susceptibility, geographical distribution and severity (Lederberg/Shope/Oaks 1992). Such divergence arises from the naturally volatile behaviour of the microbial world, amplified by recent ecological and demographic trends. Constant evolution and adaptation are the survival mechanisms of the microbial world. Infectious disease agents readily and rapidly multiply, mutate, adapt to new hosts and environments, and evolve to resist drugs. This natural propensity to change has been greatly augmented by the pressure of a crowded, closely interconnected, and highly mobile world, which has given infectious agents unprecedented opportunities to exploit (Rodier/Ryan/Heymann 2000). Vulnerability to the threat is now recognized as universal. As adversaries, microbial pathogens have particular advantages in terms of invisibility, mobility, adaptability, and silent incubation periods that render national borders meaningless.

Changes in the way humanity inhabits the planet have disrupted the delicate equilibrium of the microbial world. Population growth, incursions into previously uninhabited areas, exploitation of the environment, and intensified agricultural and farming practices have disturbed the natural environment in which pathogens, plants, and animals have peacefully coexisted for centuries (Heymann/Rodier 2001). These pressures have given pathogens multiple opportunities to exploit new environments and invade new hosts, including humans. As a result, new diseases, which are poorly understood, difficult to treat, and often initially highly lethal, are now emerging at an unprecedented rate (Woolhouse/Dye 2001). During the past three decades, more than 40 new viruses, bacteria, and other pathogens capable of infecting humans have been identified, and this trend is certain to continue (Heymann 2003).

Apart from favouring the emergence of new diseases, demographic trends have created conditions that allow infectious diseases – whether old or new – to flourish. Populations throughout the world are now larger, older, and more closely crowded in urban centres, often living under squalid conditions. Even

the wealthiest nations have pockets of poverty that act like reservoirs, incubating epidemic-prone diseases linked to poor hygiene and sanitation. The growing numbers of complex emergencies and refugees living in crowded camps also provide fertile breeding grounds for outbreaks of both common and exotic diseases. Wealthy nations, too, can contribute to the emergence of new diseases. The emergence of bovine spongiform encephalopathy, or 'mad cow' disease, has been linked to processed animal feeds; processed foods using lower quality meat are thought to have contributed to the emergence of a related disease in humans which, though rare, is invariably fatal (WHO 2002b). The food chain has likewise become globalized with two results: the investigation of food-borne outbreaks has become enormously complex; recalls of contaminated food can stretch across continents and cost millions of dollars (WHO 2002; Tauxe 1997).

The misuse of antibiotics and other drugs is another ominous trend introducing another universal problem: the rapid development of resistance to front-line drugs, leaving some major diseases with no affordable treatment (WHO 2001a). Healthcare in all countries is now compromised by the shrinking number of effective antimicrobials. Fuelled by co-infection with HIV, the return of tuberculosis as a global menace has been accompanied by the emergence of multi-drug-resistant forms costing up to 100 times more to treat (Kindhauser 2003). Malaria may soon be resistant worldwide to all currently available first-line drugs (Kindhauser 2003). Drug resistance to common bacterial infections is now so pervasive that it raises the spectre of a post-antibiotic era in which many life-saving treatments and routine surgical procedures could become too risky to perform (WHO 2001).

These developments have eroded past confidence that high standards of living and access to powerful medicines could insulate domestic populations from infectious disease threats abroad. They have also restored the historical significance of infectious diseases as a disruptive force – this time cast in a modern setting characterized by close interdependence of nations and instantaneous communications (Heymann 2003a). Within affected countries, the disruptive potential of outbreaks and epidemics is expressed in ways ranging from public panic and population displacement to the interruption of routine functions that occurs when containment requires the emergency immunization of populations numbering in the millions. Disruption can also be measured in economic terms. Outbreaks are always expensive to contain. Affected countries can experience heavy additional burdens in the form of lost trade and tourism—estimated at US $ 2 billion during the 1994 outbreak of plague in India (Cash/Narsimham 2002). The losses to Asian economies associated with SARS have been estimated as at least US $ 30 billion (WHO 2003a). As of May 2005, the total direct losses in gross domestic product accruing from the poultry sector in Asia, damaged by H5N1 avian influenza, were estimated at US $ 10 billion; indirect costs are still being estimated (Cash/Narasimham 2002). At the global level, some of the most telling efforts to measure economic consequences, in terms of international relations and foreign affairs, have centred on determining what the AIDS epidemic in sub-Saharan Africa means for the economies of wealthy nations. At one extreme, the high mortality caused by this disease and the particular age group it affects has been interpreted as the cost to industrialized countries of lost export markets (Kassalow 2001). At the other extreme, the economic costs of AIDS to the international community have been expressed in terms of the price of drugs and services needed to rescue a continent (Sachs 2001). The human suffering caused by this disease defies calculation in any terms.

