

SARSControl

**Effective and Acceptable Strategies for the Control of SARS and
New Emerging Infections in China and Europe**

**Report On
Control Measures Implemented by the Non-
European SARS Affected Countries**

**Work Package 8
Deliverable 8.2**

World Health Organization

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The Severe Acute Respiratory Syndrome epidemic in 2003 showed that new infectious diseases can spread rapidly across borders and continents with wide ranging consequences. The EU SARSControl project is an integrated multidisciplinary project funded by the European Commission within the sixth framework programme. It has the objective to aid European policy on public health management of new emerging infections. The work package 8 deals with policy evaluation based on an inventory analysis of the European and Non-European SARS control strategies along with outcomes of the work packages 2 – 7.

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Introduction

Emerging infectious diseases can have enormous consequences on public health, national economies and social life. Severe Acute Respiratory Syndrome (SARS) was the first new emerging infectious disease to hit the world in the 21st century, which had the potential of becoming a global epidemic. (1) It was caused by a previously unknown, new corona-virus subtype, which crossed the species barrier with subsequent human to human transmission. As a result of the SARS corona-virus transmission from November 2002 – July 2003, 8,096 SARS cases and 774 deaths were reported from 29 countries and areas. (2) More than 95% of cases occurred in 12 countries of the Western Pacific Region with Mainland China being the worst affected with 5,327 cases. (1) 21% of the world-wide SARS cases occurred among health care workers. (2) The average global case fatality ratio was estimated around 15%, increasing to more than 55% for people above 60 years of age. (3)

Retrospectively the earliest SARS cases appeared in the southern Chinese Province of Guangdong, in mid Nov. 2002. (3) The Guangdong health authority officially informed about the outbreak of atypical pneumonia affecting 305 people on 11th Feb. 2003. (1) On 21st Feb.'03 a physician from Guangdong who had been infected with the virus while treating patients, travelled to Hong Kong where he transmitted the virus to at least 16 guests at the hotel where he stayed. Some of them became the index cases for transmission chains in hospitals of Vietnam, Singapore, Canada and in Hong Kong itself. (4)(WHO update 83)

First atypical pneumonia cases outside China, were reported to the WHO on 3rd March by Dr. Carlo Urbani from Hanoi-Vietnam, where HCWs had developed an acute respiratory illness following the admission of a businessman who had returned from Hong Kong with similar symptoms. (1) This was followed on 11th March by reports of infected health care workers in a hospital in Hong Kong. (5) followed by subsequent reports on 14th March of similar cases from Canada, Singapore and Taiwan. (4)

In response to the hospital clusters, WHO issued a first global alert on 12th March'03, about the appearance of a new contagious respiratory disease of unknown aetiology. The signs and symptoms were described and as a first measure WHO recommended to isolate suspect cases, apply barrier nursing and to report such cases to national authorities. (1)(4) On 15th March WHO

issued a second alert, following the realization that SARS had spread to several countries in a short time via air travel. Travellers and airline crew were informed of the main signs and symptoms of SARS and people having those symptoms were advised not to travel. (6)(1) The new disease was named SARS and case definitions, based purely on clinical signs and symptoms (high fever, respiratory symptoms) and contact history or travel to areas reporting these cases were formulated. (1)(4) On 1st May the case definition was revised to include laboratory tests for SARS coronavirus. (4)

The WHO adopted a unique role in coordinating the global SARS containment efforts. It formulated policies, case definitions, and guidelines and gave recommendations on how to deal with SARS. Early in the outbreak, WHO established contact with affected countries and offered epidemiologic, laboratory, and clinical support. Through its Global Outbreak Alert and Response Network (GOARN) partners, WHO was able to rapidly mobilize expertise and resources to find answers to the key epidemiologic parameters, identify the causative agent and send teams to affected areas.

For a rapidly spreading disease that was not clearly understood and that did not respond to the classic antibiotic and antiviral therapies and for which no vaccines were available, traditional public health interventions, like early case detection, isolation of cases, contact tracing and quarantine, decreasing social interaction and keeping the public informed were the only options available to contain spread. In less than 4 months intensive national and international efforts and cooperation led to WHO announcing on 5th July'03, that human to human SARS transmission had been interrupted. (1)

The risk of infectious disease like SARS or more contagious infections recurring and spreading is high, specially in today's interconnected world. Unknown, etiologic agent, route and mode of transmission, infectiousness, incubation period, prophylaxis and treatment are features of all new emerging infections and it is under these circumstances that national and international public health authorities have to take rapid and decisive steps to control spread.

SARS control measures were implemented by the affected countries, both in response to WHO recommendations and as considered appropriate and feasible by the national governments. (7)

This report lists up and summarizes the major control measures implemented individually by the Non-European countries affected by major SARS outbreaks, due to local transmission within the country and by countries affected by SARS due to imported cases and highlights similarities and differences in approach.

Methods

The European Commission Report of June 2003 on the “Measures undertaken by member states and accession countries to control the outbreak of SARS” provided the outlining concept for this report. (8) For the EU report a questionnaire inquiring about the measures implemented by the individual countries to control the SARS outbreak was sent to the national authorities and the answers compiled. As this was not possible for the Non-European SARS affected countries, an intensive literature search formed the basis for this report on the individual countries response to SARS.

The countries included in this report, for which an inventory of control measures was to be prepared, were chosen from the WHO list “Summary of probable SARS cases with onset of illness from 1st Nov.2002 – 31st July 2003”. (2) The Non-European countries were divided on the basis of presence or absence of local SARS transmission within the country, into the following two categories:

- **Countries with local SARS transmission**
- **Countries with imported SARS cases**

For the category “**Countries with local SARS transmission**” the following 6 countries/areas, which had 98% of the world SARS cases, were identified.

| | |
|--|--------------|
| - Singapore | (238 cases) |
| - Hong Kong, Special Administrative Region-China | (1755 cases) |
| - China Mainland | (5327 cases) |
| - Taiwan, Republic of China | (346 cases) |
| - Vietnam | (63 cases) |
| - Canada | (251 cases) |

Countries with less than 15 SARS cases were not selected for this category.

For the category “**Countries with imported SARS cases**” the following countries were chosen.

- United States (27 cases)
- Thailand (9 cases)
- Malaysia (5 cases)
- Australia (6 cases)

Countries having less than 5 imported SARS cases were not included in this category.

In the next step a list of **control categories** covering the major control areas was developed from the list of control actions in the EU Report and the control measures related to each category listed accordingly. The following 7 categories were identified:

1. Organizational and administrative measures
2. Case detection and contact tracing
3. Quarantine
4. Hospital and community containment measures
5. Infection control measures for protection of health care workers
6. Travel related measures
7. Guidance and information to the public

The report consists of two parts, the first giving an overview with respect to the selected control categories and related control measures (in the form of summary tables) listing whether these were implemented by the countries included in the report. This is followed by a discussion, which highlights variations in approach and reflects on the effectiveness of the implemented control strategies.

The second part of the report consists of a more detailed inventory of control measures implemented individually by each of the 10 countries during the 02/03 SARS outbreak. It briefly explains how SARS evolved, the important control measures implemented and gives information on the chronology and time of implementation of these measures where available.

For the literature search online databases including Medline and Pubmed and the search instrument Google were used to identify relevant studies and reviews. Search terms included 'SARS control measures', 'SARS containment measures', 'Public health measures and SARS' and 'Response to SARS' along with the name of the respective country.

In addition official Ministry of Health, Department of Health, Public Health Agency and Centres for Communicable Disease Control (CDC) websites of the respective countries were searched for reports and documents related to SARS. SARS chronology, SARS control policy manuals and directives, SARS fact sheets, guidelines and recommendations issued by the respective countries on the SARS control measures implemented were reviewed.

Information provided on the WHO website, textbooks on SARS published by WHO Western Pacific Region and other publishers along with the regular WHO SARS updates and US CDC's morbidity and mortality weekly reports, served as additional sources of information. Personal communication with experts in Vietnam and China helped to identify additional published information.

Articles up to December 2006 were considered for the review, preference was given to reports and studies focusing on the implementation and evaluation of public health intervention measures. Papers and abstracts written in English language were selected. Further relevant papers were identified from the reference lists of the retrieved articles.

The selected articles, reports and official documents were studied for information on the above mentioned control categories. In addition information on the epidemiology and transmission chains of SARS was sought for a better understanding on the evolution of events and stepwise implementation of control measures. Articles and reports focusing on the lessons learned from the SARS outbreak in the individual countries were reviewed to provide an impression on the effectiveness of measures undertaken.

Considerable efforts were made to systematically collect information on the major control measures implemented by these 10 countries, yet this report is a selection and does not represent the large variety of diverse control measures implemented during different phases of the epidemic

by the national authorities. On account of minor differences of figures like case numbers or dates in the different literature sources, figures stated in this report might differ from those in other reports.

Results and summary tables

As the new contagious respiratory disease ‘SARS’ began to spread outside China in 2003, national governments, public health authorities as well as international organizations began recommending and introducing measures to prevent the outbreak from spreading. This started with alerting health care providers and providing them with case definitions to facilitate an early diagnosis, isolation and treatment of SARS cases. The realization that the extent of spread was greater than expected, led to the introduction of measures like quarantine of contacts of SARS cases, entry and exit screening at airports, risk communication to raise public awareness and institution of even stricter infection control and barrier precautions in health care settings.

The following control category tables present a list of the major control measures adopted by the 6 countries/areas namely Singapore, Hong Kong (SAR)-China, China-mainland, Taiwan-China, Vietnam and Canada, which had the highest number of SARS cases as result of local transmission. In addition the control measures adopted by 4 countries namely United States of America, Thailand, Malaysia and Australia, which were affected by SARS due to imported cases are also listed.

Organizational and Administrative Measures

Once the presence of SARS was realized, all countries set-up SARS task forces and committees at central and regional level for coordinating surveillance, response, and communication activities. They were generally looked over by the national Ministry or Department of Health. In Hong Kong a working group for “severe community acquired pneumonia” was set up as early as mid Feb.’03 following reports of cases from Guangdong. (9)

All countries made legislative amendments in their infectious disease acts making SARS a notifiable disease, most of the severely affected countries also instituted mandatory quarantine. In Vietnam, Singapore, Hong Kong, Taiwan and Canada SARS became a notifiable disease by end of March and they all reported cases to the WHO as they were identified. In China SARS

reporting became mandatory on 8th April and complete reporting of cases to WHO started around 21st April. (1)

China, Singapore, Hong Kong, Canada and USA set up centralised databases to compile all information on cases and contacts. In Hong Kong among other databases a police computer system for tracing criminals was used to detect SARS clusters, geographical distribution, source and route of spread, and the connection between cases and contacts. (10)

Several high level regional ASEAN + 3 meetings were held in April to enhance co-operation and information exchange and develop joint action plans for SARS prevention and control in the Asian region. In addition bi-lateral agreements among neighbouring countries like Singapore – Malaysia, Singapore - Indonesia and between Hong Kong, Macao and Guangdong Province on contact tracing, pre-departure checks and exchange of medical information on SARS between the health ministries were made. (11)(12)

| Organizational and Administrative measures | Countries with local SARS transmission | | | | | | Countries with imported SARS cases | | | |
|--|--|------------------------|---------------------|----------------|-------------|--------------|------------------------------------|----------|----------|-----------|
| | Singapore | Hong Kong (SAR, China) | China | Taiwan (China) | Vietnam | Canada | USA | Thailand | Malaysia | Australia |
| Date of SARS onset (2) | 25.2.03 | 15.2.03 | 16.11.02 | 25.2.03 | 23.2.03 | 23.2.03 | 24.2.03 | 11.3.03 | 14.3.03 | 26.2.03 |
| Removed from WHO list of areas with recent local transmission (18) | 31.5.03 | 23.6.03 | 24.06.03 Beijing | 5.7.03 | 28.4.03 | 2.7.03 | NA | NA | NA | NA |
| Mandatory SARS notification | Y 17.3.03 | Y 27.3.03 | Y 8.4.03 | Y 27.3.03 | Y 3.3.03 | Y 25.3.03 | Y 4.4.03 | Y | Y | Y |
| Mandatory Quarantine of contacts | Y | Y | Y | Y | | N | N | N | N | N |
| SARS case reporting at central level | Y | Y | Y | Y | | Y | Y | Y | Y | Y |
| SARS case reporting to the WHO | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Central Administrative Authority for co-ordination of SARS surveillance and management | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Database of SARS cases | Y | Y | Y | | | Y | Y | | | |
| Co-operation and information exchange with neighbouring countries | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Co-operation with the WHO | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Allocation of a special budget for SARS management | Y | Y | Y | | Y | Y | | | | |
| Guidelines for professionals on how to proceed with a probable SARS case | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Inter-ministerial co-operation | Y | Y | Y | Y | Y | Y | | | Y | Y |
| Laboratory handling guidelines | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |

