

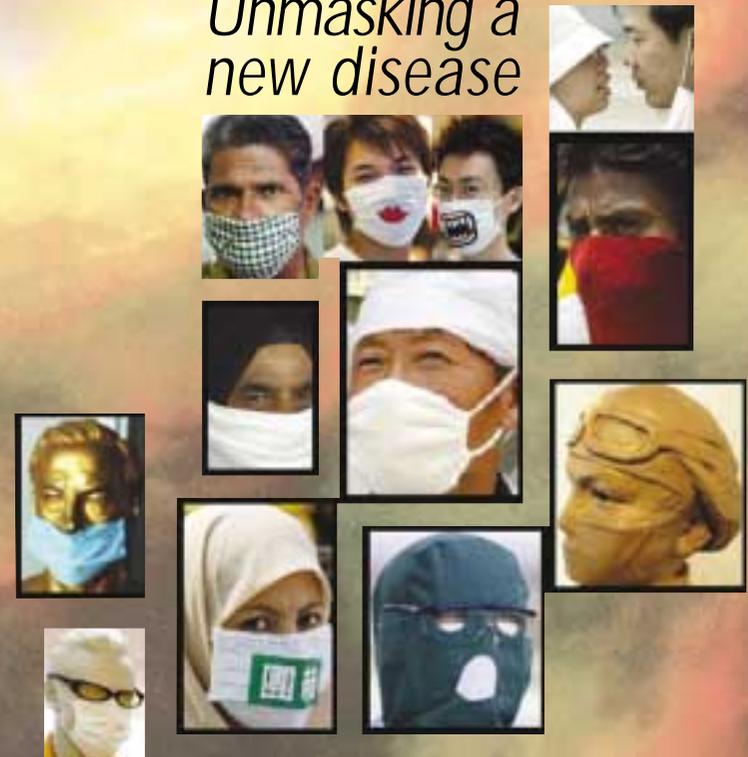
Severe acute respiratory syndrome (SARS): Status of the outbreak and lessons for the immediate future

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World Health Organization
Communicable Disease Surveillance and Response

*Unmasking a
new disease*



Severe acute respiratory syndrome (SARS)

Unmasking a new disease

WHO maintains its position that SARS can and must be contained – pushed back out of its new human host.

One by one, the many puzzling features of this new disease are being unmasked.

One by one, the most severe outbreaks in the initial waves of infection are being brought under control.

Recommended measures – case detection, isolation and infection control, and contact tracing and follow-up surveillance – are working.

With this reassurance, the image of populations masked because of fear, the public face of SARS, can now begin to fade.



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Severe acute respiratory syndrome (SARS): Status of the outbreak and lessons for the immediate future

This document describes the evolution of severe acute respiratory syndrome, or SARS, and explains some of the features that make this new disease an especially challenging threat to international public health. Brief examples of economic, social, and political repercussions illustrate the wide-ranging impact a new disease can have in a closely interconnected and highly mobile world. Lessons learned from efforts to contain SARS, particularly concerning the strengths and weaknesses of systems for surveillance and response, are then used to assess global capacity to respond to other infectious disease threats, most notably the next influenza pandemic and the possible deliberate use of a biological agent to cause harm. Priority areas for urgent improvement are identified and discussed.

SARS: a puzzling and difficult new disease

SARS is the first severe and readily transmissible new disease to emerge in the 21st century. Though much about the disease remains poorly understood and frankly puzzling, SARS has shown a clear capacity for spread along the routes of international air travel. At present, the outbreaks of greatest concern are concentrated in transportation hubs or spreading in densely populated areas. WHO regards every country with an international airport, or bordering an area having recent local transmission, as at potential risk of an outbreak.

The first cases of SARS are now known to have emerged in mid-November 2002 in Guangdong Province, China. The first official report

of an outbreak of atypical pneumonia in the province, said to have affected 305 persons and caused 5 deaths, was received by WHO on 11 February. Around 30% of cases were reported to occur in health care workers. Confirmation that cases were consistent with the definition of SARS was made after permission was granted, on 2 April, for a WHO team to visit the province.

In the meantime, SARS was carried out of Guangdong Province on 21 February by an infected medical doctor who had treated patients in his home town. He brought the virus to the ninth floor of a four-star hotel in Hong Kong. Days later, guests and visitors to the hotel's ninth floor had seeded outbreaks of cases in the hospital systems of Hong Kong, Viet Nam, and Singapore. Simultaneously, the disease began spreading around the world along international air travel routes as guests at the hotel flew home to Toronto and elsewhere, and as other medical doctors who had treated the earliest cases in Viet Nam and Singapore travelled internationally for medical or other reasons.