37.5 Changing Perceptions of Security

Efforts to understand the security implications of emerging and epidemic-prone diseases have taken place within the context of a reconsideration of what constitutes a security threat in the post-Cold War era. In its traditional meaning, 'security' has long been a strictly national pursuit aimed at defending territorial integrity and ensuring state survival. It is intrinsically self-centred, focused on shielding state citizens from external danger in an international system ruled by anarchy (Burchill 1996). Traditional approaches to the defence of national security are military functions: protecting borders, fighting wars, and deterring aggressors (Ban 2001; CSIS 2000).

Two events have challenged these traditional views. First, the end of the Cold War meant an end to security issues polarized by the ideological conflict and geopolitical interests of the superpowers, and kept on edge by the nuclear arms race. As old threats subsided, more attention focused on threats arising from civil unrest, internal conflicts, mass migration of refugees, and localized wars between neighbouring countries, particularly when these had the capacity to

undermine state stability or contribute to state failure (Nichiporuk 2000; Kelley 2000; Weiner 1992; Price-Smith 2002). The absence of a bipolar power system magnified these threats considerably, as intervention to prop up a failing state of geopolitical strategic interest was no longer assured (Fidler i.p.; Tickner 1995; Cooper 1996). As a result, security issues became broader and more complex, and attention began to focus on ensuring the internal stability of states by addressing the root causes of unrest, conflict, and mass population movement rather than defending national borders against external aggressors (Holsti 1996). In the wake of these changes, a number of factors – from environmental conditions to income, education, and health – were put forward as determinants of internal state stability and therefore of potential relevance to the evolving security debate (Elbe 2002).

In a second event, the forces of globalization demonstrated the porous nature of national borders and eroded traditional notions of state sovereignty. In a closely interconnected and interdependent world, the repercussions of adverse events abroad easily cross borders to intrude on state affairs in ways that cannot be averted through traditional military defences (Ban 2001). For example, in the world's tightly interrelated financial system, a crisis in a distant economy can rapidly spread to affect others.[6] Many other transnational threats – whether arising from environmental pollution or tobacco advertising – were recognized as having an effect on internal affairs that went beyond the control of strictly national actions. Emerging and epidemic-prone diseases qualified as a transnational threat for obvious reasons: they easily cross borders in ways that defy traditional defences and cannot be deterred by any state acting alone (Ban 2001). In the broadened debate, their disruptive potential gave them added weight as a possible security concern, although this potential differs considerably between industrialized and developing countries (Kelley 2000).

This disruptive potential arises from several general characteristics of outbreaks, which are further defined by the pathogen and the political, economic, and cultural context in which the outbreak occurs. Epidemics are disruptive because of the large number of people they can infect within a short period of time. For example, within a single week in February 2006, the Chikungunya virus disease affected an estimated 22,000 people on the small island of La Réunion in the Indian Ocean. A severe new disease of unknown cause and epidemiological potential is more alarming for the public than an established epidemic-prone disease that recurs according to well-characterized patterns. These characteristics give outbreaks their potential to cause social disruption and economic losses well beyond health care costs and out of proportion to the true severity of the risk.

First, outbreaks are urgent public health emergencies accompanied by rapid efforts to care for cases, prevent further spread, and bring the outbreak under control. Necessary control measures can be drastic: mass emergency immunization, quarantine, border control, travel restrictions, and mass slaughter of animals.