Table 1: Organizational and administrative measures (Y=yes, N=no, NA=not applicable)

Case Detection, Contact Tracing

Early case detection followed by rapid and effective isolation was the key measure to control SARS spread. (1)(7). All countries affected by local SARS transmission instituted various intensive case finding activities, which began with alerting health care providers and providing diagnostic protocols. This included the wide dissemination of a case definition usually as defined by the WHO often with some changes. Countries like Singapore for e.g. expanded on the WHO's case definition and adopted a "wide-net" surveillance policy to additionally detect cases with atypical presentations. (13)

All countries started epidemiologic investigation of probable and suspect cases as soon as possible, by interviewing cases for exposure, travel and contact history, in many cases using questionnaires developed for this purpose. As SARS was mostly being transmitted to close contacts, active contact tracing was one of the measures applied by all countries experiencing local transmission. Singapore for e.g. made intensive efforts to locate contacts by interviewing cases within 24 hrs. of case notification, setting up a contact tracing centre with up to 140 employees, involving the armed forces in contact tracing and maintaining a contact database accessible to all hospitals. (13)

In Toronto-Canada a SARS screening tool was developed for early case detection, which had to be answered by all people before entering hospitals.

Singapore, Hong Kong, Vietnam, Taiwan and Canada all instituted regular monitoring of the health status and temperatures of HCWs working in SARS affected areas/institutions. Details of HCWs who came in contact with SARS cases were noted, Singapore also instituted active surveillance of clusters of 3 or more HCWs having fever above 38°C to prevent transmission in hospitals.

Different systems were set-up by the countries to ensure that all cases were being reported to the health authorities by the health care providers, for e.g. case report forms, reply slips, hospital audits, "Zero reporting" in China etc.

| Case detection, Contact tracing | Countries with local SARS transmission | | | | | | Countries with imported SARS cases | | | |
|---|--|---------------------------|-------|-------------------|---------|--------|------------------------------------|----------|----------|-----------|
| | Singapore | Hong Kong (SAR, China) | China | Taiwan (China) | Vietnam | Canada | USA | Thailand | Malaysia | Australia |
| Central Case reporting by hospitals, diagnosing physicians etc. (daily) | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Epidemiological investigation and contact information by interviews of SARS cases | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Questionnaire for clinical, travel and contact history of SARS case | Y | Y | Y | | | Y | Y | | Y | |
| Clear case definition (as per WHO guidelines or broader) disseminated to all involved health care staff | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Active tracing of identified close contacts | Y | Y | Y | Y | Y | Y | | | | |
| Enhanced SARS surveillance activities | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Clear definition of a close contact of a SARS Case | Y | Y | Y | Y | | Y | Y | Y | Y | Y |
| Monitoring absenteeism of employed hospital staff; Temperature monitoring of HCWs | Y | Y | | Y | Y | Y | | | Y | Y |

Table 2: Case detection, Contact tracing (Y=yes, N=no, NA=not applicable)

Quarantine

Quarantine of close contacts was instituted in all countries experiencing local SARS transmission, only the extent differed. Generally a 10 – 14 day home quarantine of close contacts of probable and suspect SARS cases, where people were asked not to leave the home was instituted. While Singapore placed contacts of SARS cases under home quarantine from the beginning (24th March), Hong Kong initially put contacts under medical surveillance asking them to visit a designated medical centre for 10 days.

In addition to home quarantine people in Taiwan, Vietnam, Hong Kong (SAR) and China were also quarantined in groups e.g. government housing, hospital, hotels, holiday camps etc. for e.g. residents of the Amoy Gardens apartment complex in Hong Kong (329 residents infected). In China people in some hospitals, universities, communities and construction sites were placed under collective quarantine on the site and some villages were also sealed. (14)(1)

Most countries with local SARS transmission made legislative amendments legalising quarantine enforcement. In Canada the contacts were asked to place themselves under home quarantine, most did so voluntarily. (G15) Countries affected by imported SARS cases, requested the contacts to voluntarily observe home quarantine. The fact that the incubation period for SARS was 10 days made observation and quarantine of contacts feasible. (1)

In Hong Kong and Singapore home quarantine was very strictly implemented and monitored by telephone surveillance, police checks, visiting HCWs and electronic cameras installed at home in front of which the quarantined person had to appear when telephoned. Non-compliance was punishable with high fines, electronic wrist tags and even prison sentences. (12)(1)(16) In China neighbours were asked to be vigilant and monitor compliance with quarantine rules. (1)

Convalescent SARS patients after discharge from hospital were placed under a 10 – 14 day home quarantine in Singapore, Taiwan and Canada while in Vietnam SARS patients were discharged 5-6 weeks after hospital admission.

As a result of the high exposure risk in hospitals and on account of staff shortage, often health care workers were placed under a 10 day work quarantine. In Canada HCWs were to observe the

rules of home quarantine when off work, while in some other countries like Taiwan, Vietnam and China they were frequently quarantined on the hospital site.

According to a review SARS was diagnosed in 0.22% of quarantined contacts in Taiwan, 2.7% in Hong Kong and 3.8 – 6.3 % in Beijing-China. (7)

| Quarantine | Countries with local SARS transmission | | | | | | Countries with imported SARS cases | | | |
|---|--|------------------------|--------------------------|----------------|---------|--------|------------------------------------|----------|----------|-----------|
| | Singapore | Hong Kong (SAR, China) | China | Taiwan (China) | Vietnam | Canada | USA | Thailand | Malaysia | Australia |
| Home quarantine of close contacts of probable SARS cases for 10 – 14 days | Y 24.03.03 | Y 10.04.03 | Y Beijing 21.04.03 | Y 18.03.03 | | | | | | |
| Home quarantine of close contacts of suspected cases | Y | Y | Y | Y | | | | | | |
| Home quarantine of casual contacts | Y | | | Y | | | | | | |
| Home quarantine of children of contacts | Y | | | | | N | | | | |
| Voluntary home quarantine of contacts | | | | | | Y | Y | Y | Y | Y |
| Quarantine in groups /institutions /designated sites | | Y | Y | Y | Y | | | | | |
| Enforcement of quarantine / monitoring/e-cameras /police checks | Y | Y | Y | Y | | N | | | | |
| Work quarantine for health care staff | | | Y | Y | Y | Y | | | | |
| Home quarantine for high-risk exposed health care staff | Y | | | | | | Y | | Y | Y |
| Active follow-up of quarantined persons by nurses, telephone calls etc. | Y | Y | Y | Y | | | | | | Y |
| Clear instructions to contacts on quarantine rules | Y | Y | Y | Y | | Y | Y | | | |
| Quarantine of discharged SARS patients | Y | | | Y | | Y | | | | |

Table 3: Quarantine (Y=yes, N=no, NA=not applicable)

Hospital and Community Containment measures

Hospitals acted as major sites for transmission and multiplication of SARS cases. In Singapore and Canada more than 75% of cases were hospital acquired (13) (17)

All countries isolated probable and suspect SARS cases either in single private rooms if available (as for e.g. was done in Canada) or set up cohort wards in hospitals with isolation facilities as was the case in Vietnam and Hong Kong. In the USA cases were generally isolated at home.

Countries affected by local SARS transmission like Singapore and Vietnam strictly designated one hospital for the treatment of all suspected and probable SARS cases which were transferred to the designated hospital. (16)(1) Taiwan, China and Hong Kong initially designated SARS units followed later during the epidemic by designated hospitals for the treatment of SARS patients. In China-Beijing a 1000 bedded hospital was also constructed within a week for this purpose. (1) Canada required all hospitals to be prepared for isolating and treating SARS cases, hence focusing capacity building in multiple institutions. (15)

Countries with local transmission generally instituted patient triage, i.e. screening and separating symptomatic patients at the first point of presentation (for e.g. emergency department, GP practice) to prevent transmission to other patients and HCWs. Canada and Singapore developed triage charts, which gave exact instructions on how to proceed in a stepwise manner. Patients identified through triage were isolated or placed under observation. Hong Kong had 4 designated medical centres, while Taiwan and China-Beijing had set up over 100 fever clinics, at health care facilities to triage patients with fever and respiratory symptoms. In Beijing, about ½ of these clinics had to be closed as they also acted as amplification sites for SARS due to improper separation from the general patient area and inadequate isolation facilities.

All countries developed hospital infection control guidelines, and many countries had teams in hospitals to monitor the proper implementation.

Some countries issued special instructions on precautions to be taken while performing procedures like intubation, bronchoscopy etc. which were recognised to facilitate virus spread through aerosolization.

Additional measures to prevent the transmission of SARS out of the hospitals included the restriction of HCWs to work at one health care institution only and the restriction or prohibition of visiting SARS patients in hospitals. Singapore, Taiwan and Canada had hospital discharge guidelines for both convalescent SARS and non-SARS patients, generally requiring them to observe home quarantine in addition hospital transfers were also restricted or prohibited. In Hong Kong 72 elderly home residents had been infected with SARS hence Hong Kong issued special guidelines for this vulnerable group. HCWs were also asked to employ a high index of suspicion when dealing with immuno-compromised or chronic patients due to their often atypical presentations as was seen in Hong Kong and Singapore.

Some measures to enhance early detection of cases in the community and to reassure the public included public temperature screening for e.g. before entering schools, public buildings, offices, hospitals etc. as was done in Singapore, China and Taiwan. In addition Singapore, Hong Kong and China also closed schools for a couple of weeks, even in Toronto-Canada some schools were closed and students placed under home quarantine. Singapore closed a large market that had been associated with a SARS cluster, for 15 days and placed >1000 people under home quarantine. (1)

In China-Beijing >3500 public places like libraries, bars, indoor sports complexes etc. were closed, and traffic in a huge city like Beijing reduced by up to 75%. (1) By late April China made a unique move, to mobilize its rural and urban population in a “People’s War” against SARS and developed a people’s surveillance system to ensure that SARS cases were identified quickly. (1)

| Hospital and community containment measures | Countries with local SARS transmission | | | | | | Countries with imported SARS cases | | | |
|--|--|------------------------|--------------------------|----------------|---------|---------|------------------------------------|----------|----------|-----------|
| | Singapore | Hong Kong (SAR, China) | China | Taiwan (China) | Vietnam | Canada | USA | Thailand | Malaysia | Australia |
| Isolation of probable cases | Y | Y | Y | Y | Y | Y | Y Home | Y | Y | Y Home |
| Starting Date | 6.3.03 | 11.3.03 | | 15.3.03 | 5.3.03 | 13.3.03 | | | | |
| Isolation of suspect cases | Y | Y | Y | Y | Y | Y | Y Home | Y | Y | Y Home |
| Triage guidelines | Y | | Y | | | Y | Y | | Y | |
| Triage facility/SARS clinics/fever clinics | Y | Y | Y | Y | | Y | | | Y | |
| Designated SARS hospitals | Y | Y | Y | Y | Y | N | N | N | Y | Y |
| Designated SARS wards/units | | Y | Y 27.04.03 Beijing | | Y | Y | N | N | Y | |
| Guidelines for Hospital Infection Control Measures | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Hospital Infection Control Committees/Auditing of Hospital Infection Control | Y | | | Y | Y | Y | | | | |
| Presence of negative pressure isolation rooms | | | N | Y | N | Y | Y | | Y | Y |
| Guidance to physicians practicing in community setting | Y | Y | Y | Y | | Y | Y | | Y | Y |
| Special ambulance services/instructions for transporting SARS patients | Y | Y | Y | | | Y | Y | Y | Y | Y |
| Guidelines for performing high risk procedures (Intubation, Bronchoscopy etc.) | Y | | | | | Y | Y | | Y | Y |