When the disease moved out of southern China, the outbreaks it seeded – in Hanoi, Hong Kong, Singapore, and Toronto – became the initial “hot zones” of SARS, characterized by rapid increases in the number of cases, especially in health care workers and their close contacts. In these areas, SARS first took root in hospital settings, where staff, unaware that a new disease had surfaced and fighting to save the lives of patients, exposed themselves to the infectious agent without barrier protection. All of these initial outbreaks were subsequently characterized by chains of secondary transmission outside the health care environment.

16 NOVEMBER 2002

First known case of atypical pneumonia occurs in Foshan city, Guangdong Province, China.

11 FEBRUARY 2003

WHO receives reports from the Chinese Ministry of Health of an outbreak of acute respiratory syndrome with 305 cases and 5 deaths in Guangdong Province.

12 FEBRUARY

WHO is informed that the outbreak in Guangdong affected six municipalities. Laboratory analyses are negative for influenza viruses.

14 FEBRUARY

The Chinese Ministry of Health informs WHO that the outbreak in Guangdong is clinically consistent with atypical pneumonia. Further investigations rule out anthrax, pulmonary plague, leptospirosis, and haemorrhagic fever.

By 15 March, WHO had received reports of more than 150 cases of a new disease, which it named severe acute respiratory syndrome. Epidemiological analysis indicated that the new disease was spreading along the routes of international air travel. WHO immediately issued emergency travel recommendations to alert health authorities, physicians, and the travelling public to what was now perceived to be a worldwide threat to health. The global alert achieved its purpose. After the recommendations, all countries with imported cases, with the exception of provinces in China, were able, through prompt detection of cases, immediate isolation, strict infection control, and vigorous contact tracing, to either prevent further transmission or keep the number of additional cases very low.

During the last week of April, the outbreaks in Hanoi, Hong Kong, Singapore, and Toronto showed some signs of peaking. On 28 April, Viet Nam became the first country to stop local transmission of SARS. However, new probable cases, including cases in hospital staff, additional deaths, and first cases imported to new areas continued to be reported from several countries. The cumulative total number of cases surpassed 5000 on 28 April, 6000 on 2 May, and 7000 on 8 May, when cases were reported from 30 countries on six continents. At present, most new cases are being reported from Beijing and, increasingly, other parts of mainland China. Of the cumulative global total of 7761 probable cases and 623 deaths reported on 17 May, 5209 cases and 282 deaths had occurred in mainland China. Also of concern is a rapidly growing outbreak in Taiwan, China, with a cumulative total, on 18 May, of 344 cases, including many in hospital staff, and 40 deaths.

A particularly serious threat

SARS demonstrates dramatically the global havoc that can be wreaked by a newly emerging infectious disease. At this moment, public health authorities, doctors, nurses, scientists, and laboratory staff around the world are struggling to cope with SARS at a time when some hope

remains that the disease might still be contained. Economists and market analysts are simultaneously struggling to calculate the present and future costs, initially estimated at US\$ 30 billion in the Far East alone. Public panic is widespread, some government officials have lost their jobs, and social stability has been jeopardized in some of the hardest hit areas. Hospitals, schools, and borders have been closed, and several governments have advised their citizens not to travel to hard-hit areas. In Hong Kong, an electronic tracking system developed by the police force for use in criminal investigations has been adapted for contact tracing and monitoring of compliance with quarantine. In Singapore, military forces have been deployed to assist in contact tracing and to enforce quarantines that have halted the normal lives of thousands of people. No visitors are allowed at any public hospital.

SARS needs to be regarded as a particularly serious threat for several reasons. The disease has no vaccine and no treatment, forcing health authorities to resort to control tools dating back to the earliest days of empirical microbiology: isolation and quarantine. The virus comes from a family notorious for its frequent mutations, raising important questions about the future evolution of outbreaks and prospects for vaccine development. Epidemiology and pathogenesis are poorly understood. The initial symptoms are non-specific and common. All available diagnostic tests have important limitations. If tests are poorly conducted or results wrongly applied, patients excreting virus and thus capable of infecting others can slip through the safety net of isolation and infection control. The disease continues to show a disturbing concentration in previously healthy hospital staff – the human resource vital to control. A significant proportion of patients require intensive care, thus adding to the considerable strain on hospital and health care systems. Evidence is mounting that certain source cases make a special contribution to rapid spread of infection. The maximum incubation period, currently estimated at 10 days, allows spread via air travel between any two cities in the world. WHO's most recent analysis estimates overall case fatality

20 FEBRUARY

Hong Kong officials inform WHO of an outbreak of 2 cases (1 fatal) of avian influenza following the detection of influenza A(H5N1) in members of a family who had recently travelled to Fujian Province, China.