Second, the behaviour of outbreaks is unpredictable, making it difficult for authorities to reassure the public on such key questions as who is at risk, will the outbreak spread, and will the recommended control measures offer adequate protection. The history of recent outbreaks yields many examples of a sudden surge in cases or spread to another country after an outbreak was thought to have peaked. Such setbacks can arise from a single lapse in infection control at a hospital, a hidden pocket of infection missed by surveillance, smuggled animals, or the simple volume of international air travel. Given the propensity of the microbial world to undergo rapid change, new risks groups can emerge, modes of transmission can change, and treatments can fail if drug resistance develops.

As a third feature, outbreaks are usually alarming events that can elicit great anxiety in the general public. This anxiety can endure even when new knowledge about the outbreak is reassuring. A disease that spreads easily from person-to-person by the airborne route will be more frightening than a disease that requires close contact with an infected person or animal, as these behaviours can theoretically be avoided. Other features likely to amplify public concerns include high fatality in the absence of a vaccine or cure, a propensity to spread internationally, suspicions that a disease has been deliberately introduced, and an amplification of cases in health care facilities, thus diminishing response capacity when it is needed most.

Such public reactions give outbreaks a fourth shared feature: their high political profile. The extreme behaviours that can result are well documented and range from the wearing of masks and avoidance of travel, through fear of hospitals and stigmatization of patients and minority groups, to riots, loss of confidence in governments, and consumer avoidance of certain food items. Such public reactions give out-

6 Thomas Homer-Dixon: "Now comes the real danger", in: *Toronto Globe and Mail*, 12 September 2001.

breaks a fourth shared feature: their high political profile. When public anxiety, social disruption, and economic losses accompany an outbreak, it gains attention at government levels far higher – and more powerful – than public health. Such attention can be a major advantage when it brings full political commitment to outbreak control, supported by adequate resources. At the other extreme, outbreak control can be severely impeded when political authorities, motivated by economic rather than public health concerns, decide to withhold information about an outbreak, downplay its significance, or conceal it altogether. Political conditions can also shape the impact of an outbreak. Countries with a democratic tradition, in which politicians are elected and held accountable for their actions and the press enjoys full freedom, will be expected to issue reliable information about an outbreak, and retain public confidence. More authoritarian governments may be less forthcoming with public information but will have the political power to enforce public compliance with control measures and can thus bring an outbreak under control with impressive speed, albeit frequently without regard for public sentiment or human rights.

All of these features working together give outbreaks yet another shared characteristic: they are nearly always newsworthy events closely followed by the national if not the international press. On the positive side, media coverage can be used effectively, especially near the start of an outbreak, to keep the general public informed and communicate recommended protective measures. Unfortunately, media coverage often fuels public alarm and intensifies the associated economic losses. As one recent example, reports in several European countries of H5N1 avian influenza in a small number of wild birds brought immediate drops in poultry consumption of 30 per cent and higher. In France, confirmation of H5N1 infection in a single commercial farm cost the poultry industry an estimated US $ 48 million within a month.

In industrialized countries, an event such as an influenza pandemic, where supplies of vaccines and antiviral drugs are clearly insufficient, has the capacity to destabilize populations, especially when life-saving interventions are made available to only a select few groups. This capacity helps explain why avian influenza and the prospects of another pandemic have been so widely discussed as issues important to national security and foreign affairs. All the implications of the intrusion of public health within the security arena still need to be understood and taken into account to ensure proper coordination between the two sectors.

While neither the timing nor the severity of the next pandemic can be predicted, history shows that these events consistently bring an explosive surge in the number of illnesses and deaths sufficient to temporarily paralyse public services and economic productivity (WHO 2005). Another consequence will be increased absenteeism in all sectors of the labour force, with capacity temporarily reduced in such essential public services as health care, law enforcement, transportation, utilities, and telecommunications. As SARS so amply demonstrated, a new disease with the right features can have a devastating effect on economic activity in some of the world's most sophisticated cities. Conservative estimates indicate that SARS caused economic losses in Asia alone of around US $ 30 billion. In November 2005, the World Bank estimated that an influenza pandemic could cost the world economy US $ 800 billion within a year; these losses would largely arise from the uncoordinated efforts of the public to avoid infection. SARS and pandemic influenza are, however, exceptional diseases. In industrialized countries, outbreaks of the more common infectious diseases are always costly but rarely qualify as socially disruptive.