Table 4: Hospital and community containment measures (Y=yes, N=no, NA=not applicable)

| Hospital and community containment measures | Countries with local SARS transmission | | | | | | Countries with imported SARS cases | | | |
|--|--|------------------------|-------|----------------|---------|--------|------------------------------------|----------|----------|-----------|
| | Singapore | Hong Kong (SAR, China) | China | Taiwan (China) | Vietnam | Canada | USA | Thailand | Malaysia | Australia |
| Restriction of HCWs to work in a single health care institution only | Y | | | | Y | Y | | | | |
| Restrict/Prohibit hospital visitors | Y | Y | Y | Y | Y | Y | | | Y | Y |
| Closure/Suspension of regular activity in hospitals where SARS transmission occurred | Y | Y | Y | Y | Y | Y | NA | NA | NA | NA |
| Construction of special hospital /clinic /negative pressure rooms for management of SARS cases | | Y | Y | Y | | Y | NA | NA | NA | NA |
| Hospital Discharge guidelines for convalescent SARS patients (e.g. home quarantine) | Y | Y | | Y | | Y | | | Y | Y |
| Hospital Discharge guidelines for Non-SARS patients in SARS hospitals | Y | | | Y | | Y | | | | |
| Inter-hospital transfer guidelines | Y | | | | | Y | | | | |
| Recruitment of extra HCWs, personnel | Y | | Y | | | Y | Y | Y | | |
| In-hospital SARS management team | Y | Y | | Y | Y | Y | | | Y | Y |
| Special guidelines/control measures for residential care homes for the elderly | Y | Y | | | | Y | | | | Y |
| Public temperature screening (in the city, schools, buildings, offices etc.) | Y | | Y | Y | | | | | | |
| Closure of Schools | Y | Y | Y | | | Y | NA | NA | NA | NA |
| SARS prevention guidelines for schools | Y | Y | | | | | | Y | Y | |
| Restriction on mass gatherings / closure of public places like libraries, cafes etc | | | Y | N | | | NA | NA | NA | NA |
| SARS mobile teams | | | Y | | Y | | | | | |
| Disinfection of SARS households, buildings | | Y | | Y | | | | | | |

Table 4 (cont.): Hospital and community containment measures (Y=yes, N=no, NA=not applicable)

Infection Control Measures for the protection of Health Care Workers (HCWs)

Hospitals acted as major sites for SARS transmission, which made HCWs particularly vulnerable to contract SARS. 21% of the SARS cases worldwide were HCWs and in Canada and Vietnam they constituted 43% and 57% of the SARS cases respectively. (2)

All countries affected by SARS, developed detailed infection control guidelines and manuals for HCWs. They covered rules on the Personal Protective Equipment (PPE) to be applied in different hospital areas (emergency dept., SARS unit, triage area etc.), how PPE was to be donned and removed, barrier nursing techniques, how equipment was to be disinfected or discarded etc. These countries particularly those affected by local transmission, developed and conducted special infection control training courses for their HCWs, some were assisted by WHO and other institutions. The knowledge on infection control methods was often limited, specially outside the main cities where basic facilities were also lacking.

Singapore, Taiwan, Vietnam and Canada had hospital infection control teams, which monitored the proper use of PPE by HCWs.

The basic recommended protective attire generally included masks (N-95 masks or 12 layered cloth masks or surgical masks), goggles or face shields, long sleeved gowns and gloves. Hand hygiene (washing or hand rub) before and after contact was also stressed upon. In Canada and Singapore N-95 masks were mostly used by HCWs, which were often fit tested, this being a costly procedure. In Vietnam during the early phase only paper or cloth masks were available.

Many countries faced acute shortage of masks and other protective equipment, which was especially hard on HCWs, even in countries like Singapore the PPE resources became stretched. (4)

| Infection control measures for the protection of Health Care Workers (HCWs) | Countries with local SARS transmission | | | | | | Countries with imported SARS cases | | | |
|---|--|------------------------|-------|----------------|---------|--------|------------------------------------|----------|----------|-----------|
| | Singapore | Hong Kong (SAR, China) | China | Taiwan (China) | Vietnam | Canada | USA | Thailand | Malaysia | Australia |
| Infection control guidelines for HCWs | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Hand washing instructions | Y | | | Y | Y | Y | | Y | Y | Y |
| Personal protective equipment (PPE) to be worn by HCWs. PPE includes (N95 masks, gloves, gowns) | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Training of HCWs on SARS management, droplet and barrier precautions and proper use of PPE | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Provision of information on Infection control measures (pamphlets, CDs) | Y | Y | Y | Y | Y | Y | | | | |
| Use of fit tested N95 masks | Y | | | | | Y | | | | |
| Screening health status/ temperature of HCWs at work | Y | Y | | Y | Y | Y | | | Y | Y |
| Infection control team for monitoring of Infection control practice | Y | | | Y | Y | Y | | | | |

Table 5: Infection control measures for the protection of health care workers
(Y=yes, N=no, NA=not applicable)

Travel related measures

From 15th March WHO issued emergency travel advisories but no travel restrictions for areas affected by local SARS transmission. From 2nd April WHO issued travel recommendations for some of the more severely affected areas, to postpone all but essential travel to these areas. (18) Similar alerts and advisories were also given out at national level by many countries. Countries were removed from WHO's list of affected areas with local transmission 20 days after the last case was reported.

Information on SARS was provided to millions of travellers by the countries national authorities using posters, videos, making announcements at airports and on flights, at railway stations and by providing written information. Health alert notices informing about the signs and symptoms of SARS, and where to seek help if they develop were distributed by most countries to arriving passengers. (7)

From 27th March WHO recommended countries experiencing local SARS transmission to screen departing passengers, which included asking them questions and checking their temperature. Passengers arriving in or departing from Canada, China, Hong Kong, Taiwan and Singapore had to submit health declaration cards certifying that they were free of SARS symptoms and had no contact to SARS cases, or were asked questions. (7) Millions of domestic and international travellers entering or leaving affected areas via different routes were subjected to thermal scanning. Passengers at Vietnam airport underwent visual health screening, which helped identify one case.

In Taiwan all passengers (around 80,000) returning from SARS affected areas were placed under a less restricted form of quarantine for 10 days.

| Travel related measures | Countries with local SARS transmission | | | | | | Countries with imported SARS cases | | | |
|--|--|------------------------|----------------|----------------|---------|--------|------------------------------------|-----------|----------|-----------|
| | Singapore | Hong Kong (SAR, China) | China | Taiwan (China) | Vietnam | Canada | USA | Thailand | Malaysia | Australia |
| Travel advice at national level | Y | Y | Y | Y | | Y | Y | Y | Y | Y |
| Distribution of SARS information at Airports at arrival / Health Alert Notices | Y | Y | Y | Y | | Y | Y | Y | | Y |
| Distribution of SARS information at Airports in departure area / Health Alert Notices | Y | | | | Y | Y | | | | |
| Fill in Health Declaration Cards/ Survey form on arrival | Y | Y | Y | Y | | Y | N | Y | Y | Y |
| Fill in Health Declaration Cards / Survey form on departure | | Y | | Y | | Y | N | | | |
| Questions on SARS symptoms and contact, on departure at airport / Exit screening of passengers | Y | Y | | Y | Y | Y | N | | | |
| Home quarantine for passengers coming from SARS-affected countries | | | | Y | | | N | voluntary | N | N |
| Temperature screening for incoming passengers | | | | | | | | | | |
| Airport | Y | Y | Y | Y | | Y | N | Y | Y | |
| Seaports | Y | Y | Y | - | | - | N | Y | Y | |
| Land border | Y | Y | Y | - | | - | N | Y | Y | |
| Temperature screening of outgoing passengers | | | | | | | | | | |
| Airport | Y | Y | Y | Y | | Y | N | | | |
| Seaport | Y | Y | Y | - | | - | N | | | |
| Land borders | Y | Y | Y | - | | - | N | | | |
| Presence of medical staff at airports | Y | Y | | Y | Y | Y | Y | Y | Y | Y |
| Presence of isolation areas for passengers | | | | Y | Y | | | | | |
| Information guidelines for Airlines and air crew | Y | Y | | Y | | Y | Y | | Y | Y |
| Information guidelines for ships and crew | Y | | | | | Y | Y | | Y | Y |
| Fill in Traceability cards (Contact information form) by arriving passengers at airport | Y | | | | | Y | | | | |
| SARS information / announcements on flights | | | | | | Y | | Y | Y | Y |
| Date of issuing WHO travel recommendation (18) | | 02.04. | 23.04. Beijing | 08.05. | | 23.04. | NA | NA | NA | NA |
| Date of lifting WHO travel recommendation (18) | | 23.05. | 24.06. Beijing | 17.06. | | 30.04. | NA | NA | NA | NA |

Table 6: Travel related measures (Y=yes, N=no, NA=not applicable)

Guidance and information to the public

The provision of accurate, timely and truthful information and guidance tailored according to the target audience was another essential factor for controlling the SARS epidemic as it led to earlier reporting and isolation of cases. All countries held official press conferences and issued press releases to inform their public and different stakeholders about SARS, the status of the outbreak in the country and other affected countries, about the risk factors and preventive measures and about government actions to counter the epidemic. Some countries did so as soon as information became available while others initially tried to restrict the flow of information to the public.

Various means of communication including electronic media, print media, the internet, telephone hotlines, advertisements, roving exhibitions etc. were used. All countries, in particular the severely affected countries broadcasted special educational programmes on television, Singapore dedicated a TV channel solely for informing about SARS.

The ministries of health of most countries set-up telephone hotlines for public enquiry, Hong Kong for instance during peak times had 84 lines with more than 100 nurses attending the calls. In addition Hong Kong authorities held roving exhibitions at shopping malls, railway stations and health centres, arranged health talks at schools and conducted mass public health education campaigns using posters, pamphlets, exhibition boards etc. to inform the public. (9)

After mid April, once China officially declared a “People’s War” against SARS, a huge propaganda machinery was activated to inform the public. From 21st April daily press conferences were held, SARS educational programmes were broadcast on TV, seminars were organized and educational materials distributed. Folk songs, huge wall murals, banners, billboards, advertisements on buses etc. were some of the different means used to inform and motivate the people to protect themselves and fight against SARS. (1)

It was the first time that during an outbreak the internet was so widely available. It enabled a much faster distribution of updated information to a much larger public than would have been achieved with print media and fax services. (19) Apart from the WHO and CDC SARS websites,

most countries had specific SARS websites with facts sheets, guidelines, information for travellers, telephone hotline numbers etc.

| Guidance and information to the public | Countries with local SARS transmission | | | | | | Countries with imported SARS cases | | | |
|--|--|------------------------|-------|----------------|---------|--------|------------------------------------|----------|----------|-----------|
| | Singapore | Hong Kong (SAR, China) | China | Taiwan (China) | Vietnam | Canada | USA | Thailand | Malaysia | Australia |
| Official information on SARS | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Information on SARS prevention measures and how to react if SARS like symptoms appear | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Distribution of information by Television (press conferences, educational programs etc.) | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Information disseminated by designated websites | Y | Y | | Y | | Y | Y | Y | Y | Y |
| Information disseminated by Telephone hotline | Y | Y | Y | Y | | Y | Y | Y | Y | Y |
| Information disseminated by pamphlets, posters, leaflets, fact sheets etc. | Y | Y | Y | Y | | Y | | | Y | |
| Public Information campaigns /exhibitions | Y | Y | Y | | | | | | | |

Table 7: Guidance and information to the public (Y=yes, N=no, NA=not applicable)

Discussion

The worldwide transmission of SARS was successfully contained within less than 4 months of its spread outside China, on 5th July 2003. 21st century science and communication systems helped in rapidly identifying the virus and providing continuously updated information yet it was the 19th century classical public health tools of case detection, contact tracing, quarantine and isolation and infection control which besieged the virus.

