Severe Acute Respiratory Syndrome (SARS)  
—Summary of SARS outbreak, response in Japan, and actions at Infectious Disease Surveillance Center, National Institute of Infectious Diseases—

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Abstract

March 12, 2003, the WHO issued a Global Alert on the atypical pneumonia of unknown cause that broke out in Asia, naming the disease SARS. Supported by the cooperation of specialists from various countries, the WHO announced on April 15 that the pathogen was a new-type of coronavirus and proposed calling it SARS Coronavirus. Following international efforts, the WHO declared on July 5 that there was no new transmission of SARS. The outbreak came to an end, recording about 8,000 cases including about 800 deaths. Japan actively participated in the collection and sharing of information, establishment of testing and reporting systems in the country, and contributed to WHO and affected areas to control SARS. While 68 cases, including 52 suspect and 16 probable cases, were reported from the front line in Japan, all met the exclusion criteria and the number reported to the WHO was zero by the Government.

Although no new cases of SARS have since been reported, we cannot categorically state that this disease and the virus has been eradicated. We need to maintain the system for intensive surveillance and be prepared for a possible resurgence of SARS.

Key words SARS, Japan, Emerging infectious disease, Epidemic

Introduction

Following the global alert on SARS from World Health Organization (WHO) in March 2003, many countries cooperated under the initiative of WHO to identify the cause of this disease and enforce an appropriate response, and the outbreak gradually faded. On July 5, 2003, WHO announced that no country remained on the list of “recent local transmission.” As of September 26, SARS had affected 8,098 patients and caused 774 deaths. While further cases were confirmed later, including 1 case each in Singapore and Taiwan, 4 cases in Guangdong Province in China, and 9 cases each in Beijing and Anhui Province in China, no new patients in the world have been confirmed since May 2004.

Although nobody has developed SARS for over 1 year now, this disease may not be extinct. We need to maintain the strengthened surveillance in case the disease reappears.

This article summarizes the SARS out-
break, the response to SARS in Japan, and the actions taken by the authors and colleagues at the Infectious Disease Surveillance Center (IDSC), National Institute of Infectious Diseases (NIID).

First Cases of SARS

From November 2002, many cases of atypical pneumonia were reported in Guangdong Province, China, and WHO was aware of this accumulation of cases. As this situation became evident in 2003, ProMED and other information sources started to list this information in February. On February 11, 2003, WHO announced on its website that 300 cases, including 5 fatal cases, of acute respiratory syndrome had occurred in Guangdong Province, China, and efforts were being made to identify the pathogen. The Chinese government initially announced that these patients were affected by Chlamydia infection.

On February 19, 2003, avian influenza virus H5N1 was isolated from a father and his son, who had returned from Fujian Province near Guangdong to Hong Kong. The father died and the 9-year-old son recovered. This was the first case of isolation of H5N1 from humans after the 1997 outbreak in Hong Kong. Influenza experts all over the world noted this as a possible premonition of an influenza pandemic originating from Guangdong Province.

More news suggesting a pandemic of new-type influenza followed. One was the nosocomial outbreak of atypical pneumonia in Hanoi, Vietnam on March 5. Another was the occurrence of multiple nosocomial cases of atypical pneumonia in Hong Kong. Although the involvement of new-type influenza was suspected initially, investigation disproved that H5N1 infection was the cause. Various known pathogens were also disproved as the cause one after another, and WHO started a full investigation of atypical pneumonia of unknown origin among medical workers in Asia. As similar pneumonia of unknown cause appeared in Canada, Germany, Singapore, etc. among the persons who visited Hong Kong. WHO recognized the situation as an outbreak of an unknown respiratory disease with the threat of becoming a worldwide epidemic. WHO named it “severe acute respiratory syndrome” (SARS), and issued a global alert (specifying an infectious disease of unknown cause requiring surveillance on a global scale). Later, outbreaks were reported in Beijing, Hong Kong, Taiwan, Singapore, Toronto, etc.