In developing countries, where economies are fragile and infrastructures weak, outbreaks and epidemics are far more directly and frequently disruptive. In these countries, the destabilizing effect of high-mortality endemic diseases, including malaria and tuberculosis as well as AIDS, is amplified by emerging and epidemic-prone diseases, as they disrupt routine control programs and health services, often for extended periods, due to the extraordinary resources and logistics required for their control (Kindhauser 2003).

For example, outbreaks of epidemic meningitis, which regularly occur in the African 'meningitis belt,' disrupt normal social functions and bring routine health services to the brink of a standstill as containment depends on the emergency vaccination of all populations at risk (Kindhauser 2003). During the recent SARS outbreak in China, programmes for childhood immunization, AIDS, and tuberculosis were halted for months as all staff and resources were diverted to SARS control. The resurgence of African sleeping sickness, which is also a disease of livestock, has disrupted productive patterns of land use and jeopardized food security in remote rural areas (Kindhauser 2003). Recent outbreaks of dengue in Latin America required the assistance of military forces,

sometimes from neighbouring countries, for their containment. The response to the 2005 outbreak of Marburg haemorrhagic fever in Angola likewise drew support from military forces.

Outbreaks of new or unusual diseases can cause public panic to a degree that calls into question government's capacity to protect its population, as happened when the Nipah virus encephalitis began killing pig farmers in Malaysia in 1999. As another example, management of the SARS outbreak jeopardized political careers in several countries. In addition, the dramatic interruption of trade, travel, and tourism that can follow news of an outbreak places a further economic burden on impoverished countries with little capacity to absorb such shocks (Cash/Narasimham 2002).

37.6 New Tools: Real-time Disease Intelligence

In 1995, the Democratic Republic of the Congo experienced its second highly fatal outbreak of Ebola haemorrhagic fever, this time in Kikwit. That outbreak, which smouldered undetected for three months, caught the international community by surprise and demonstrated the urgent need to improve outbreak alert and response capacity in several specific ways (Heymann/Barakamfitiye/Szezeniowski 1999). It underscored the need for stronger infectious disease surveillance and control worldwide, for better international preparedness, and for new and faster systems for gathering disease intelligence at the international level and arranging the logistics of emergency response. It also underscored the need to accommodate the demands of the press and the public for authoritative and continuous information. A need for more broad-based international health regulations, and for electronic information systems connecting all parts of WHO, became evident, as did the realization that timely and adequate outbreak detection and response required coordinated support from a broad coalition of partners. The urgency of the situation was formally acknowledged in May 1995, when the World Health Assembly, in its first resolution on emerging infections, asked WHO to draw up plans and strategies for improving world capacity to recognize and respond to new diseases (WHO 1995).

In 1996, WHO began building up an operational system, supported by a 'virtual' architecture, for meeting these needs. Earlier detection of outbreaks was of utmost importance. To expedite the gathering of epidemic intelligence, WHO introduced the *Global Public Health Intelligence Network* (GPHIN) in 1997.[7] This powerful new tool, developed and maintained for WHO by Health Canada, is a customized search engine that continuously scans open web sites, in six languages, for rumours and reports of suspicious disease events. GPHIN operates as a sensitive real-time early warning system by systematically searching for key words in over 950 news feeds and electronic discussion groups around the world. Human review and computerized text mining are used to filter, organize and classify the more than 18,000 items it picks up every day, of which around 200 merit further analysis by WHO. Apart from its comprehensive and systematic search capacity, GPHIN brought great gains in time over traditional systems in which an alert is sounded only after case reports at the local level progressively filter to the national level and are then notified to WHO (Public Health Agency of Canada/GPHIN 2004; Mawudeku/Lemay/Werker/Andraghetti/St. John 2007).