The control measures implemented by the countries closely resembled each other and were generally in line with the WHO recommendations. Differences among the countries were seen in the timeliness of implementation of control measures and in the mode and extent to which individual countries went to apply or enforce measures like quarantine. Many countries used national cases definitions to identify suspect and probable cases, which differed from the WHO case definition making comparability between countries difficult.

Coordinating role of the WHO

Apart from issuing global alerts, travel advisories and giving guidance on SARS control and taking an unprecedented bold step to issue travel recommendations, WHO had a major role in coordinating the global response to SARS.

WHO's Global Outbreak Alert and Response Network (GOARN) established in 2000, is an electronically interconnected network of more than 120 institutions and experts worldwide, consisting of specialized staff and technical resources. It acted as an international "strike force" and was mobilized rapidly to provide assistance. Teams were sent to various affected countries.

(1)

Under GOARN a collaborative network of 11 research laboratories was set-up, who regularly exchanged information via secure web sites and telephone conferences. They were able to identify a new corona virus as the causative agent for SARS by the end of March and developed early diagnostic tests. (20)(1)

The Canadian Global Public Health Intelligence Network (GPHIN), used by the WHO since 1997, is an epidemic intelligence tool, which continuously scans the world-internet for keywords to identify reports on infectious disease outbreaks. It picked up information on a "flu outbreak" in Guangdong-China as early as late November 2002 (21), but the international community first

became aware of an outbreak in Feb. 2003. GPHIN provided intelligence information throughout the outbreak, which helped the WHO to provide updated and reliable information.

More than 95% of SARS cases occurred in the western pacific region. The WHO regional office immediately set up a SARS team aiming to assist affected countries by supporting their health care infrastructure, providing guidelines on enhanced surveillance, hospital and community infection control, training HCWs, guidance for screening of travellers and establishing national and regional reference laboratory networks and arranging shipment of specimens. Logistic support and supplies like masks etc. were also sent to affected and at risk countries. WHO provided up to date information to health officials, improved public awareness and informed travellers through daily updates of the outbreak on the WHO website and by establishing contact with the national media. (20)

The good co-operation among the Ministry of Health in Singapore, the WHO and the German authorities led to the interception and isolation of a Singaporean physician suffering from SARS, at the Frankfurt airport on 15th March. The passengers and crew of that plane were monitored, 2 family members and 1 crewmember who developed SARS were isolated and recovered. (1)

Early case reporting at national and international level

WHO member states have the obligation under the legal framework of the international health regulations to report outbreaks of epidemic prone infectious disease like cholera, plague and yellow fever, SARS was not one of them. On 15th March, WHO issued reporting requirements, and began reporting case numbers on its website as they evolved. (1) During the SARS outbreak all countries included in this report regularly updated the WHO on the SARS situation and number of cases, with the exception of China, which started regular case reporting in late April. (1)

The initial silence and secretive policy adopted by China, in an attempt to maintain economic and social stability actually had a high price. It led to nations being unprepared, resulting in a delayed response of control measures thereby facilitating the rapid transmission of SARS. Researchers at the military academy of medicine in China had already isolated the Coronavirus in late Feb. but did not make their findings public. (22) In mid April once China changed its SARS control policy they set up a highly effective monitoring and reporting system within a short time. (1)

Timely information followed by immediate institution of control measures has been vital in containing the SARS outbreak, calculations reveal that delaying the application of control

measures by 1 week could result in an almost three fold increase in epidemic size and a 4 week longer duration. (23)

Different national case definitions

On 15th March WHO issued a case definition for suspect SARS cases, which included presence of fever above 38°C and respiratory symptoms along with a history of close contact to a diagnosed SARS case and/or recent travel to an area reporting SARS cases. If a suspect case also had x-ray findings of pneumonia they were classified as probable cases. The case definition was revised to include contact to suspect cases as well and on 1st May a positive test for SARS Corona-virus was added as an additional criteria. Cases for whom an alternative diagnosis could be fully explained were excluded. (1)

The case definition was criticised for not being sensitive enough, for e.g. a study evaluating the clinical presentations of SARS patients in Hong Kong found that the WHO criteria would miss nearly 75% of cases when applied to people presenting early in their course of illness. (15) An Australian study criticised the case definition for being too unspecific to be applied in countries which only had few sporadic cases, and hence Australia applied additional exclusion criteria. (24) Singapore established a “wide-net” surveillance system to also detect cases with atypical presentations as early as possible. They expanded the WHO surveillance case definition to additionally include contact to any health care setting, HCWs with fever and/or respiratory symptoms, febrile clusters in health care settings and patients with unexplained atypical pneumonia even in the absence of contact history. (13) This resulted in a large number of suspicious cases and contacts being traced, which had to be managed.

The Canadian SARS case definition did not include Toronto-Canada in the list of affected areas but in the end of March Canadian authorities included contact to a setting associated with SARS clusters (e.g. certain hospitals in Toronto) to the case definition. (15) China did not include laboratory testing for SARS Corona-virus to the case definition. (25)

Criteria for case definitions of new diseases evolve as information accumulates. In June 2003 at the WHO Global Meeting on SARS in Malaysia it became clear that many countries had adopted their own case definitions. (15) Discrepancies between the WHO definition and those used by individual countries were a source of confusion and made comparison difficult. Patients considered as a SARS case in one country were not classified so in another.

Isolation of cases

Early case detection followed by rapid and effective isolation was the key measure to control SARS spread. (1)(7). The incubation period of SARS ranges from 2- 10 days with a median of 5 days. The infectious period for SARS during which the virus can be transmitted starts after the onset of symptoms. Usually infected individuals do not transmit the infection until several days after symptom onset with highest transmission rates during the second week of illness around day 10 where virus excretion is highest. (4) Data from Singapore shows that few secondary cases occur if infected individuals are isolated within 3 – 4 days of symptom onset i.e. detection and isolation of cases after more than 8 days was associated with a markedly increased risk of secondary transmission. (26) Modelling data from Hong Kong supported this finding. (1) These characteristics of the SARS Corona-virus made early detection and isolation an effective measure to control spread, it would have been much more difficult if asymptomatic individuals would also have transmitted the virus. (1)

Contact Tracing

SARS was mostly being transmitted to close contacts defined as people who lived with or cared for the SARS patient or had contact with their respiratory secretions or body fluids. Thus contact tracing was one of the measures applied by all countries experiencing local transmission in their effort to control spread. Apart from Singapore's intensive efforts to locate contacts within 24 hrs. of case notification (13), Hong Kong had initiated contact tracing activities in late February for cases of atypical pneumonia.(9). Taiwan, Vietnam and Canada also started contact tracing activities in March as cases appeared, China followed later. While Singapore identified 58 (25%) SARS cases by surveillance prior to their developing symptoms (13), Hong Kong identified 240 (14%) SARS cases (12), yet the percentage of contacts traced in most of the severely affected countries was generally very limited. (4)

Apart from quarantine of contacts, the contact tracing data helped to estimate transmission and distribution patterns in addition to the incubation period and basic reproductive number (R_0) of the infectious agent. (4)

Quarantine

Quarantine refers to the restriction of movement or separation of asymptomatic individuals who have been exposed to a contagious disease. Although being a highly effective tool for preventing disease spread, it definitely impinges on personal rights and freedom. (7)(27)

Most of the severely affected countries made legislative amendments to legalise quarantine enforcement yet in some areas like China and Taiwan the fact that whole institutions like hospitals or universities were placed under quarantine is controversial. In countries affected by imported SARS cases, quarantine was generally voluntary.

Retrospectively the effectiveness of quarantine in containing SARS spread considering that only a very small percentage of quarantined individuals developed SARS and that it is not transmitted by asymptomatic individuals is questionable.

Singapore placed nearly 8000 contacts under home quarantine, while 4300 contacts were followed up through daily telephone surveillance. A total of 58 SARS cases were identified by surveillance prior to their developing symptoms. (13) In Hong Kong about 23,000 contacts were traced and 1262 were quarantined of which 34 (2.7%) developed SARS. (4)

While Singapore placed contacts of SARS cases under home quarantine from the beginning Hong Kong initially put contacts under medical surveillance asking them to visit a designated medical centre for 10 days, before starting with home quarantine on 10th April. (16)(12) The basic reproductive number (R_0) i.e. the number of secondary cases per infected person (2 – 4 in case of SARS) in Hong Kong had started to decline from initially 2.7 to 0.9 and then 0.14 even before home quarantine was introduced. (4)

Taiwan instituted a more strict “Level A” quarantine for close contacts of SARS cases and a less restricted “Level B” quarantine where people could leave the quarantine site, mostly for travellers coming from SARS affected areas. (28) More than 130,000 persons were quarantined in Taiwan and SARS was diagnosed in only 0.22% of cases. (7) In Toronto-Canada more than 23,000 contacts were traced and more than 13,000 placed under quarantine. (17) In Beijing-China more than 30,000 contacts had been quarantined. (1)

Quarantine is generally considered to be effective for contagious diseases having a high reproductive number (R_0), transmitted by asymptomatic individuals and where contact tracing of asymptomatic individuals is efficient. (29)

As quarantined persons are under observation, it enhances the speed of isolation when the individuals become symptomatic yet this can also be achieved by informing and asking them to

monitor their status and report to a hospital as soon as symptoms develop. This could greatly reduce the extensive financial and human resources needed for quarantine and is less impinging on individual rights and freedom. (29)

SARS could be effectively controlled in the absence of quarantine only if the isolation measures in place are very effective and strict (29) which actually might be difficult. Hence all countries relied on a combination of isolation of cases and various forms of quarantine for contacts, as a major instrument to prevent further spread only the degree of implementation differed.

Hospital transmission and containment measures

Hospitals acted as major sites for transmission and multiplication of SARS cases. (1) This is reinforced by the fact that transmission rates were highest from the severely ill patients, who were generally hospitalised. A large number of HCWs were infected due to unprotected exposure to the first cases of atypical pneumonia in the hospital setting. Procedures like intubation, nebulization or suction resulted in aerosolization of infectious respiratory droplets and transmission to health care workers despite use of protective equipment. (1) In Singapore 41%, in Canada 43% and in Vietnam 57% of SARS cases were HCWs. (2)

Transfer of unrecognised SARS cases with atypical presentations to other hospitals and HCWs working in multiple institutions led to further transmission and new clusters. In Singapore and Canada more than 75% cases were hospital acquired, while in Hong Kong only 48% cases were infected in hospitals owing to the large outbreak in Amoy Gardens apartment. (4) ‘Superspreaders’ defined as cases who transmit the infection to 10 or more individuals markedly worsened the situation. They accounted for 71% of cases in Hong Kong and 75% of cases in Singapore. (1)

Modelling studies from Singapore and Hong Kong have shown that early isolation of cases within 4 days of symptom onset under proper infection control had the greatest impact on reducing R_0 and was hence the best way to contain SARS spread. (1) SARS cases were isolated in negative pressure isolation rooms if available, as for e.g. in Taiwan and Canada. In China cases were isolated in well ventilated rooms with exhaust fans maintaining an air flow direction to the outside.