21 FEBRUARY

A 65-year-old medical doctor from Guangdong checks into the 9th floor of a Hong Kong hotel. He had treated patients with atypical pneumonia prior to departure and is symptomatic upon arrival in Hong Kong.

This medical doctor infects at least 12 other guests and visitors to the 9th floor of the hotel.

26 FEBRUARY

A 48-year-old Chinese-American businessman is admitted to the French Hospital in Hanoi with a 3-day history of respiratory symptoms.

He had previously been in Hong Kong, where he visited an acquaintance staying on the 9th floor of the hotel where the Guangdong physician was a guest.

in the range of 14% to 15%. In persons over the age of 65, the case fatality ratio can exceed 50%.

With the notable exception of AIDS, most new diseases that emerged during the last two decades of the previous century or have become established in new geographical areas have features that limit their capacity to pose a major threat to international public health. Many (avian influenza, Nipah virus, Hendra virus, Hanta virus) failed to establish efficient human-to-human transmission. Others (*Escherichia coli* O157:H7, variant Creutzfeldt-Jakob disease) depend on food as a vehicle of transmission. Diseases such as West Nile fever and Rift Valley fever that have spread to new geographical areas require a vector as part of the transmission cycle. Still others (*Neisseria meningitidis* W135, and the Ebola, Marburg, and Crimean-Congo haemorrhagic fevers) have strong geographical foci. Although outbreaks of Ebola haemorrhagic fever have been associated with a case fatality ratio in the range of 53% (Uganda) to 88% (Democratic Republic of the Congo), person-to-person transmission requires close physical exposure to infected blood and other bodily fluids. Moreover, patients suffering from Ebola during the period of high infectivity are visibly very ill and too unwell to travel.

Chronology of an emerging disease

SARS was first identified in Viet Nam on 28 February, when Dr Carlo Urbani, an epidemiologist from the WHO office in Hanoi, examined a patient with a severe form of pneumonia with no known cause. By 11 March, at least 20 hospital workers in Hanoi's private French Hospital, and 23 at a hospital in Hong Kong, were ill with a similar acute respiratory syndrome.

SARS occurred at a time of heightened surveillance for atypical respiratory disease. From 11 February, the WHO office in Beijing,

which reinforced its staff with two epidemiologists, had been working with the government of China to learn more about the outbreak of atypical pneumonia in Guangdong. Surveillance was heightened further when a 33-year-old man who had travelled with his family to Fujian Province in China died of unknown causes in Hong Kong on 17 February. The next day, Hong Kong authorities announced that avian influenza A(H5N1) virus, the cause of "bird flu", had been isolated from both the man and his nine-year-old hospitalized son. Another member of the family, an eight-year-old daughter, died while in Fujian and was buried there.

On 12 March, after an assessment of the situation in Asia with WHO teams in Hanoi, Hong Kong, and Beijing, a global alert was issued about cases of severe atypical pneumonia with unknown etiology that appeared to place health workers at high risk.

Two days later, on 14 March, WHO received a report from the government of Canada that health authorities had taken steps to alert hospital workers, ambulance services, and public health units across the provinces that there were four cases of atypical pneumonia within a single family in Toronto that had resulted in 2 deaths. At 2 a.m. Geneva time on the following day, 15 March, the government of Singapore notified WHO, by urgent telecommunication, of a similar illness in a 32-year-old physician who had treated cases with a severe respiratory syndrome in Singapore, all subsequently linked to the Hong Kong hotel. This Singapore physician had travelled to the United States for a medical conference, and at the end of the conference boarded a return flight to Singapore in New York. Before departure he had indicated to a colleague in Singapore by telephone that he had symptoms similar to the patients he had treated in Singapore. The colleague notified health authorities. WHO identified the airline and flight, and the physician and his two accompanying family members were removed from the flight at a stopover in Frankfurt, Germany, where the three were immediately isolated and placed under hospital care. As a result of this prompt action,

28 FEBRUARY

Dr Carlo Urbani, a WHO official based in Viet Nam, is alarmed by several cases of atypical pneumonia in the French Hospital, where he has been asked to assist. He notifies the WHO Regional Office for the Western Pacific.

WHO headquarters moves into a heightened state of alert.