To broaden international capacity and share the burden of outbreak response, the *Global Outbreak Alert and Response Network* (GOARN) was set up in early 2000 to ensure that a 'strike force' of specialized staff and technical resources could be rapidly assembled and deployed for emergency investigations and on-the-spot assistance. This overarching network currently interlinks, in real time, 120 existing networks and institutes which together possess much of the data, laboratory capacity, specialized skills, and experienced personnel needed to keep the level of international preparedness high. As GOARN partners have a broad geographical base and many have staff within countries frequently affected by outbreaks, this network formally complements GPHIN's 'artificial intelligence' as a first-hand human source of early information about outbreaks (Heymann/Rodier 2001).

The establishment of GOARN solved many long-standing problems. First, by drawing on the resources and expertise of a broad range of technical partners, the network obviated the need – with all its associated expenses – to maintain a permanent staff of dedicated experts in the face of a danger that emerges only sporadically and unpredictably. Second, as outbreaks present widely varying demands for their control, GOARN brought much-needed flexibility and a surge capacity that could be tailored to outbreak needs. The network has a light 'virtual' operational structure,

7 D. Balkisoon: "Canada begins global inspection for infection", in: *Capital News*, 12 March 1999.

overseen by a steering committee outside WHO, and has been kept free of heavy administrative or bureaucratic procedures. The establishment of GOARN also helped ensure that experts from any single country would have frequent opportunities, during international responses, to exercize and sharpen their technical skills. Finally, GOARN introduced a formal mechanism for balancing national and international strategic interests, particularly when the response to an outbreak in one country has implications for the international community at large.

A new system of electronic communications was also set up to make better use of a unique geographical and strategic resource: WHO's 141 country offices, concentrated in the developing world and located within or in close proximity to ministries of health. Although the size of these offices varies according to the disease situation in the country concerned, all offices are staffed with medical experts and often with epidemiologists, and all have the essential logistic equipment, including vehicles and local communications, needed for prompt on-the-scene investigation of outbreaks. During outbreak response, these offices facilitate the arrival of international staff by arranging flights, customs and immigration clearance, and accommodations. By electronically interlinking these offices, WHO added yet another channel for feeding in rapid news about unusual disease events within countries, and allowing those countries to tap the resources of GOARN.

With all these systems bringing in abundant rumours, WHO simultaneously introduced a novel approach for the systematic verification of outbreaks, with the goal of rapidly determining which rumoured outbreaks were of genuine international concern, and then translating the results into action-oriented information for electronic transmission to partners (Grein/Kamara/Rodier/Plant/Bovier/Ryan/Ohyama/Heymann 2000). Procedures for outbreak verification rely on an initial assessment that uses standard epidemiological criteria to determine whether an event meets the definition of an outbreak, and additional criteria, developed by WHO, to determine its international significance. These criteria include unexpectedly high rates of illness and death for a particular geographical area or season, potential for spread beyond national borders, interference with international travel or trade, likely need for international assistance to contain the event, and possible accidental or deliberate release of a pathogen. Once an event has been determined to have potential international importance, the process of verification is initiated. This process relies on confirmation of details from national health authorities, usually through the WHO country office, and from GOARN partners present in the field. For rapid diagnostic confirmation, especially of unusual or highly pathogenic agents, WHO relies on its network of collaborating laboratories, many of which are specialized in the diagnosis of specific diseases or groups of diseases. An evaluation of the effectiveness of this new system of outbreak verification was conducted after two years and revealed that sources other than official government notifications were by far the most frequent origin of initial information about outbreaks in all geographical areas and for all diseases (Grein/Kamara/Rodier/Plant/Bovier/Ryan/Ohyama/Heymann 2000)

To facilitate the coordination of large-scale international assistance, often involving many agencies from many nations, operational protocols were developed setting out standardized procedures for the alert and verification process, communications, coordination of the response, emergency evacuation, research, evaluation, monitoring, and relations with the media (WHO 2000; 2000a). Other guidelines provide a code of conduct governing the behaviour of foreign nationals during and after field operations in the host country. By setting out a chain of command and executing the containment response in an orderly way, these protocols help protect against the very real risk that samples of a lethal pathogen might be collected – under the often hectic conditions that surround an outbreak – and used for bioterrorist purposes. All of these developments became the driving force for initiating a sweeping revision of the International Health Regulations, which govern international procedures for the reporting of epidemic-prone diseases and the application of measures to prevent their spread (WHO 2002a).