WHO in its first global alert on 12th March recommended isolation and barrier nursing of cases as was already being applied in Hong Kong and Vietnam. All countries developed detailed infection control guidelines for this purpose, yet this was not sufficient without adequate supplies of

personal protective equipment (PPE) like masks, gowns, gloves etc. and knowledge on proper application of PPE and infection control practice. Shortage of PPE supplies and inadequate use of PPE was a problem faced by many of the severely affected countries. All countries trained involved HCWs in infection control practice and SARS case management by conducting courses and using written materials, videos, CDs etc. The WHO with the help of its GOARN partners and various NGO's assisted national health care institutions in training and provision of PPE supplies. Proper infection control practice eventually stopped nosocomial transmission as was seen in Tan Tock Seng hospital in Singapore, while relaxing infection control led to the second outbreak in Toronto-Canada. Non-clinical staff in hospitals had the highest attack rate among hospital workers in Hong Kong and Vietnam. (1)

As there was a high risk of HCWs transmitting the infection to other patients and hospital staff, active surveillance including regular temperature checks often twice to thrice daily was undertaken. In addition hospitals maintained contact registers with personal details of HCWs and dates of contact to SARS patients and also monitored HCWs on sick leave.

Surge capacity was another problem as a large number of additional HCWs had to be recruited within a short time to work risking their own health. In many countries HCWs worked voluntarily but in some countries like Taiwan or China those who refused were punished or threatened with the withdrawal of practicing license. (30)

Community containment strategies

Households with SARS cases were the second most important transmission setting after hospitals. (1) Community transmission was rare, one large incident in which 329 residents of an apartment complex "Amoy Gardens" were infected occurred in Hong Kong. A defective drainage system with dried up 'U' water traps was considered to be the cause. (31)

Countries affected by local SARS transmission instituted various community containment strategies which affected daily public life immensely, causing a standstill in many of the highly affected areas. These containment strategies included screening people for temperature before they entered hospitals, public places, schools etc. closing schools, postponing business meetings and conferences etc. In Taiwan for e.g. people were asked to wear masks in closed public places, like public transport, or before entering a hospital or while working in restaurants etc. The temperature screening carried out at schools, offices and other institutions in Singapore were not

helpful in detecting any additional cases yet they probably reassured the parents and the public that schools and community were safe. (13)

During the epidemic in Hong Kong more than 90% of people wore face masks in public places and more than 85% avoided visiting public areas. In addition frequent hand washing and disinfecting the household greatly increased. In general visiting public places was not associated with a higher risk of acquiring infection but these measures might have been beneficial in limiting community spread in Hong Kong to some extent. (32)

China's community containment efforts, which materialized in a short time, were impressive, as a Finnish journalist said "Once there was nothing on SARS. Now, there is nothing but SARS." (1) The setting up of a peoples surveillance system in which neighbourhood committees and villagers checked on one another, villagers set-up roadblocks at entrances, setting up of numerous stop-spray-screen stations for vehicles etc. helped in early detection and containment within 2 months of the initiation of these activities. (1)

Travel related measures

Historically diseases travelled along sea routes taking 6 – 8 months to spread globally, but in today's interconnected world SARS could spread within days along the route of international air travel. From 16th March WHO maintained a list of "affected areas" from where local transmission was reported and later also classified them into low, medium and high transmission areas. (1) Following this, countries became more vigilant about suspected SARS cases in incoming passengers from affected areas and also issued travel advisories and alerts at national level.

On 27th March WHO recommended countries experiencing local SARS transmission to screen departing airline passengers for SARS symptoms. This included asking them 3 questions, whether they had fever, respiratory signs and symptoms or contact with a possible SARS case and checking their temperature, the method of implementation was chosen individually by each country. (1)(4) In addition airlines were advised on measures to be taken if a suspect case is on board. (21)

Initially WHO did not advise any restriction on travel or trade but from 2nd April WHO issued travel recommendations for some areas advising postponing all but essential travel to these areas, which led to some controversies. (1) This had considerable impact on the travel volume, which during the peak months reduced by 50-70% among international travellers. Yet it also served as

benchmark for safety of travel and motivated countries to collaborate and undertake all measures to be removed from the list as soon as possible. (4)

No SARS cases were detected by thermal scanning among the millions of international travellers undergoing entry and exit scanning at airports and border crossings in Canada, Hong Kong, Taiwan and Singapore. Of the 14 million travellers checked for temperature while entering or leaving China-Beijing only 12 cases were detected among domestic travellers. (7)

In Taiwan more than 80,000 travellers coming from SARS affected areas were quarantined, out of which 21 probable and suspect cases were diagnosed. (7)(1)(28) It was difficult to monitor adherence to quarantine, hence many skipped.

Despite intensive border screening activities in Canada, no SARS cases were detected and it cost Canada around Can\$ 7.5 mill. Canada had a total of 5 imported cases none of whom had symptoms during travel. (33) Similarly Singapore's stringent border control measures did not help to detect any of their 8 imported cases. (16) Detecting a rare disease with non-specific tools like health alert notices, health declaration cards or thermal scanners is very unlikely and hence of limited value. (33)

The overall travel screening results obtained from different countries that applied border screening for SARS raise questions about the effectiveness considering the very low detection rate and the immense resources involved. Yet interventions at the borders reassure citizens and business travellers that measures are being undertaken to prevent the disease from entering the country and spreading and it might deter sick passengers from travelling. (33) Maintaining passenger contact information and preventing ill passengers from air travel are effective preventive measures and exit screening may be more helpful in preventing SARS spread than entry screening. (7) Health care facilities are the actual points of entry of SARS into a country as was seen in most of the countries which experienced local transmission. (33)

Role of the media

The media played an essential role in the wide dissemination of the global alerts thereby increasing the awareness and vigilance of health care providers resulting in early isolation of cases and case reporting both at national and international level. In addition most countries also used various means of communication to ensure that knowledge about prevention measures reached the public and other stakeholders but the timeliness varied. During peak times daily more than 4000 articles were published in English alone. (1)

WHO press officers and media experts assisted many of the affected countries to deal with the local and international media in a coordinated manner and provide regular information. (1) Informing the public in an open, consistent and understandable manner is necessary for the successful and effective implementation of programmes to limit spread of disease, gaining public trust, alleviating fear and counter acting rumours, like for instance the perception in China that the fumes of boiling vinegar are preventive. (1)

Once the public became aware of the signs and symptoms of SARS, they were able to act taking appropriate preventive measures as recommended. In Singapore the interval between onset of symptoms to isolation of cases decreased from 6.8 days in the 2nd week to 1.3 days in the last week. (13) Similar effects were seen in China where the time between symptom onset and hospitalisation significantly reduced from initially 5-6 days before the outbreak was made public, to 2 days after widespread information became available. (14)

In Canada the uncoordinated interaction with the media and lack of a coherent communication strategy with too many “talking heads” with sometimes divergent opinions was felt to cause confusion. In Singapore a single spokesperson in a daily evening press conference informed about the situation. The need of having one chief spokesperson and communicating messages in a clear and consistent language was felt, in order to create public confidence and lend credibility to the messages. (15)

Publicising the cumulative SARS figures rather than the daily incidence rate presented a graver picture of the epidemic and was not helpful in alleviating public fear. (15) Media exaggeration can create unnecessary panic, and have enormous economic consequences. Yet overall the media acted in a responsible manner and were indispensable for spreading invaluable and updated information rapidly. (1)

Limitations

This report is based on a comprehensive literature review and much of the information was drawn from official government sites, hence the information published might be selective not focusing on certain negative aspects, mistakes or failures, in addition to delayed or improper implementation of control measures.

Difficulty in obtaining comprehensive data for some countries like Vietnam and China was also encountered. Published reports and articles on the control measures implemented often describe the ideal situation and guidelines but there might be a significant gap between the ideal situation

and reality. This is specially true for the condition in some of the far flung rural areas of the affected countries. For the countries affected by imported cases only, the control measures are recommendations and guidelines but to which extent they could have been implemented in an emergency situation is not known.

Conclusion

The containment of the SARS epidemic was not a natural phenomenon, occurring due to decrease in virulence or burn out of the disease. The SARS epidemic in 2003 was halted by the aggressive use of public health intervention measures which mainly included case detection, isolation, contact tracing and quarantine and stringent infection control measures applied in hospital settings. (7) This was only possible due to the co-ordinated efforts of governments, international organizations, health care institutions and many dedicated people.

A clearly reasoned, well planned, effectively managed and adequately publicised response is essential for public acceptance, minimizing economic losses, gaining public confidence and most importantly for a successful containment of an outbreak.

References

1. SARS: How a global epidemic was stopped. Published in 2006 by the “World Health Organization, Western Pacific Region”
2. World Health Organization. Summary of probable SARS cases with onset of illness from 1 November 2002 to 31 July 2003. (Based on data as of the 31 December 2003). Available at: www.who.int/csr/sars/country/table2004_04_21/en/print.html
3. Consensus document on the epidemiology of severe acute respiratory syndrome (SARS). May 2003. World Health Organization. Department of Communicable Disease Surveillance and Response.
4. Peiris M, Anderson LJ, Osterhaus A, et al. Severe Acute Respiratory Syndrome. Blackwell Publishing.
5. SARS: experience at Prince of Wales Hospital, Hong Kong. *The Lancet* 2003;361:1486-87
6. World Health Organization issues emergency travel advisory, 15 March 2003. Available at: www.who.int/csr/sars/archive/2003_03_15/en/index.html
7. Bell DM. World Health Organization Working Group on Prevention of International and Community Transmission of SARS. Public health interventions and SARS spread, 2003. *Emerg Infect Dis.* 2004 Nov.
8. Measures undertaken by member states and accession countries to control the outbreak of SARS. 05.06.2003. Report by the European Commission. SANCO Public Health Directorate.
9. Chronology of the SARS Epidemic in Hong Kong. Appendix III. Available at: www.sars-expertcom.gov.hk/english/reports/reports/reports_fullrpt.html
10. Severe Acute Respiratory Syndrome: Response from Hong Kong. Presentation by Dr. Yeoh EK, Secretary of Health, Welfare and Food, at the WHO global conference on SARS Kuala Lumpur 17-18 June 2003. Available at: http://www.who.int/csr/sars/conference/june_2003/materials/presentations/en/sarshksar170603.pdf
11. James L, Shindo N, Cutter J, et al. Public health measures implemented during the SARS outbreak in Singapore, 2003. *Public Health* 2006;120:20-26
12. Tsang T, Lam TH. SARS: public health measures in Hong Kong. *Respirology* 2003;8:S46-S48.
13. Tan Chorh Chuan. SARS in Singapore – Key lessons from an epidemic. *Ann Acad Med Singapore* 2006;35:345-9.
14. Pang X, Zhu Z, Xu F, et al. Evaluation of control measures implemented in the severe acute respiratory syndrome outbreak in Beijing, 2003. *JAMA.* 2003;290:3215-21.
15. Learning from SARS. Renewal of Public Health in Canada. HealthCanada. A report of the National Advisory Committee on SARS and Public Health, October 2003.
16. Goh KT, Cutter J, Heng BH, et al. Epidemiology and control of SARS in Singapore. *Ann Acad Med Singapore* 2006;35:301-16.
17. Svoboda T, Henry B, Schulman L, et al. Public health measures to control the spread of the severe acute respiratory syndrome during the outbreak in Toronto. *N Engl J Med* 2004;350:2352-61
18. WHO - Update 92 - Chronology of travel recommendations, areas with local transmission. Available at: www.who.int/csr/don/2003_07_01/en/index.html