Spread of SARS: (1) A Common Factor among Cases in Hong Kong, Vietnam, Singapore, and Canada

The first patient in Hong Kong, who was considered to have initiated nosocomial infection, was a physician who reportedly had examined a pneumonia patient in Guangdong Province, China. He developed symptoms while staying at Hotel M (9th floor) in Hong Kong, was hospitalized in Hong Kong as having pneumonia, and died. Subsequently, many nosocomial cases of pneumonia occurred in this hospital. The Chinese American who was hospitalized as having pneumonia in Hanoi, Vietnam, and started nosocomial infection in Hanoi was found to have stayed at Hotel M (9th floor) at the same time as the first patient in Hong Kong. Similarly, the 10 persons who developed symptoms in Singapore, Canada, the U.S., etc. were also staying at Hotel M at the same time. These patients were staying in different guest rooms on the same floor (9th). While some form of direct or indirect contact among them was suspected, there was no evidence of such contact. None of the hotel workers developed symptoms.

No cases of large-scale spread of infection mediated by hotel stay have been reported after the outbreak centered on Hotel M. The spread of infection in this form is considered exceptional.
Spread of SARS: (2) Expansion from Nosocomial Infection to Communities in Hong Kong

The outbreak in Hong Kong was important, as it suggested the possibility of infection and epidemics in communities, in addition to the nosocomial infection that also occurred in Vietnam. SARS developed in 321 persons (as of April 15, 2003) among the approximately 15,000 inhabitants of an apartment house complex (A Garden). The investigation revealed the following facts: Of the several buildings in this complex, the cases were initially accumulated in Block E. The index case was a 33-year-old male who visited his relative in the hospital and a relative living in this building as well. This patient was associated with the infection in 2 relatives and 2 nurses living in A Garden, and the Hong Kong government considers that he initiated the outbreak. This male patient showed diarrhea as a symptom of SARS (while diarrhea was initially considered rare in SARS, it was found that some cases present with diarrhea). The rapid spread of infection among the apartment inhabitants was believed to be related to the lack of U traps in bathroom drains, the amplifying effect of bathroom exhaust fans, cracked sewer plumbing in Block E, aerodynamic effect in the lightwell to which bathroom windows opened, and other factors contributing to the spread of the virus. Although SARS is a respiratory infection, later study clarified that patient’s stools frequently contain a large amount of virus. While this outbreak alerted us about the expansion from nosocomial infection to communities, there have been no further outbreaks in general residential districts in this pattern. The source and route of the spread of infection in this case are considered to be uncommon, like those in the outbreak at Hotel M. The investigation did not yield epidemiological or experimental evidence supporting the transmission of the SARS virus via air, water, or infectious dust aerosol. In addition, no patients were reported in facilities around the apartment house complex, including schools, department stores, and movie theaters.

Registration of SARS Patients (Syndromic Surveillance)

Patient registration of infectious diseases is made usually after a definitive diagnosis has been fixed. However, in the case of the outbreak of a disease whose cause is unknown or difficult to identify, the traditional surveillance system based on the diagnosis of the disease may not be effective in achieving the needed sensitive monitoring of occurrence, as the process of diagnosing the name of the disease may slow the detection of the outbreak and delay response. An alternative is syndromic surveillance based on the reporting of a symptom complex before definitive diagnosis. This system is useful when an unknown disease or even a known disease requires speedy execution of epidemiological survey.

In the case of SARS, WHO for the first time promoted syndromic surveillance on a global scale, as it was necessary to collect epidemiological data concerning the number, location, and trends of patients. While an advantage of syndromic surveillance is the speedy understanding of the situation of outbreak, inclusion of other diseases showing similar symptoms is likely to occur without confirmation of pathogenic diagnosis. This could turn all the efforts into simple execution of surveillance for pneumonia. Therefore, it is necessary to introduce a method for screening (definitive diagnosis) as soon as possible. While SARS was initially defined as a symptom complex, virological assay results were added as supporting data to the case reports after SARS coronavirus was identified as the pathogen.

In brief, the disease concept called SARS was first highlighted by elimination of other possibilities, and measures and response
The role of the syndromic surveillance was considerable with respect to the speed of action. However, there is the possibility that “pneumonia syndrome” other than the “definite cases” of SARS might be included on one hand, and the possibility that SARS coronavirus infections failing to meet the case definition of SARS might be excluded on the other, hampering the accurate understanding of SARS. To gain better understanding, we need to examine both the confirmed cases with virological “proof” and the cases of SARS infection including non-typical cases.

Infectious Disease Surveillance Center (IDSC), National Institute of Infectious Diseases (NIID), Tokyo, Japan, has already executed such study on the occasions of the G8 summit on a small scale and then World Cup Soccer 2002, and this experience greatly helped the introduction of syndromic surveillance for SARS.