37.7 Tools Refined in Practice

Mechanisms for outbreak detection and response were refined as WHO responded to other infectious disease emergencies or strengthened vigilance for especially worrisome diseases. In 1996, the so-called 'meningitis belt', a group of 18 semi-arid African countries that stretch across the bulge of the continent from Ethiopia in the east to Senegal in the west, experienced the largest recorded outbreak of epidemic meningococcal disease in history (Kindhauser 2003). More than 200,000 cases and 20,000 deaths occurred. Neither countries nor the international com-

munity nor the manufacturers of vaccines and other supplies could cope with the scale of the crisis. The emergency response fully exhausted international vaccine supplies and drew attention to the need to be prepared for future outbreaks on a similar scale. In January 1997, WHO established the *International Coordinating Group on Vaccine Provision for Epidemic Meningiti*s (ICG) in partnership with UNICEF, the International Federation of Red Cross and Red Crescent Societies, Médecins Sans Frontièrs, other agencies, ministries of health in affected nations, and the major vaccine manufacturers and drug suppliers. The ICG worked quickly to replenish vaccine stocks and ensure that these were pre-positioned in countries at greatest risk. To date, more than 20 million doses of meningococcal vaccine have been channelled through the ICG mechanism. It has also accelerated improvements in the surveillance system, as the prospect of assistance is a compelling incentive for countries to report cases (Kindhauser 2003).

The dramatic recent resurgence of yellow fever, especially in West Africa, resulted in similar problems with vaccine supply. The seriousness of the problem became apparent during a yellow fever epidemic that began in 2000 in Guinea, where no routine or catch-up vaccination campaigns had been conducted since the end of the 1950's. Vaccine shortage delayed mass immunization in some areas until four weeks after the epidemic's peak. This situation prompted the ICG to establish a similar mechanism for the stockpiling of 2 million doses of yellow fever vaccine, with priority distribution reserved for outbreaks as opposed to routine immunization. As for epidemic meningitis, this mechanism has left the international community better prepared and better equipped to cope with emergency situations. Even so, the present level of preparedness may not be adequate. For example, in 2001, the first outbreak of urban yellow fever in Africa in 10 years occurred in Abidjan, Côte d'Ivoire, necessitating the emergency vaccination of 2.9 million persons in less than two weeks. Although vaccine reserves were again depleted, the emergency response averted an estimated 30,000 deaths (Kindhauser 2003).

The WHO Global Influenza Surveillance Network, the oldest disease-specific surveillance system at WHO, has also expanded its functions in line with recent public health emergencies. The network, which presently unites 110 laboratories in 84 countries, keeps watch over constant changes in the genetic composition of circulating influenza viruses, which are highly unstable. Apart from guiding the twice-yearly composition of influenza vaccines, as recommended by WHO for the northern and southern hemispheres, the network operates as an early warning system, keeping the world alert to the emergence of influenza variants and novel strains, including those that might herald the start of a new influenza pandemic. The network was put to the test in 1997, when the highly pathogenic H5N1 avian influenza strain, previously thought to infect only birds and pigs, crossed the species barrier to infect humans, causing 18 cases and 6 deaths in Hong Kong. In the current outbreak of H5N1 avian influenza in Asia, which has already caused more than 100 cases, laboratories in the network are again playing an instrumental role in providing diagnostic support to affected countries and performing the essential 'detective work', at the molecular level, needed to understand the origins of the outbreak and interpret its significance for public health (WHO 2005).