1 MARCH

A 26-year-old former flight attendant is admitted to a hospital in Singapore with respiratory symptoms. A resident of Singapore, she was a guest on the 9th floor of the Hong Kong hotel.

4 MARCH

A 26-year-old local Hong Kong resident, who had visited an acquaintance at the hotel while the Guangdong doctor was a guest, is admitted to the Prince of Wales Hospital with respiratory symptoms. Over the next 7 days, he is treated with a jet nebulizer four times daily.

Germany experienced no further spread linked to its first imported cases.

A rare emergency advisory

Later in the morning of 15 March, with this background and chronology of events, a decision was made by WHO to increase the level of the global alert issued on 12 March. The decision was based on five different but related factors. First, the causative agent, and therefore the potential for continued spread, of this new disease were not yet known. Second, the outbreaks appeared to pose a great risk to health workers who managed patients, and to the family members and other close contacts of patients. Third, many different antibiotics and antivirals had been tried empirically and did not seem to have an effect. Fourth, though the numbers were initially small, a significant percentage of patients (25 of 26 hospital staff in Hanoi, and 24 of 39 hospital staff in Hong Kong) had rapidly progressed to respiratory failure, requiring intensive care and causing some deaths in previously healthy persons. Finally, the disease had moved out of its initial focus in Asia and appeared to have spread to North America and Europe.

At this time, the epidemiology of SARS was poorly understood. A virulent strain of influenza had not been ruled out as a possible cause, even though transmission patterns were not characteristic for influenza. There was also some hope that the new disease, like many other new diseases of the recent past, would fail to maintain efficient person-to-person transmission, or that it might attenuate with passage and eventually self-contain. Despite the lack of understanding about the disease, its cause, and future evolution, the need was great to introduce a series of emergency measures to contain SARS outbreaks in the affected areas and prevent further international spread, thus reducing opportunities for the new disease to establish itself. WHO thus decided, on 15 March, to issue a rare emergency travel advisory as a global alert to international travellers, health care professionals, and health authorities.

The global response

The existing system for alert and response

In April 2000, WHO formally launched the Global Outbreak Alert and Response Network (GOARN) as a mechanism to link together, in real time, 112 existing networks which together possess much of the data, expertise, and skills needed to keep the international community alert to outbreaks and ready to respond. By electronically linking together existing networks WHO is able to maintain close vigilance over the evolving infectious disease situation and to mobilize outbreak verification and response activities when needed. From January 1998 through March 2002, WHO and its partners investigated 538 outbreaks of international concern in 132 countries.

One of the most powerful new tools for gathering epidemic intelligence is a customized search engine that continuously scans world Internet communications for rumors and reports of suspicious disease events. This is the Global Public Health Intelligence Network (GPHIN), a computer application developed by Health Canada and used by WHO since 1997. 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. GPHIN provided some of the earliest alerts to the November outbreak in China.

In outbreak alert and response, every hour counts, as the window of opportunity for preventing deaths and further spread closes quickly. GPHIN has brought great gains in timeliness over traditional systems in which an alert is sounded only after case reports at the local level progressively filter to the national level before being formally notified to WHO. GPHIN currently picks up – in real time – the first hints of about

5 MARCH

In Hanoi, the Chinese-American businessman, in a stable but critical condition, is air evacuated to the Princess Margaret Hospital in Hong Kong. Seven health workers in Hanoi who had cared for him are ill.

Dr Urbani continues to treat cases at the Hanoi French Hospital.

An elderly Toronto woman, who had been a guest on the 9th floor of the Hong Kong hotel, dies at Toronto's Scarborough Grace Hospital. Five members of her family are found to be infected and are admitted to the hospital.

7 MARCH

Health care workers at Hong Kong's Prince of Wales Hospital start to complain of respiratory tract infections, progressing to pneumonia.

8 MARCH

Fourteen staff at the French Hospital in Hanoi are ill with an acute respiratory syndrome. A WHO team arrives to provide support.

40% of the roughly 200 to 250 outbreaks subsequently investigated and verified by WHO each year. While the early alert to outbreaks of genuine concern is most important, GPHIN also allows WHO to step in quickly to refute unsubstantiated rumors before they have a chance to cause social and economic disruption.

During outbreak response, WHO uses a custom-made geographical mapping technology to assist in the location of cases and rapid analysis of the epidemic's dynamics. This epidemiological mapping technology is also used to predict environmental and climatic conditions conducive for outbreaks. An event management system, introduced in 2001, is now used to gather and communicate data throughout the course of outbreak investigation and response. The system generates a dynamic picture of operations, aids organization of logistics, and provides a systematic way to prepare better, respond faster, and manage resources more effectively.