19. Arguin PM, Navin AW, Steele SF, et al. Health Communication during SARS. *Emerg Infect Dis.* Feb. 2004;10:377-380.
20. The World Health Report 2003. Chapter 5: SARS: Lessons from a new disease
21. Severe acute respiratory syndrome (SARS): Status of the outbreak and lessons for the immediate future. Geneva, 20 May 2003. WHO, Communicable disease surveillance and response
22. Zhong N, Zeng G. What we have learnt from SARS epidemics in China. *BMJ* 2006;333:389-91
23. Wallinga J, Teunis P. Different epidemic curves for severe acute respiratory syndrome reveal similar impacts of control measures. *Am J Epidemiol* 2004;160:509-516
24. Fielding JE, Yohannes K, Vally H, Spencer JD. Severe acute respiratory syndrome surveillance in Australia. *Commun Dis Intell* 2004;28:181-186.
25. Pang X, Zhu Z, Xu F, et al. Evaluation of control measures implemented in the severe acute respiratory syndrome outbreak in Beijing, 2003. *JAMA.* 2003;290:3215-21.
26. Lipsitch M, Cohen T, Cooper B, Robins JM, Ma S, James L, et al. Transmission dynamics and control of severe acute respiratory syndrome. *Science* 2003;300:1966-70.
27. Knobler S, Mahmoud M, Lemon S, et al. Learning from SARS: preparing for the next disease outbreak. Forum on microbial threats, board of health. Institute of Medicine of the National Academies. Washington: National Academics Press;2004.
28. CDC. Use of quarantine to prevent transmission of severe acute respiratory syndrome – Taiwan, 2003. *MMWR* 2003 July;52, No. 29
29. Day T, Park A, Madras N, et al. When is quarantine a useful strategy for emerging infectious diseases? *Am J Epidemiol* 2006;163:479-485.
30. Hsin DH, Macer DR. Heroes of SARS: Professional roles and ethics of health care workers. *The Journal of Infection* 2004;49(3):210-5
31. S.H.Lee. The SARS epidemic in Hong Kong – A human calamity in the 21st century. *Methods Inf Med* 2005;44:293-8.
32. Lau JTF, Tsui H, Lau M, Yang X. SARS transmission, risk factors, and prevention in Hong Kong. *Emerg Inf Dis.* April 2004;10(4):587-592
33. St. John RK, King A, de Jong D, et al. Border screening for SARS. *Emerg Infect Dis.* 2005 Jan. Available from <http://www.cdc.gov/ncidod/EID/vol11no01/04-0835.htm>

Country Reports

Inventory of SARS control measures implemented in countries affected by local SARS transmission

Singapore

Facts and Figures

Date of SARS onset: 25th Feb. 2003 (9)

Date of onset of last SARS case: 5th May 2003 (9)

Declared free of local SARS transmission by WHO: 31st May 2003 (14)

Cumulative number of cases: 238 cases (9)

Number of deaths attributable to SARS: 33 cases (including 5 HCWs) (9)

Population of Singapore: 4.3 million

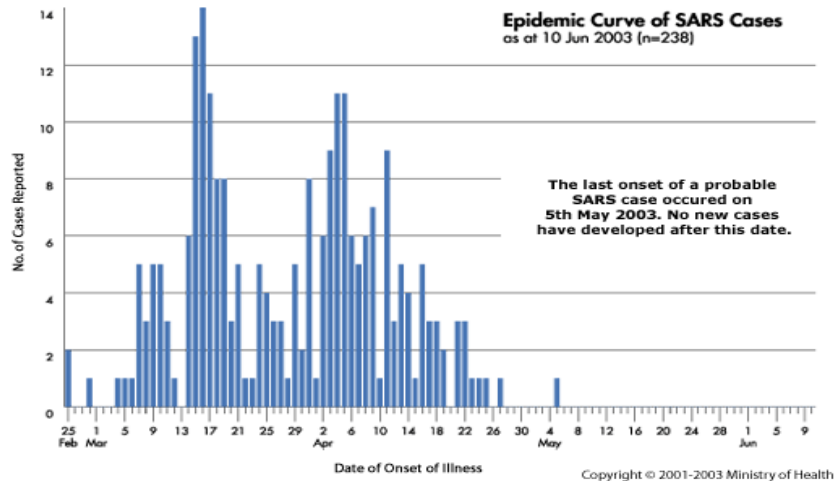
Introduction

The SARS virus was introduced into Singapore, by 3 people who had been guests at the Hotel Metropole in Hong Kong. 2 cases were admitted to the Singapore General Hospital (SGH), with symptoms of atypical pneumonia on 3rd March but they did not pass on the virus. One guest a 22 year old woman who had been symptomatic since her return to Singapore on 25th Feb., was hospitalised at the Tan Tock Seng Hospital (TTSH) on 1st March. She was isolated on 6th March and first recognized as a SARS case on 15th March. (7) She transmitted the virus to 21 close contacts (9 HCWs & 12 family members) and became the first super spreader in Singapore. (8)(3)(6) One of the HCWs who contracted the virus while caring for her became the 2nd super spreader infecting 23 contacts including one 53 year old diabetic patient with diarrhoea who in turn was linked to 23 more cases. After these 3 waves of spread and a cluster of 109 SARS cases TTSH was able to interrupt the transmission to contacts within the hospital. (3) (7)

One 60 year old case who had been discharged from TTSH on 20th March was admitted in Singapore General Hospital (SGH) on 24th March, with GI bleeding and low fever (atypical symptoms). He is linked to 62 probable and suspect SARS cases including 37 HCWs. One visitor (the brother, a vegetable hawker) of this patient was the source of the wholesale market cluster and spread the infection to at least 12 people including contacts at the National university hospital (NUH), 2 taxi drivers, 2 hawkers etc., which led to closure of the market for 15 days and quarantine for many. (3) Other smaller clusters including one of 7 cases occurred in a senior citizens nursing home. (3)

In Singapore 5 super spreading events directly accounted for 121 cases being infected. In addition some atypical case presentation (e.g. diarrhoea or a case with bacteremia) made an early detection very difficult leading to further spread of the epidemic. (2)

From 1st March to 11th May a total of 238 probable cases of SARS were reported, 206 were diagnosed on the basis of the case definition while 32 patients were identified later on the basis of positive SARS serology or culture. (1)(2)

SARS epidemic curve, Singapore (25th February'03 – 5th May'03)

Source: SARS, Ministry of Health, Singapore. (<http://www.moh.gov.sg/corp/sars/index.html>)

SARS Containment Strategies

Singapore adopted the strategy “prevent – detect – isolate and contain”. The following list briefly explains the control measures adopted by Singapore that eventually led to the containment of SARS after 11 weeks.

Organizational and Administrative Measures

- On **6th March** the Ministry of Health (MOH) was informed by the WHO of an outbreak among HCWs in Hanoi. The MOH, subsequently advised the hospitals to **isolate** the 3 patients from Hong Kong with atypical pneumonia symptoms **and implement strict infection control measures** for all new cases with similar symptoms. (8)(1)(4) At that time bird flu was considered a likely diagnosis on account of the Hong Kong cases. (7)
- On **15th March** the MOH **established a SARS task force** comprising of hospital CEOs, members from different ministries, chairmen of medical boards, infectious disease physicians, epidemiologists and experts focusing on the containment and prevention of SARS in the health care sector. Later WHO and Global Outbreak and Alert Response Network (GOARN) experts also joined in. Strategies to contain the nosocomial transmission were discussed, formulated and implemented and information disseminated. (8)(7)(1)(6)
- From **15th March** the **WHO case definition was provided to physicians** and all suspected cases were screened at the centre for disease control and reported to the MOH. (1)
- The **MOH held daily epidemiological meetings** where decisions on public health responses and implementation of measures were taken and the **clinical data in the database** reviewed. (7)
- On **17th March** **SARS was made a notifiable disease** and all suspect and probable cases had to be **reported to the MOH within 24 hrs**. Amendments made in the infectious

- disease act on 24th March, provided the **legal basis to quarantine** all close contacts of SARS cases and fine those who violate orders or require them to wear an electronic wrist tag. (8)(6)(11)
- Several **ASEAN + 3 meetings were held** to enhance co-operation and information exchange and develop joint action plans and resolutions for SARS prevention and control.(1) **Bi-lateral agreements between Singapore and Malaysia and Singapore and Indonesia on cooperation** to conduct contact tracing, pre-departure checks and exchange of medical information on SARS between the health ministries were made. (10)(6)
 - On 7th April a **Ministerial Committee** was established to supervise the **implementation of different operational response plans**, to resolve cross ministry policy issues and to give political guidance on how best to manage the impact of SARS both on the economy and society. (1)(6)
 - On 17th April a \$230 million SARS Relief Package was made available to provide assistance. (13)
 - A ministerial **SARS combat team formed** on 19th April was given the responsibility of containing existing SARS outbreaks and **prevent new clusters in public and private hospitals.**(7)
 - In June a framework of measures to be adopted by health care facilities during different SARS alert levels was developed. (1)

Case Detection, Contact Tracing

- Contact tracing was undertaken within 24 hrs. of case notification followed by quarantine within 48 hrs. (1)(6)
- Following the WHO global alert on 12th March, the MOH issued a press release and alerted all hospitals and doctors of 3 cases in Singapore and to be aware of the presence of an atypical pneumonia in Hong Kong, Hanoi and Guangdong and required all cases of atypical pneumonia to be isolated. (2)(1)(11)
- The MOH on 22nd March set-up a **hotline** for hospitals to get **information on SARS contacts.** (1) From 19th April a **secure web based system, “SARS Web” provided information** on suspect and probable cases and the **contact/quarantine/hospital discharge status of a patient.** It was accessible to all hospitals. (1)(6)
- Singapore established a **“wide-net surveillance”** system to detect suspicious cases as early as possible. A very broad case definition was used in Singapore, which expanded the WHO case definition to additionally include contact to any health care setting. (3) Surveillance criteria for suspect cases included any HCWs with fever and/or respiratory symptoms and patients with atypical pneumonia of unknown cause or patients clinically suspicious of SARS even in the absence of contact history. (2)(3)
- Case finding was intensified in May by **active surveillance of, febrile clusters in nursing homes and hospitals** specially among immunocompromised patients and clusters of 3 or more HCWs with fever >38°C within 48 hrs. (2)(3)
- From 22nd March HCWs had to monitor their temperature twice – thrice daily and **HCWs on sick leave were centrally monitored** (1)
- The MOH posted **8 nurses and a public health physician at TTSH** to interview suspect cases to facilitate **epidemiological investigation and contact tracing** and enter the data into a clinical database. (7)

- The **Singapore armed forces also assisted** the MOH in contact tracing and major quarantine operations in April and May'03. (7)
- The **MOH contact tracing centre** with up to 140 employees was responsible for speedy contact tracing, which by mid April was supported by an IT system. (1) In the initial weeks this was carried out manually leading to a delay in public health response. (2)
- All suspicious cases were reviewed in a daily meeting and decisions on contact tracing and quarantine made. (2)
- From 1st May **criteria for contact tracing and issuance of home quarantine** in line with the revised WHO case definitions were used. (1)
- Intensive case finding was carried out in May and June'03 by reviewing over 10,000 patients who had been at TTSH, SGH or NUH during the active SARS transmission time. (7)

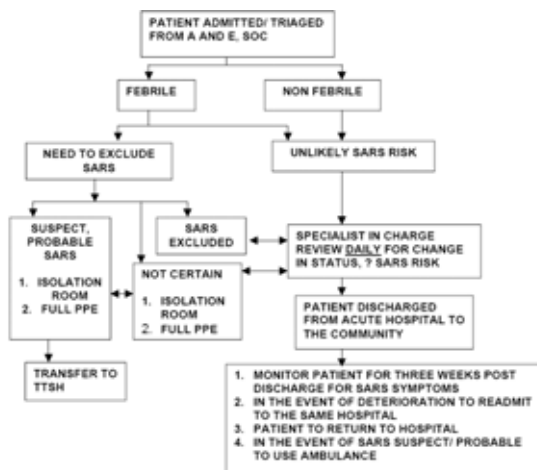
Quarantine

- From 24th March the MOH ordered **home quarantine of all contacts of probable and suspect SARS cases for 10 days**. People under home quarantine were strictly prohibited to leave home. (1)(7)
- From 10th April onward home quarantine notices, were served by a private security firm CISCO hired by the government, which also **installed cameras** at the respective homes to **ensure compliance**. (8)
- People under home quarantine were **called daily at random intervals and visited by nurses** and checked for temp. (1)
- A **home quarantine allowance scheme** gave compensation to self employed persons and companies. (11)
- From 15th April **convalescent SARS patients who were discharged from hospital** were required to observe **home quarantine for 14 days**. (8) (1)(11)
- Non-SARS patients suffering from **chronic conditions** after **discharge from TTSH or SGH** were placed under **10 day home quarantine** from 17th April, while the other recovered patients were on 21-day phone surveillance. (1)(11)
- From 3rd May **the home quarantine orders included all children under 18 years** in the household of the person under quarantine. (1)
- Clear instructions on **home quarantine rules**, where to seek help for problems encountered during quarantine and telephone hotlines were given on the SARS website. (13)
- On 12th May a government-run resort was converted into a SARS quarantine facility for tourists and discharged hospital patients. (8)
- HCWs who had unprotected exposure to a probable SARS case were placed under home quarantine. (6)
- Strict and "**wide-net surveillance**" resulted in nearly 8000 contacts being placed under home quarantine and 4300 contacts being followed up through daily telephone surveillance. (2)