**Discovery of the Causative Virus: SARS Coronavirus**

Because of the concern regarding the reappearance of avian influenza from human subject or the emergence of a new influenza type, the problem of SARS was first addressed by the Influenza Network connecting WHO Influenza Collaborating Center (including the Department of Virology III, NIID) and influenza research centers in various countries. However, the involvement of influenza was disproved. Following the coordination by WHO, the SARS Network was formed by 11 research facilities in 9 countries (including Japan) participating in the Influenza Network. As the result of cooperative efforts with information sharing, a new type of coronavirus was identified as the pathogen of SARS, and WHO announced it under the name of SARS-CoV (SARS corona virus) on April 15, 2003. There had been no precedents of such an international cooperation of researchers aiming at the discovery of a pathogen. The identification of the causative virus enabled pathogenic diagnosis, and the medical understanding of SARS progressed quickly. However, our knowledge remains at the investigational stage with respect to how the new virus gained the ability to infect humans, the pathology, causal treatment, and the methods of prophylaxis including vaccines.

**Present Situation of SARS: World**

The accumulated number of probable cases reported from all over the world to WHO and the situation updates are exhibited on the WHO website (http://www.WHO.int/en/), and the Japanese translation of this information is presented on the IDSC/NIID website. The focuses of epidemics were mainland China, Taiwan, Hong Kong, Vietnam, and Canada.

As a result of the international efforts to identify the cause and enforce an appropriate response, SARS gradually faded, and WHO announced that no country remained on the list of “recent local transmission” on July 5, 2003. As of September 26, SARS had affected 8,098 patients and caused 774 deaths. One patient in Singapore in September 2003 and 1 in Taiwan in December 2003 were reported as cases of infection within laboratories, and these cases did not cause secondary infection. These cases suggest that a high risk of infection is present in laboratories handling pathogenic organisms and such infection, if overlooked, can lead to the spread of SARS.

In addition, 4 cases of natural infection were confirmed in Guangdong Province, China in December 2003. Although these were sporadic cases of infection and not likely to cause the spread of infection, they suggest the need for continued surveillance for this disease.

The Ministry of Health of China further reported 9 cases of SARS in April 2004. One patient died and another developed into a serious condition requiring respirator treatment. The first patient, who had been study-
ing viruses at the National Institute of Virology, traveled between Beijing and his hometown in Anhui Province. The infection spread among the family, caregivers, and other people around this postgraduate student. The Ministry of Health of China admitted that the outbreak started from infection in the laboratory and attributed the cause to inappropriate biosafety management in the laboratory, non-compliance to rules, inappropriate performance of experiment procedures, and insufficient safety measures in the laboratory. This example emphasizes the need for strict enforcement of necessary infection control measures in performing experiments using SARS-CoV.

Response of the Japanese Government (Ministry of Health, Labour and Welfare)

On March 12, 2003, the Ministry of Health, Labour and Welfare (MHLW) issued a notice concerning the outbreak of pneumonia of unknown cause in Hanoi and Hong Kong for the purpose of ensuring information to relevant organizations. On March 14, in response to and in accordance with the WHO case definition of SARS, the Ministry stipulated the case definition for registration purpose and started the SARS surveillance in Japan. At the same time, MHLW developed and publicized measures for providing medical services, standards for patient management in hospitals and standards for controlling nosocomial infection. Other measures were also taken, including information disclosure, advice on travel to confirmed SARS-affected areas, reinforcement of quarantine, and a telephone service for the general public. On March 15, IDSC of NIID published “Urgent Information: Severe Acute Respiratory Syndrome (SARS)” on the IDSC website (http://idsc.nih.go.jp/index-j.html) to provide the information concerning SARS.

With respect to the positioning of SARS under the Law Concerning the Prevention of Infectious Disease and the Medical Care for Patients with Infectious Disease (Infectious Disease Law), it was decided on April 3 that SARS should be handled as a “new category of infectious disease”, so that administrative agencies could address SARS based on the Law. A government ordinance on July 14 added SARS to the list of specified infectious diseases. In August 2003, the Section of Infectious Diseases, Health Science Council submitted a proposal to designate SARS as a class 1 infectious disease in the Infectious Disease Law, and this designation was enacted by the amendment of the Law in November.