SARS: sealing off the opportunities to establish endemicity

SARS has been an extremely demanding test of the effectiveness of WHO and its GOARN partners to mount an adequate response, get teams and supplies into countries, and ensure adequate monitoring and reporting. The urgency of SARS has further challenged WHO to set in motion high-level international scientific and medical collaboration in which natural competition for publication and prestige is set aside in the interest of solving the scientific mysteries of a shared threat.

To date, the global response, coordinated by WHO and strongly supported by its GOARN partners, has been designed to rapidly seal off opportunities for SARS to establish itself as a common disease. The initial emergency plan, mapped out from 12 to 15 March, called for an attack on the ground and in the "air". On the ground, WHO sent teams of experts and specialized protective equipment for infection control in hard-hit hospitals to countries requesting such assistance. In the "air",

WHO used the model of its electronically interconnected global influenza network to quickly establish a similar "virtual" network of 11 leading laboratories, connected by a shared secure website and daily teleconferences, to work around the clock on identification of the SARS causative agent and development of a robust and reliable diagnostic test. This network, in turn, served as a model for similar electronically linked groups set up to pool clinical knowledge and to compare epidemiological data. WHO also decided to issue daily updates on its website to keep the general and travelling publics informed and, to the extent possible, counter rumors with reliable information.

In late March, Chinese authorities issued updated data on cases and deaths for the previously reported outbreak of atypical pneumonia in Guangdong Province, raising the cumulative totals from 305 to 792 cases and from 5 to 31 deaths. Chinese scientists, epidemiologists, and clinicians also became full partners in the three working groups that were studying SARS. On 2 April, a WHO five-person team was given permission to travel to Guangdong Province to confer with officials there about the SARS outbreak. The Chinese government has given highest priority to the SARS response. Visits to assess the situation in several provinces, including some that are likely ill-equipped to manage a health crisis on the magnitude of SARS, have been visited by Ministry of Health and WHO teams. The first joint Ministry of Health-WHO team visited Hebei Province, which borders Beijing municipality, in mid-May.

A system of alert and response for emerging and epidemic-prone diseases is being developed for all of mainland China. Electronic reporting of new cases and deaths, by province, now occurs daily. Equally important, health officials now hold televised press conferences, thus taking the important step of increasing the awareness of the population and hospital staff of the characteristic symptoms, the need to seek prompt medical attention, and the need to manage patients according to the principles of isolation and strict infection control.

10 MARCH

At least 22 staff at the Hanoi hospital are reported ill with respiratory symptoms. The Chinese Ministry of Health asks WHO to provide technical and laboratory support to clarify the cause of the Guangdong outbreak.

11 MARCH

Dr Urbani departs for Bangkok, where he is scheduled to give a presentation on tropical diseases. He is ill upon arrival and is immediately hospitalized.

12 MARCH

WHO issues a global alert about cases of severe atypical pneumonia following mounting reports of cases among staff in the Hanoi and Hong Kong hospitals.

13 MARCH

WHO sends an emergency alert to GOARN partners. The American businessman dies in isolation at the Hong Kong hospital. Altogether, 3 Hong Kong hospitals are now reporting cases of an unusual and severe respiratory disease.

Near the end of March, WHO recommended screening measure at airports for passengers departing from areas with recent local transmission, and issued advice to airlines on steps to take should a suspect case be detected in flight. Twice in April and once in early May, to prevent further international spread, WHO issued the toughest travel advisories in its 55-year history when it recommended postponement of all but essential travel to designated high-risk areas.

WHO teams continue to provide operational support and specialized expertise in the most seriously affected areas. Requests for additional country assistance continue to be received, most notably from authorities in China. Abundant additional support is available to all through information posted at the WHO website (www.who.int/csr/sars). Guidance ranges in nature from forms for collecting and reporting data, through guidelines for clinical management and infection control in hospitals, to the materials for local production of diagnostic tests. The evolution of the outbreak is constantly and closely monitored and daily updates are posted on the website.

Rapid advances in knowledge

On 17 April, exactly a month after its establishment, the laboratory network announced conclusive identification of the SARS causative agent: a new coronavirus unlike any other known human or animal virus in its family. Complete sequencing of its RNA followed shortly. The laboratory reagents needed to calibrate, standardize and assure the quality of laboratory tests are being made available by WHO, at no cost, to laboratories designated by ministries of health. On 4 May, network scientists released the first results of studies on the survival time of the SARS virus on various environmental surfaces and in various bodily specimens, including faeces, respiratory secretions, and urine. The results will provide solid scientific guidance for recommended public health measures and may shed some light on why so many staff in sophisticated and well-equipped hospitals continue to become infected.