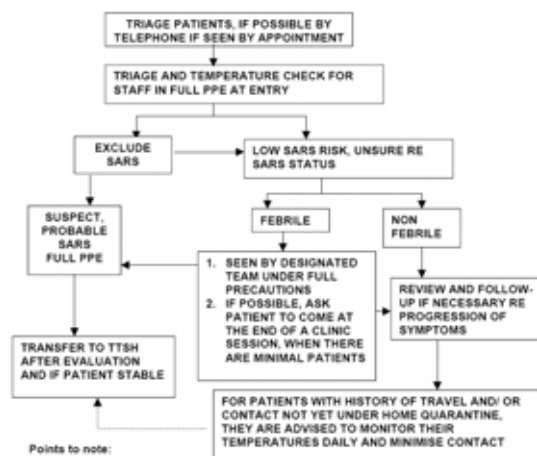
Hospital and Community Containment measures

- From 6th March the MOH, advised the hospitals and A&Es to **isolate patients** and **implement infection control measures**. (8)(1)
- Additional **isolation rooms were created by converting wards in public hospitals** and by setting up a 120 bed container at TTSH hospital. (7)
- Starting from 18th March all hospitals were instructed to **employ triage procedures** at their **A&E departments** in order to separate febrile patients (suspected cases) before they could infect others in the hospital and in public. (1) **Fever centres and adjacent triage areas** in hospitals were set-up for screening. (6) Similarly the outpatient services and GPs also had to follow triage guidelines.

WORKFLOW FOR INPATIENT MANAGEMENT: HOSPITALS



WORKFLOW FOR OUTPATIENT, GP SERVICES



Source: Manual for SARS infection control in hospitals 26.04.03, www.moh.gov.sg/corp/sars

- On 22nd March the MOH **designated** the Tan Tock Seng Hospital (TTSH) as the **hospital for the treatment of all suspected and probable SARS cases**, which were hence forth transferred to this hospital while all non SARS patients went to other hospitals. Added infection control measures were employed for the staff. (1)
- From 24th March the MOH **prohibited visiting SARS patients** in hospital. From 9th April **non – SARS patients were allowed 2 visitors** who had to register contact details.(1) From 29th April until 1st June, all 6 public hospitals strictly **prohibited the entry of visitors**. (8)
- **Powered air purified respirators** were to be used while **performing risky procedures** like intubation. In addition careful disinfection of various equipment like stethoscopes was recommended. (1) (12)
- All HCWs were to employ a **high index of suspicion in patients** with **chronic** medical conditions or **immunocompromised** patients. (13)

- On 22nd March the Ministry of Education **instructed teachers and students** having a history of travel and fever to stay away from school for 10 days and be isolated. (1)
- Educational institutions including **schools and colleges were closed** on Government orders from 27th March for 2 – 3 weeks, to allay public fear. (8)(6)
- **Special ambulance services** were designated for transferring suspected cases to TTSH. (1)(6)
- **SOP** were issued to the acute hospitals on how to deal with and **dispose off bodies** of SARS patients. (1)
- From 8th April **transfer of patients** from TTSH to **nursing homes** was **not allowed** and transfer from other hospitals only if the patient was afebrile for 72 hrs.
- On 11th April a **10 day quarantine** was imposed by the ministry **for all work permit holders** coming back from SARS affected countries. (1)(11)
- All **people entering health care institutions** including both HCWs and other staff had to undergo a compulsory **temperature check** from 12th April before starting to work in the hospital. (1)
- **Transfer of non-SARS patients to other hospitals was not allowed** from 19th April onwards and patients seeking readmission within 21 days were to go back to the same hospital. (1)
- On 20th April **a large fruit and vegetable market was closed** for 15 days and >1000 vendors and visitors were placed under home quarantine for 10 days, as a cluster of SARS cases was discovered. On 28th April many more food markets were closed for thorough cleaning (8)(6)
- Shortage of staff led to **recruitment and redeployment of staff** by the MOH. This included infectious disease physicians, staff for telephone surveillance, contact tracing staff etc. (7)
- From 22nd April **HCWs** were instructed to **work for any one hospital only**. (11)
- From the end of April until 25th July, more than 200,000 primary **school students** were to **monitor their body temperature** twice daily. (1)(2) They were not allowed to attend school if their temperature exceeded 37.5 – 37.8°C (2)
- In the beginning of May tents for fever screening and treatment were set-up outside 3 polyclinics in Singapore. (8)
- **Temperature screening** of people **entering public institutions**, of employees at the workplace, of wet market workers and children at school was carried out. (7)

Infection Control Measures for protection of HCWs

- From 22nd March hospital were to strictly follow the hospital infection control guidelines issued by the WHO and US CDC, specially in high risk areas like A&E and ICU.(1)(2)
- HCWs at TTSH having contact with SARS cases were to monitor their temperature twice daily and seek help at their staff clinic if sick. (1)(2)
- In April a detailed **manual giving guidelines for infection control in hospitals** was formulated and made available to HCWs and on the SARS website. Following careful triage and isolation of suspect and probable cases all contacts were to follow protective guidelines from point of presentation until discharge. (12)
- The **basic recommended protective attire included fit tested N-95 respirators, goggles or face shields, disposable long sleeved gowns and disposable gloves and hand hygiene** (washing or hand rub) before and after contact. Compliance was mandatory since

- 9th April for all HCWs (people coming in contact) caring for probable or suspect cases. (1)(12)
- Every health care organisation needed to have a **designated infection control team for monitoring and guidance. Training** was made mandatory for all staff and HCWs. (12)
- A VCD on SARS prevention measures for HCWs was also made available. (12)
- From 9th April **HCWs** in the inpatient wards of **all hospitals** were required **monitor their temperature thrice daily**. (1)
- From 14th April audits were conducted at different hospitals to monitor that the directives of the MOH and infection control guidelines were being followed (1)
- From 15th April the movement of non-medical staff in clinical areas was restricted. (1)

Travel related measures

- From 14th March the MOH advised its citizens to **avoid travelling to SARS affected areas**. (1)
- From 18th March all **passengers going to or coming from Hong Kong, Guangdong or Hanoi** were given a **travel advisory**. (1)
- On 31st March, initially **visual screening of passengers arriving** from affected areas was carried out by nurses at the Changi Airport. (8)
- Starting 23rd April **thermal imaging scanners** were installed at the Changi **airport** and at two main land entry points bordering Malaysia, where **inbound** and later **outbound** passengers were screened for temperature. (1)(2)
- On 28th April **thermal scanners** were installed at certain **cruise and ferry terminals**. In addition ear thermometers were used. (8) Temperature screening was extended to people coming via land route on different vehicles. (1)
- From 28th March **shipmasters** had to submit a **health declaration** 4 hrs. before arriving at the port.(8)
- From 30th March onwards airlines at the Changi airport were required to **ask all departing passengers 3 questions about SARS symptoms** as well as any history of SARS contact before the flight. (1)
- From 30th March all **air and sea passengers arriving** from SARS affected areas were given **“Health alert notices” describing the symptoms of SARS** and how to get assistance. Travellers identified by the thermal scanners were rechecked, and if unwell sent to TTSH for assessment. (1)
- From 9th April all **incoming passengers** (both from affected and non-affected areas) had to **fill in health declaration cards to facilitate contact tracing** if needed, and those from SARS affected areas were checked for fever. (1)(6)
- On 6th May the US CDC changed the travel advice status of Singapore from travel advisory to travel alert. (1)
- From 7th May visitors coming via land route were also required to fill in the health declaration card. (1)
- From 13th May the Singapore Airline gave out health kits to passengers of SARS affected countries. (11)

Guidance and information to the public on SARS

- The MOH **SARS hotline** provided information to the public.(1)
- In early April a **public education campaigns** were started on how to prevent and reduce SARS transmission. (4)(5)
- **Poster and brochures** informed about the essential facts of SARS and what to do. (7)
- **Press releases, newspapers** and media coverage of the epidemic were used to inform and update the public in a timely and transparent manner. (5)
- On 21st May “ **The SARS Channel**” a TV channel devoted to SARS was started. (6)
- An MOH SARS **website** www.moh.gov.sg/corp/sars was created to inform both the public, as well as health professionals.
- The Singapore Ministry of Health and the Singapore Tourism Board provided information to travellers and tourists on their website. (13)

Discussion

As is evident from the above chronology of control measures, new containment strategies were adopted, or existing ones rapidly modified and adapted according to the changing situation and information as the epidemic progressed. The interval between the onset of symptoms to isolation of the case decreased from 6.8 days in the 2nd week to 1.3 days in the last week. The sensitivity of suspect cases becoming probable cases also steadily increased to more than 80% and during the last 2 weeks 50% -100% of cases had been under observation or quarantine before developing symptoms. (2)

The super spreading events and the atypical case presentations greatly contributed to the spread of the epidemic. SARS being predominantly a nosocomial infection, led to 78% cases being hospital acquired. Hence most of the control measures focused on hospital containment. The measures felt to be most effective were a triage system at the first point of patient contact, strict use of PPE, temperature monitoring of HCWs and exclusively designating a hospital for the treatment of SARS. (2)

The stringent containment measures implemented at the borders to stop imported cases from infecting the population did not help to detect any of the 8 imported cases (1) The temperature screening carried out at schools and other institutions were not helpful in detecting any additional cases yet they probably reassured the parents and the public that schools and community were safe. (2)

The provision of timely and accurate information in a transparent manner on the local SARS situation to the public helped counter misinformation, greatly enhanced public trust, acceptance and compliance and allayed public anxiety. (2)(5)

Strict and “**wide-net surveillance**” resulted in nearly 8000 contacts being placed under home quarantine and 4300 contacts being followed up through daily telephone surveillance. A total of 58 SARS cases were identified by surveillance prior to their developing symptoms. (2)

The enforcement of a multitude of strict SARS control measures led to the epidemic being contained within 2 ½ months yet it caused massive disruption in the normal life, business and social activities. As a consequence of the SARS epidemic the public health systems in Singapore are now better prepared for future infectious disease threats. (2) The WHO praised Singapore’s public health efforts as being a 21st century model of epidemic control. (8)