Projects conducted as urgent international assistance included surveys in Vietnam, Hong Kong, China, the Philippines, WHO Western Pacific Regional Office, etc.; dispatch of specialists for preventing the spread of infection; and provision of resources for nosocomial infection control to various countries.

Situation of SARS in Japan

After the launch of the SARS surveillance in Japan, the number of case reports from hospitals peaked in the earlier half of April 2003. The total number of reported cases was 68 (52 suspect cases and 16 probable cases). Except for the 2 cases exposed to close contact with suspect and probable cases respectively in Japan, all others were the suspected cases exposed with SARS overseas. The destinations of the travel of these patients were Taiwan, Hong Kong, mainland China (mostly Guangdong Province), and Singapore in decreasing order of frequency. Male cases were 3.0 times as many as females. The age of patients was 30–39 (25%), 20–29 (19%), 40–49 (18%), and less than 10 (16%). The Special Committee on SARS, formed under MHLW, reviewed all reported cases including the information on later clinical courses, and all cases were found to meet the exclusion criteria: “1. An alternative diagnosis can fully explain the illness. 2. Symp-
toms are improved by standard therapies such as antibiotic therapy within 3 days (high probability of bacterial infection or other antibiotic-sensitive disease). Based on this result, the probable cases reported to WHO were reclassified as not having SARS. The number of SARS cases occurring in Japan was amended to zero.

One traveler who visited Japan from overseas in June 2003 and developed symptoms was hospitalized and diagnosed as having SARS after returning to their home country. This patient was not diagnosed in Japan, and was not included in the report from Japan. At the time, case tracing surveys on persons having close contact with the patient were conducted with the cooperation of relevant local governments, MHLW, and IDSC, but no secondary infection in Japan was detected.

As the assay for SARS-CoV became available, a system for virological diagnosis was established in Japan. Tissue culture cells for the separation of SARS-CoV were supplied to Prefectural and Municipal Public Health Institutes in April 2003, as well as the positive control cDNA for RT-PCR in May, enabling assays at these institutions and Virology III/NIID. While 158 specimens were assayed at NIID, there were no positive cases. In fact, there have been no cases of SARS-CoV infection presenting with the symptoms of SARS in Japan. However, there are problems from the standpoint of virological diagnosis, such as that not all cases were tested by pathogenic assay, few paired sera have been submitted, and the time course of serum antibodies has been confirmed only in a limited number of cases.

Actions at Infectious Disease Surveillance Center (IDSC)

IDSC has been at anytime sharing information with WHO, U.S. Centers for Disease Control and Prevention (CDC), U.K. Public Health Laboratory Service (PHLS), and other international and national organizations engaged in infection control in collecting, evaluating, and publicizing official and unofficial information concerning infections in the world. IDSC has also been contributing to international infection prevention efforts as a partner of WHO’s Global Outbreak Alert and Response Network (GOARN). Since the response to SARS emerged as an international issue from the beginning, the response at IDSC was commenced as a continuation of these routine activities. When the situation grew to require the entire workforce of IDSC, the SARS Response Team including Field Epidemiology Training Program (FET) was organized to address the issue.

1) International information collection and publicity in Japan

Working in close cooperation with WHO, NIID vigilantly watched the development of the situation following the outbreak of atypical pneumonia in China in November 2002, collecting information and strengthening cooperation. NIID increased alert when A/H5N1 influenza virus was detected on February 19 in Hong Kong from the patients with influenza-like symptoms, 3 members of a family returning from the travel to Fujian Province. The outbreak of respiratory syndrome among medical workers in Hanoi, Vietnam on March 5, followed by the report of a similar situation in Hong Kong on March 7, and the issuance of the WHO’s Global Alert concerning the outbreak of respiratory syndrome of unknown cause prompted the preparatory work for providing information to Japanese citizens. As WHO issued a worldwide Travel Advice on March 15, NIID in cooperation with MHLW started to publish the “Urgent Information: Severe Acute Respiratory Syndrome (SARS)” page on the IDSC website in the next week. This page included the translation of the official announcements of WHO, with additional explanation as needed. Updating was continued every day from the WHO’s first update on March 17.
to the “Update 96” on July 7. Updating is continuing to reflect the latest bulletins.