All of these new mechanisms, networks, and procedures were put to the test – under extremely challenging conditions – when severe acute respiratory syndrome began spreading internationally in early 2003. Like the 1995 Ebola outbreak in the Democratic Republic of the Congo, which took the world by surprise. SARS was also a surprise, but the international community was far better prepared to respond. The response to SARS also tested an assumption of fundamental importance to public health: all these safeguards, working at their best, might be able to prevent a new disease from establishing endemicity, and thus spare the world untold suffering and expense. From the outset, this was the goal pursued by WHO in coordinating the activities of many partners. Although the emergence of SARS went undetected and then unreported at the national level, international mechanisms for outbreak alert and response performed well (Heymann/Rodier 2004). The spread of a severe new disease along the routes of international air travel was promptly detected and immediately brought to worldwide attention through two global alerts. The international response worked on two main fronts to manage cases and interrupt transmission at the main outbreak sites, and to seal off opportunities for further international spread.

The possibility of stopping SARS 'dead in its tracks' brought all-out support at levels ranging from heads of state to community volunteers, and in forms ranging from reverse transcriptase PCR assays of virus isolates to mass distribution of thermometers. The interruption of all known chains of transmission was accomplished less than four months later, largely through the use of 19th century public health measures

and 21st century communications tools (Heymann/Rodier 2004). As telling evidence of the importance of accrued experience, the ability to recommend these public health measures, with technical confidence in their efficacy, drew largely on international experience using case detection, isolation, and infection control to contain Ebola outbreaks.

37.8 Revised International Health Regulations: Faster, Stronger, Broader

In May 2005, the 192 member states of WHO unanimously adopted a significantly revised and modernized version of the *International Health Regulations*, which constitute the only legal framework governing the reporting of outbreaks and prevention of their international spread (WHO 2005a). Revisions in the regulations respond to several problems identified by WHO, its GOARN partners, and national authorities during outbreak responses. First, the scope of the previous regulations, in legal force since 1969, was far too narrow, confined as it was to only three diseases: cholera, plague, and yellow fever. The revised regulations recognize that the infectious disease threat has grown in terms of both the number of diseases that need to be watched very closely and the risk that more new diseases will emerge. Scope has been expanded accordingly, and now encompasses all public health emergencies of international concern, including those caused by chemical agents and radio-nuclear materials. Second, reporting requirements and timeframes have been tightened, reflecting the heightened sense of urgency and the greater speed allowed by electronic communications. Third, procedures have been put in place to compensate for weak detection and response capacities in many countries. The kinds of support offered by GOARN response teams are fully recognized. The regulations further acknowledge that strengthened national capacities are the best solution, as they aim to detect and stop an outbreak at the source; core capacity requirements for surveillance and response in individual countries are set out in an annex. The regulations also recognize that media reports may pre-empt official notification of an event, and include provisions for WHO actions in such a situation. Finally, by assigning responsibilities and establishing internationally agreed rules and procedures, the regulations can exert pressure on nations that fail to comply.

37.9 Strengthened Defences, Formidable Foes

Public health emergencies throw into sharp relief the strengths and weaknesses of infrastructures for protecting the public on a daily basis. The outbreaks experienced so far in the early years of the 21st century have underscored the capacity of the microbial world to deliver lethal and disruptive surprises, raising the profile of public health in the eyes of politicians and the public. The anthrax incident, by turning the unthinkable prospect of bioterrorism into a reality, made outbreaks a high-profile security concern (Heymann 2003). SARS vividly demonstrated the far-reaching social and economic costs of a new disease that spread along the routes of international air travel (Heymann/Rodier 2004). These consequences will be far more dramatic when the next influenza pandemic arrives. Ironically, the certainty of a pandemic's direct impact on national security has diminished the prospect of international collaboration that was the hallmark of the SARS response. When every nation is directly threatened by a disease, defence strategies turn distinctly towards national self-interests, especially when essential medical interventions for reducing morbidity and mortality are available in grossly inadequate quantities. Public health, chronically short of resources in even the wealthiest countries, cannot be asked to shoulder the full burden of responsibility for defending the world against diseases that have such severe implications for national and international security.