Daily teleconferences of epidemiologists, including WHO team members at the main outbreak sites, have refined the case definitions, facilitated daily reporting, confirmed modes of transmission, tracked exported cases, and greatly increased knowledge about the control measures that work best in different country settings. WHO has also sent teams of epidemiologists and other specialists to investigate environmental sources of infection and confer with authorities about the conditions under which the initial cases of SARS may have emerged. From 16 to 17 May, WHO convened the first international consultation on the global epidemiology of SARS and produced a state-of-the-art consensus document on the status of current knowledge to guide firm policy recommendations for containment and control.

Participants in the clinical network have described the clinical course of SARS, compared experiences with different treatments, developed guidelines for isolation and infection control, and explored possible reasons for the spontaneous recovery of many patients and the rapid deterioration of others, and for the very small number of paediatric cases. Despite this progress, many questions remain.

Learning from SARS

The importance of preparedness

When the first suspected SARS cases began appearing in new countries following the mid-March alert, many hospital staff cited the WHO advisory, and their subsequent high-level of awareness, as one reason why cases were quickly detected and isolated, with the result that further transmission was either avoided entirely or kept to a very small number of cases. A second explanation offered for the comparatively mild and well-contained SARS situation in countries such as the USA is the high level of nationwide planning and preparedness that followed the deliberate distribution of anthrax-tainted mail in the US postal system in October 2001.

14 MARCH

The Ministry of Health of Singapore reports 3 cases of atypical pneumonia, including the former flight attendant who had stayed at the Hong Kong hotel. Contact tracing subsequently will link her illness to more than 100 SARS cases in Singapore.

Health authorities in Ontario, Canada take steps to alert doctors, hospitals, and public health units that there are 4 cases of atypical pneumonia in Toronto that have resulted in 2 deaths.

15 MARCH

WHO intervenes to have a Singaporean physician, who had treated patients with atypical pneumonia in that country, removed from a flight in Frankfurt, Germany, and immediately placed in isolation. WHO issues a travel advisory as evidence mounts that SARS is spreading by air travel. SARS is declared "a worldwide health threat". WHO formulates global response plans, issues case definitions and guidelines for infection control in hospitals, and mobilizes GOARN partners.

The International Health Regulations provide the legal framework for global surveillance and reporting of infectious diseases and a mechanism by which measures to prevent international spread can be enforced. The regulations, which are currently undergoing a substantial revision, will be discussed during the 56th World Health Assembly. The SARS outbreak provides firm evidence of the need for such regulations and concrete examples of the areas in which revision and updating are urgently needed.

The novel nature of the SARS virus created an extra step in the containment response: scientific identification and characterization of the causative agent to allow development of a diagnostic test, treatment protocols, and a scientifically sound basis for recommending control measures. Experience with SARS has shown that, with strong global leadership by WHO, scientific expertise from around the world can work in a very effective collaborative manner to identify novel pathogens. This function would be invaluable in the event of the deliberate release of a biological agent or during future emergence of a novel or poorly understood pathogen.

WHO is continuing its aggressive containment activities aimed at preventing SARS from becoming a widely established threat. The immediate scientific priorities include development of a robust and reliable diagnostic test, improved understanding of the modes of transmission, and identification of effective treatment regimes. If, despite extraordinary efforts, the disease does become endemic, WHO and its international partners will have to settle in for a long and difficult fight. In this case, existing mechanisms developed for other public health emergencies, such as the Medicines for Malaria Venture, the Global Alliance for Vaccines and Immunization, the Global Drug Facility, and the International Coordinating Group for meningitis and yellow fever, would have to be looked to as possible models for ensuring the rapid development of SARS therapies and vaccines and equitable access in all at-risk countries.

Use of the influenza network as a model for the SARS laboratory network suggests that such an approach brings great speed as well as efficiency.

Lessons for the future

Just as the SARS response has been guided by lessons learned during preparedness planning for the next influenza pandemic and for a possible bioterrorist attack, both of these types of potential public health emergencies will benefit from lessons learned as the international response to SARS continues.