The official information from WHO, as well as the information obtained through the communication with the above-mentioned GOARN and various countries, was supplied to relevant organizations, and compiled into technical information materials for measures in Japan. These were used at seminars and training courses for SARS held by MHLW, and also were supplied for use in seminars and training courses for SARS held by the attendants of the central seminars.

2) Technical assistance for measures in Japan

The patient surveillance in Japan started with the notification of MHLW on March 16 requesting case reporting based on WHO’s case definition. Because the cause of SARS was unknown, symptoms were too nonspecific to support clinical diagnosis, and no method for early diagnosis was available at that time, syndromic surveillance was conducted based on the case definition using clinical symptoms, findings, and epidemiological linkage. While such surveillance was likely to cause inclusion of many patients with diseases other than SARS showing similar symptoms, adequate preventive measures against infection had to be practiced for the patients with SARS. Because this situation could cause difficulty in making judgment in clinical practice, IDSC set up a system to answer questions from hospitals and health departments of local governments. Questions via telephone and e-mail were answered, and answers to frequently asked questions were posted on the IDSC website. While WHO was frequently announcing guidelines on patient management, hospital discharge, etc., which were practically regarded as international standards, IDSC developed Japan’s own guidelines to supplement them in the management of ambiguous cases. These covered various topics from basic patient management and response in outpatient clinics to the selection of disinfectants and disinfection methods for workplaces and homes. After the new coronavirus was identified as the pathogen of SARS and the virological tests for SARS-CoV became available in Japan, IDSC in cooperation with Department of Virology III had to manage the numerous requests for testing. IDSC worked as the secretariat coordinating the roles of local governments and Department of Virology III. In connection with this response, guidelines for SARS-CoV tests and those for laboratory biosafety were also announced. The information from IDSC reflected the frequent updates and incorporated the responses and guidelines in the U.S., Canada, Singapore, and other countries.

As the surveillance in Japan became established and suspected and probable cases of SARS reported from local governments to MHLW and the information in the reports of suspected and probable SARS cases from local governments to MHLW started flowing from the Ministry to IDSC, the data were converted to electronic form, linked to assay information and compiled in a database of patients who might have SARS in Japan.

In the incident where a traveler from a SARS affected area developed SARS and traveled to Japan, we provided technical support to the Operation Center established in MHLW, prepared an on-site epidemiological survey manual, and sent active surveillance team including FETP, to support epidemiological surveys in response to the request from relevant

3) Technical assistance for international measures

Personnel have been sent on a long-term basis from IDSC to Communicable Disease Surveillance and Response (CSR; the organization responding to the SARS outbreak) in the WHO headquarters. This arrangement has proved very useful in the response to this kind of situation. The epidemics of SARS were centered on Asia and in the jurisdiction of the Western Pacific Region Office (WPRO)
among the regional offices of WHO. IDSC sent 5 personnel to Hong Kong and Manila in response to the request from GOARN or WPRO. They supported epidemiological surveys and nosocomial infection control measures in Hong Kong and worked in Manila to support data analysis and the development of guidelines for the areas covered by WPRO. Various kinds of information were obtained through such cooperation and then utilized for the response in Japan.

**Infection Routes, Symptoms, and Infectivity of SARS: Summary of Epidemiological Surveys**

At present, the SARS virus is believed to infect mostly from human to human. Based on the situation of reported infection, the highest risk of infection is associated with “close contact with SARS patients,” such as giving nursing care or assistive care to SARS patients presenting with pneumonia (especially in severe cases), living with patients with symptoms, and direct contact with the body fluid or airway secretion of patients. Droplet infection and contact infection via airway secretion are considered the most important route of infection. The possibility of fecal-oral infection, airborne infection, etc. cannot be ruled out, but these are considered rare. SARS initially spread from Hotel M in Hong Kong, but there has been no further incidence of infection spread mediated by hotels. The spread of infection in general residential districts such as A Garden was also exceptional, and no similar outbreaks have been reported. While cases of secondary infection in aircrafts have been reported, all these cases were infection from passengers with manifest symptoms, and infection from asymptomatic carriers has not been reported. The epidemiological surveys conducted so far indicate that a large majority of patients became infected by secondary infection from medical workers and families of SARS patients. The most important factors were the spread within medical institutions treating symptomatic patients and the leak from there to communities.