Nonetheless, few would question that recently developed infrastructures and mechanisms have strengthened collective defences and have performed well under the demanding conditions – particularly favourable to the international spread of diseases – of the 21st century. Adoption of the strengthened International Health Regulations has established the legal framework for increased global security against the threat of emerging and epidemic-prone diseases. GPHIN brings in the intelligence, systematically screening rumours for the first alerts to an outbreak. From January to March 2005, 40 per cent of the initial alerts to outbreaks, subsequently investigated by WHO, came from the media and other non-official sources. GOARN provides the operational mechanism for deploying a strike force when international assistance is needed. From 1 May 2002 to 31 March 2005, WHO detected and verified 760 outbreaks of potential international concern in collaboration with 138 affected countries. International assistance was re-

quested for more than 70 of these events. For more than 50, international teams were deployed to provide on-the-ground support using expertise from WHO and its GOARN partners.

Every outbreak presents a unique set of problems that have to be solved, innovatively and quickly, under emergency conditions. Each outbreak of international concern leaves WHO and its partners with more experience and more technical innovations to draw on when the next event inevitably occurs. For example, experts in medical anthropology were first used during an Ebola outbreak in 2003 to introduce community behaviours conducive to outbreak control. These experts are now a standard part of international teams deployed to control viral haemorrhagic fevers in Africa. The technique of mathematical modelling, first used during the SARS outbreaks, is now a strong component of pandemic influenza risk assessment, forecasting, and testing of strategies for delaying international spread. Risk communication to the public was introduced during the SARS outbreak as a strategy for mitigating the excessive social and economic consequences attributed to an anxious public. It is being used again, now supported by new guidelines, as part of preparedness for the next influenza pandemic.

While these mechanisms and accrued experiences have strengthened the world's collective defences against the infectious disease threat, they cannot provide full protection as long as national capacities to detect outbreaks remain weak. The world's largest and deadliest outbreak of the rare Marburg haemorrhagic fever, which occurred in Angola in early 2005, smouldered undetected for months. Tragically, the outbreak came to the attention of public health officials only after iatrogenic infection in a paediatric ward led to a sudden surge in cases of severe illness and deaths in children hospitalized for other conditions. As is often the case in developing countries, detection of the outbreak at its start was delayed by the large number of other severe infectious diseases that commonly kill young children. On the positive side, the speed and intensity of the international response to this outbreak, including rapid funding of activities and support from more than 100 international staff drawn from GOARN institutions, underscore heightened concern about emerging diseases and illustrate the resources this concern can generate in an emergency situation – even when the threat of international spread and economic disruption is far less than that posed by diseases such as SARS and pandemic influenza or the prospect of a bioterrorist attack (Ndayimirije/Kindhauser 2005).

37.10 Conclusions and Remaining Needs

To make the world more secure against the threat of emerging and epidemic-prone diseases, several activities need to be undertaken. *First*, mechanisms for using international teams to stop an outbreak have proven their effectiveness. Their value as a defence strategy must not, however, be overestimated. Such mechanisms are, at best, a 'fail-safe' operation, specifically compensating for failures to detect and contain an outbreak locally, thus quelling spread at the source. This reality, brought into focus by the revised *International Health Regulations*, has sparked a special WHO effort to strengthen outbreak detection and response capacity in epidemic-prone developing countries. Nor should the success of the SARS response create a false sense of security that WHO teams will always be able to stop new diseases "dead in their tracks". The spread of pandemic influenza to all corners of the world might be delayed somewhat, but never stopped (WHO 2005).

Second, more needs to be done to protect the world against the risk of outbreaks arising from laboratory accidents. This risk has been vividly illustrated by laboratory accidents resulting in SARS infections, some of which were fatal, in Singapore, Taiwan (China), and mainland China, and by the accidental distribution of an influenza virus, responsible for the 1957 pandemic, in test kits sent to hundreds of laboratories around the world.

Finally, when outbreaks and epidemic-prone diseases are regarded as direct threats to national and international security, defence strategies should become a priority for political leaders and government sectors, including finance, trade, and defence, that rank higher than public health and command far more resources. Trends witnessed during the first years of the 21st century are certain to continue, if not intensify. Investment in improved public health infrastructure is the best strategy for defence against this persisting threat. But unlike the response to individual outbreaks, which aims to quickly end an emergency, this investment will need to be ongoing. The threat posed by emerging and epidemic-prone diseases – and the risk to national and international security – cannot be stopped 'dead in its tracks'.