The response to SARS has already brought to light a number of positive lessons as well as highlighted a number of challenges for future preparedness planning. The SARS experience has shown the capacity of global alerts, widely supported by a responsible press and amplified by electronic communications, to improve global vigilance and awareness at all levels, from health professionals and national authorities, to politicians and the travelling public. The quick detection and reporting of the first cases in South Africa and India are indicative of the high level of global awareness and the vigilance of the world's health systems. The present climate of high alert also helps explain the speed with which developing countries have readied their health services with preparedness plans and launched SARS campaigns, often with WHO support, to guard against imported cases. In addition, the SARS experience has demonstrated the need to stimulate very rapid, high-level research to generate the scientific basis for recommending sound control interventions.

The SARS experience in Viet Nam has shown that immediate political commitment at the highest level can be decisive. Viet Nam demonstrated to the world how a developing country, hit by an especially severe outbreak, can triumph over a disease when reporting is prompt and open, when WHO assistance is quickly requested and fully supported, and when rapid case detection, immediate isolation and infection control, and vigorous contact tracing are put in place.

16 MARCH

More than 150 suspect and probable cases of SARS are reported from around the world.

17 MARCH

China provides a report to WHO on the Guangdong outbreak, which is said to have tapered off.

WHO sets up 3 virtual networks to expedite research on the SARS causative agent, to promote understanding of epidemiological features, and to develop clinical guidelines.

18 MARCH

A cumulative total of 210 cases with 4 deaths are reported to WHO from 7 countries.

20 MARCH

The cumulative total climbs to 306 cases with 10 deaths.

WHO GOARN teams are now providing support at all the main outbreak sites.

The major challenges to be addressed in future planning are those of transparency and surge capacity. SARS is now known to have begun in mid-November in Guangdong Province. Cases during the earliest phase of the SARS outbreak there were not openly reported, thus allowing a severe disease to become silently established in ways that made further international spread almost inevitable. This is the most important lesson for all nations: in a globalized, electronically connected world, attempts to conceal cases of an infectious disease, for fear of social and economic consequences, must be recognized as a short-term stop-gap measure that carries a very high price – loss of credibility in the eyes of the international community, escalating negative domestic economic impact, damage to the health and economies of neighboring countries, and a very real risk that outbreaks within the country's own territory can spiral out of control.

The report of the first WHO expert team to investigate the SARS situation in Guangdong Province reached the following conclusion:

“If SARS is not brought under control in China there will be no chance of controlling the global threat of SARS. Control of a new and rapidly disseminated disease like SARS is challenging, especially in a country as large and diverse as China. Effective disease surveillance and reporting are key strategies in any attempt to control the spread of a serious new communicable disease such as SARS.”

The next weeks and months will determine whether the current outbreaks of international concern can be contained, thus preventing SARS from becoming another endemic infectious disease in human populations that has no vaccine and no effective treatment. It is already clear, however, that the responsibility for containing the emergence of any new infectious disease showing international spread lies on all countries. In a world where all national borders are porous when

confronted by a microbial threat, it is in the interest of all populations for countries to share the information they may have as soon as it is available. In so doing, they will allow both near and distant countries – all neighbours in a globalized world – to benefit from the understanding they have gained.

Inadequate surge capacity in hospitals and public health systems has clearly been a major problem with SARS, especially since health care workers have themselves been victims of the disease and are the frontline troops at risk. The shortage of expert staff to coordinate national and global responses to a rapidly evolving public health emergency is also an issue needing additional investment and attention. In some areas, hospitals have been closed. In others, the heavy burden imposed by SARS on existing hospitals has necessitated the hasty construction of new facilities. As another lesson, evidence from SARS has shown that local and national capacities can be assisted by coordinated networks such as WHO's GOARN that can and do mobilize additional support during times of public health emergencies. Further strengthening of the surge capacity of the WHO “hub” of the global alert and response system would also assist in preparedness for future infectious disease threats.

Around the world, the SARS experience has shown – once again – the power of a poorly understood new infectious disease to incite widespread public anxiety. As many observers have noted, this fear of SARS has spread faster than the virus, causing great social unease, economic losses, and some political changes. Unwarranted discrimination has been another unfortunate problem. In such cases, clear, factual, and reassuring messages need to be issued by trusted authorities. Panic is fuelled when information is concealed or only partially disclosed. On the whole, however, and particularly as the outbreaks have matured, the transparency of national reporting has been exemplary – even when the economic consequences of doing so were known to be significant.

24 MARCH

In Hanoi, WHO epidemiologists determine that 63% of SARS cases are in health care workers. All can be linked to the index case at the French Hospital.

26 MARCH

China reports a cumulative total of 792 cases and 31 deaths in Guangdong Province from 16 November 2002 to 28 February 2003.

A WHO team in China reviews the case definition used during the outbreak of atypical pneumonia and concludes that the cases most likely represent SARS.