While 80 to 90% of SARS patients showing symptoms of pneumonia start to recover within about 1 week, 10 to 20% develop into a serious condition (acute respiratory distress syndrome: ARDS). Although there are geographical differences, the mortality rate is about 10% on average. Infectivity is stronger during the climax phase of pneumonia and in severer patients. Therefore, nosocomial infection control in hospitals treating such patients is particularly important. Although patients with fever and coughing in the prodromal phase have only weak infectivity, adequate precautions must be taken in the treatment of these patients. The possibility of infection from patients in the latent or asymptomatic phase is none or very low, if any. Therefore, the possibility of the spread of infection in community is very low. While each SARS patient is has the potential to transmit infection to 2 or 3 unprotected persons \( (R_0 = 2–3) \), a minority of patients might each transmit the infection to 10 to dozens of persons. Most of these patients, called super spreaders or hyper transmitters, developed severe conditions and died, and little is known about the factors (patient background, environment, use of protection against infection, etc.) associated with such patients. Multiple super spreaders developed symptoms and expanded the spread of infection before the presence of SARS was noticed in the outbreaks in Hong Kong, Taiwan, Singapore, and Toronto. On the other hand, it is estimated that Vietnam, the U.S., the Philippines, Korea, and Japan were fortunately visited by few or no super spreaders. The analysis of patient background indicated high mortality rate among aged persons, high incidence of infection and low mortality rate in the 20–49 age groups, and low incidence of infection and low mortality rate among children. No explanation has been given to account for these observations.
Prevention of the Spread of Infection

As the medical workers experiencing outbreaks invariably remark, the spread of nosocomial infection took place because nobody recognized the infectivity of this disease and treated it as ordinary pneumonia in the early stages of the SARS outbreak. In other words, this disease spread in hospitals taking advantage of the lack of "precautions against infection." The basics of nosocomial infection control are "the introduction of the concept of standard precautions" and "the orderly use of preventive measures." All medical institutions need to ensure the understanding of this concept and the preparedness to use it whenever needed. Aside from SARS, we now need to raise the standard of infection control in general. It is also necessary to ask for the cooperation of citizens seeking medical treatment (ask them to report any fever, cough, and recent overseas travel on the phone rather than at the time of visiting physician, ask them to use protective equipment such as a mask, etc.).

Fortunately, Japan has not experienced the spread of SARS infection, and no cases have occurred in Japan. However, there are no guarantees that this situation will continue into the future. We expect that the spread of SARS infection in Japan can be prevented fairly well by means of the triage of patients with infections in general, the introduction of standard precautions in general medical institutions, the introduction of barrier nursing in situations needing it, and the strict infection control of severe patients. In particular, general outpatient clinics seeing many cases of respiratory infections need to be prepared against emerging, probably rare diseases such as SARS, and this should be achieved through improving practice, such as the early triage of patients considered to have pneumonia (use of telephone consultation, history taking at the time of reception, flexibility in the order of patients examined, place of examination, etc.), use of surgical masks by caregivers seeing patients with pneumonia, and asking patients to wear masks, considering the acceptance by the public.

The experimental use of SARS-CoV at the institutions engaged in virological study and testing is expected to increase. These institutions need to ensure appropriate installation and management of biosafety facilities, as well as ensuring full awareness of laboratory workers.

Conclusion

After the WHO Global Alert on SARS, worldwide efforts were made to identify the cause and enforce an appropriate response. The pathogenic organism was identified exceptionally quickly, and new information and knowledge on this disease are still being accumulated. The emergence of SARS highlighted many problems in the health care system, infection control, public health, and health administration. While improvements were achieved quickly in some aspects and belatedly in others, many problems remain unsolved. While response to a specific disease such as SARS is certainly important, the most important step in preventing the spread of infection is to raise the standard of measures against infections in general.

After being active from mid March 2003 to early July, the SARS Response Team in IDSC was dissolved for the time being on July 7. The response to SARS required the entire workforce of IDSC during a period of about 3 months, and services in other areas almost declined. The most important factor in crisis management is human resources. We need further efforts in staff training and strengthening organizational capabilities. (Thanks to the understanding and cooperation from various parties, the staff in IDSC was increased by the addition of 6 chief researchers in charge of SARS.)

The experience in the SARS outbreaks and the increase in the IDSC staff greatly helped the response to the avian influenza
epidemics that occurred in and out of Japan from 2004 to the present, as well as the assistance to local inhabitants in infection control following the Sumatra Earthquake and Tsunami.

References