With the new data from China, the world cumulative total soars to 1323, with 49 deaths.

27 MARCH

Scientists in the WHO laboratory network report major progress in the identification of the SARS causative agent, with results from several studies consistently pointing to a new coronavirus. Chinese authorities report SARS cases in other parts of China.

The SARS experience also has some lessons about the importance of international collaboration, privileged access to all countries, and strong but politically neutral global leadership. Though exceptional in terms of its impact, severity, ease of international spread, and many puzzling features, SARS is only one of around 50 internationally important outbreaks to which WHO and its partners respond in any given year. The high level of medical, scientific, political, and public attention focused on SARS is helping the world to understand the severity of the infectious disease threat and the importance of international solidarity in the face of this threat. It also underscores the pragmatic value of a leadership role that can inspire the world's best scientists and clinicians to forego competition and collaborate altruistically to combat a shared threat of as yet unknown dimensions.

Finally, the response to the SARS outbreak is helping the public to understand that WHO's activities of global coordination, capacity development, communications, and mobilizing expertise enable rapid response and actually save lives. To date, in the vast majority of countries, these WHO activities have helped health authorities to identify imported SARS cases quickly, prevent a SARS outbreak, and thus avoid the devastating consequences seen elsewhere.

28 MARCH

China joins the WHO collaborative networks. Media reports describe SARS as a greater threat than the war in Iraq.

29 MARCH

Dr Carlo Urbani dies of SARS in Thailand.

30 MARCH

Hong Kong health officials announce a large and almost simultaneous cluster of probable cases among residents in a single building in the Amoy Gardens housing estate, pointing to a possible environmental source of exposure. The cumulative global total reaches 1622 cases and 58 deaths.

APRIL

- 2: WHO recommends that persons planning to travel to Hong Kong and Guangdong Province consider postponing all but essential travel. Chinese authorities give a WHO team permission to travel immediately to Guangdong Province. The cumulative global total of cases surpasses 2000.
- 4: China begins daily electronic reporting of SARS cases and deaths, nationwide by province.
- 6: A 53-year-old Finnish staff member of the International Labour Organisation dies of SARS in Beijing, where he had travelled to attend an international conference.
- 9: The WHO team in Guangdong Province presents its interim report to the Ministry of Health. It expresses serious concern about the capacity of some provinces, which lack the strong health system of Guangdong, to cope with the challenge posed by SARS.
- 15: A WHO team in Beijing is given permission to visit military hospitals, where numerous SARS cases are said to be under treatment.
- 16: One month after its establishment, the WHO laboratory network announces conclusive identification of the SARS causative agent: a new coronavirus, unlike any other human or animal member of the *Coronavirus* family.
The WHO team in Beijing estimates that the number of SARS cases in the city may be as high as 200. Official reports place the number at 37.
- 20: Chinese authorities announce 339 previously undisclosed cases of SARS, bringing the cumulative total of SARS cases in China to 1959.
- 23: WHO advises travellers to Beijing and Shanxi Province, China, and Toronto, Canada to consider postponing all but essential travel.
- 25: Outbreaks in Hanoi, Hong Kong, Singapore, and Toronto show signs of peaking.
- 28: Viet Nam becomes the first country to contain its SARS outbreak. The cumulative total of cases surpasses 5000.
- 30: China, accounting for 3460 probable cases of the global total of 5663, now has more cases than the rest of the world combined. WHO lifts its travel advice for Toronto.

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- 2: The cumulative total of cases surpasses 6000.
- 3: WHO sends a team to Taiwan, which is now reporting a cumulative total of 100 probable cases.
- 7: WHO estimates that the case fatality ratio of SARS ranges from 0% to 50% depending on the age group affected, with an overall estimate of case fatality of 14% to 15%.
- 8: WHO extends its travel advice to include Tianjin and Inner Mongolia, China and to Taipei, Taiwan. The cumulative total of cases surpasses 7000, with cases reported from 30 countries.
- 13: Outbreaks at the remaining initial sites show signs of coming under control, indicating that SARS can be contained.
- 17: The first global consultation on SARS epidemiology concludes its work. The consultation confirms that control measures recommended by WHO are supported by available evidence. The experts further confirm the consistent effectiveness of these measures, which include early identification and isolation of patients, vigorous contact tracing, management of close contacts, and public information and education to encourage prompt reporting of symptoms.
A cumulative total of 7761 probable cases, with 623 deaths, is reported from 28 countries.
Of this total, 5209 cases and 282 deaths are reported from mainland China.