References

1. Goh KT, Cutter J, Heng BH, et al. Epidemiology and control of SARS in Singapore. *Ann Acad Med Singapore* 2006;35:301-16.
2. Tan Chorh Chuan. SARS in Singapore – Key lessons from an epidemic. *Ann Acad Med Singapore* 2006;35:345-9.
3. CDC. Severe Acute Respiratory Syndrome --- Singapore, 2003. *MMWR* 2003;52(18):405-11
4. Severe acute respiratory syndrome – Singapore, 2003. *Weekly Epidemiological Record*, 2003;78:157-162
5. Deurenberg-Y M, Foo L, Low YY, et al. The Singaporean response to the SARS outbreak: knowledge sufficiency versus public trust. *Health Promot Int.* 2005;20(4):320-6.
6. James L, Shindo N, Cutter J, et al. Public health measures implemented during the SARS outbreak in Singapore, 2003. *Public Health* 2006;120:20-26
7. Peiris M, Anderson LJ, Osterhaus A, et al. *Severe Acute Respiratory Syndrome*. Blackwell Publishing.
8. SARS: How a global epidemic was stopped. Published in 2006 by the “World Health Organization, Western Pacific Region”
9. Summary of probable SARS cases with onset of illness from 1 November 2002 to 31 July 2003. (Based on data as of 31 December 2003) Available at: www.who.int/csr/sars/country/table2004_04_21/en
10. United Nations Economic and Social Council. Health and development: Selected issues: SARS: Lessons for Public Health. E/ESCAP/CESI/6. 22 July 2003
11. Ministry of Health, Singapore. SARS Website: Chronology of SARS events in Singapore. Available at: <http://www.moh.gov.sg/corp/sars/news/chronology.html>
12. Ministry of Health, Singapore. Manual for SARS infection control in hospitals 26.04.03. Available at: www.moh.gov.sg/corp/sars/information/healthcare.html
13. Ministry of Health, Singapore. SARS Website: <http://www.moh.gov.sg/corp/sars/index.html>
14. WHO - Update 92 - Chronology of travel recommendations, areas with local transmission. Available at: www.who.int/csr/don/2003_07_01/en/index.html

Hong Kong (special administrative region) China

Facts and Figures

Date of SARS onset: 15th Feb. 2003 (1)

Date of onset of last SARS case: 31st May 2003 (1)

Declared free of local SARS transmission by WHO: 23rd June 2003 (15)

Cumulative number of cases: 1755 cases (386 HCWs) (1)

Number of deaths attributable to SARS: 299 cases (1)

Population of Hong Kong: 6.9 million

Introduction

The SARS epidemic in Hong Kong (HK) can be traced back to the 21st Feb.'03 when a 64 year old physician from Guangdong province, China visited Hong Kong. He stayed at "Hotel Metropole" HK where he transmitted the virus to at least 16 guests, a local visitor, 3 family members and a nurse. (10)(3) He was admitted to the ICU of Kwong Wah Hospital (KWH) on 22nd Feb. and died on 4th March'03. He was the source for most SARS infections in HK and for the index cases in Vietnam, Canada, Singapore and USA. (4)

During the first phase in HK, the index case, a local residents became infected at the hotel and was admitted to Prince of Wales Hospital (PWH) on 4th March where he passed on the virus to >100 HCWs, as well as patients, visitors and their contacts. (2)(4)(9) By 25th March, 156 SARS patients had been admitted to PWH (4), while 138 were secondary or tertiary cases of the index case. (5) PWH had been severely affected by the SARS outbreak with a total of 239 cases. Nebuliser use by the index patient was attributed to be one of the major factors leading to aerosolization and such a large cluster. (3)(5)(7) Hospital overcrowding and outdated ventilation systems may have been additional causes. (4)

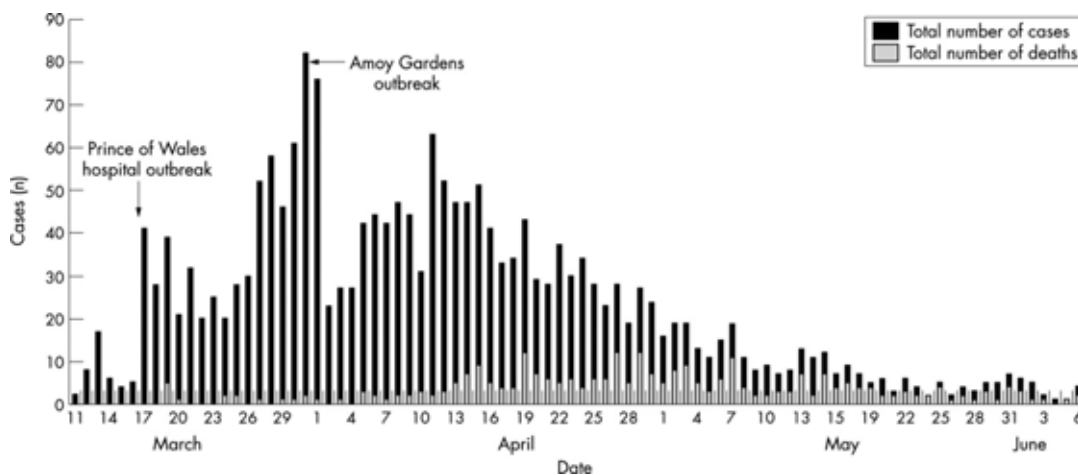
During the 2nd phase beginning in April'03 SARS spread into the community. (8)(9) It began with the second major outbreak around 26th March, accounting for 18.8% of SARS cases in HK (6) in which 329 residents (42 died) of an apartment complex "Amoy Gardens"(with 19,000 residents) were infected. (10) The source of this outbreak was a patient with renal failure who was being treated at PWH. (2). This patient had diarrhoea which was also the case in 2/3 (unusually high) of the SARS cases in this outbreak. (7)(8) Investigations on 17th April revealed leaking sewage systems, dried up 'U' water traps (water seal to prevent foul smell) in the drainage system and the updraft in light wells to have facilitated the virus to spread, which in addition to person to person contact and use of public installations resulted in such a high toll. (8) These findings were confirmed by the WHO team on 16th May.

During the last phase from early May the daily number of new cases declined to single digit figures. In this phase SARS spread to 8 hospitals and many housing states. (8) The SARS outbreak also affected 72 elderly home residents, 57 of whom died. The elderly are particularly

vulnerable on account of frequent hospital visits and weaker health status. Quite often they do not exhibit the typical symptoms. (11)

Extensive efforts to find the causative agent led to Hong Kong University announcing on 22nd March the identification of a coronavirus as the cause of SARS and the development of a diagnostic test to detect SARS antibodies. (3)

SARS Epidemic Curve, Hong Kong (SAR) (March – June 2003)



Source: S H Lee. The SARS epidemic in Hong Kong . Journal of Epidemiology and Community Health 2003 (2)

SARS Containment Strategies

The following list gives an overview of the SARS control activities undertaken in Hong Kong.

Organizational and Administrative Measures

- In early Feb. the **Hospital Authority (HA)** which is responsible for the management and control of public hospitals in HK, **set up a surveillance system** for “severe community acquired pneumonia” SCAP (until then SARS had not been recognized as a disease entity). (3)
- On 21st Feb. (before the WHO alert) the SCAP working group **prepared an information package on the management of SCAP and disseminated it to all hospitals**. These included a **case definition, reporting mechanisms, laboratory testing, infection control measures and treatment**. Amendments were made as knowledge developed. (3)
- On 20th Feb. the **Department of Health Hong Kong (DH)**, alerts the WHO, Beijing and doctors on 2 cases of H5N1 infection.(3)(10).
- By 10th March 18 HCWs at PWH had become ill.(4) The **WHO is officially informed** about the evolving outbreak at PWHospital on **11th March**. (10)
- On 13th March the Secretary for Health, Welfare and Food (SHWF) formed a **steering group** for coordination of prevention measures and information exchange.(3) This steering group together with experts from the DH, HA, Hong Kong University and WHO constituted the **Task Force**. (3)

- On 14th March the **Hospital Authority** set up a **SARS coordination centre**, which managed case reporting and information sharing among the different stakeholders. (3)
- On 17th March the WHO set up a research network of 11 laboratories including HK to search for the causative agent. The **WHO team worked together with the DH team** on SARS research. (3)
- SARS coronavirus testing in Hong Kong was performed in 3 designated laboratories where rigorous quality control procedures were established. All 3 facilities were certified as WHO reference laboratories. (6)
- On 19th March the DH was able to link the clusters in Hong Kong, Hanoi, Singapore and Toronto to the index case in Hotel Metropole. (12)
- On 19th March the HA released detailed **guidelines for the management of SARS for different professional groups** (hospitals, nurses, family and primary care physicians and institutions). It also included guidelines on the **discharge of recovering SARS patients**. These were regularly updated (3)
- On 25th March a **SARS steering committee** was established to coordinate the **Governments activities and response** to the epidemic. (3)
- On 27th March SARS was added to the list of infectious diseases making it a **statutory notifiable disease** and thereby providing the **legal basis for quarantine**. (3)(10)(14)
- By the end of March the DH distributed **guidelines for workplaces, for social contacts** of SARS cases and for **close contacts**. (3)
- On 31st March HK\$200 mill. were allotted for SARS treatment, infection control and public education, while HK\$11.8 billion were announced to relieve the economic impact. (3).
- The HA published a daily “Battling SARS Update” to keep its staff informed. (12)(3)(8)
- From 6th April a **police computer system** for tracing criminals “The major incident investigation and disaster support system” (**MIIDSS**) was used to detect SARS clusters, geographical distribution, source and route of spread, and the connection between cases and contacts. (12)(14)(8)
- In the beginning of April the “**Hospital Authority**” (HA) set up an **electronic platform (e- SARS)** with clinical and administrative details of SARS cases, for SARS surveillance and to facilitate information exchange b/w the HA, public hospitals and DH in real time. (10)(3)(14)
- During the end of April the **DH** developed a computer program (**SARS-CISS**) to have an updated **centralised database** on SARS cases and their contacts (12)
- On 11th April an infectious disease outbreak **information exchange system b/w Hong Kong, Macao and Guangdong Province** was set up. **Medical co-operations** and border quarantine arrangements were also agreed upon. (12)
- On 24th April a WHO team from Canada arrived to assist in investigating the risk factors and reasons for environmental transmission in Amoy Gardens, Hotel Metropole etc. (10)
- In May, SHWF and DH held **video-conferences** with WHO Geneva and with USA to update them on the SARS situation in HK. (3)

Case detection, contact tracing and isolation

- From 13th Feb. hospitals were asked to notify the infection control task force of the ‘Hospital Authority’ (HA) which in turn notified the ‘Department of Health’ (DH) on cases of SCAP (patients requiring assisted ventilation or ICU treatment) **From 19th**

March all private hospitals had to report SARS cases to the DH on a ‘Daily reply slip’ (3)

- Early on as the **cases of atypical pneumonia were reported** by the hospitals, the DH initiated **epidemiological investigations** and **contact tracing** for each case, this was intensified from mid March. (2)(3)
- On 11th March DH designed a **questionnaire to collect information** on clinical, travel and exposure history. A highly sensitive working case definition (from the outbreak in PWH) for case detection, surveillance and contact tracing was developed (before the WHO case definition) and the incubation period estimated. (12)(3)
- **Clear case definitions** were provided to all practitioners, on 14th March the presence of >38°C fever was added to the case definition and on 16th March following the WHO definition presence of X-ray findings were added. (3)
- As and when the hospitals reported cases the DH started **epidemiological investigations and contact tracing of all suspect and probable cases** (among staff, patients and their families, visiting doctors, visitors etc.) and subsequently placed **contacts under medical surveillance**. (12)
- From 31st March it became mandatory for **close contacts** to visit one of the **four designated medical centres** daily for 10 days after their last contact with the SARS case. Regular temperature checks and chest x-ray of those having fever or respiratory symptoms were carried out at these centres. Positive chest x-rays were referred to hospital. (12)
- From March to May about **23,000 contacts were traced** and 240 became probable SARS cases. (12)

Quarantine

- On 31st March 247 residents of block E of **Amoy Gardens** were placed under **home isolation** and residents who had shortly moved out were to report to the DH. The building was barricaded and guarded and the residents were provided food. On 1st April when investigations pointed to a defective sewage system being responsible all **quarantined residents were evacuated** and isolated for 10 days in holiday camps. (10)
- From 10th April onward **household contacts of confirmed SARS cases** were placed under **home quarantine for 10 days**, with no visitors, **monitored by police checks** and **teams of visiting nurses**. (12)(11)(10) Later in some cases close contacts were transferred to **isolation centres** for 10 days. (2)(14)
- From 25th April **home quarantine** was extended to **household contacts of suspected SARS cases** as well. (3)
- A total of **1262 persons were quarantined** and 34 developed SARS. (11)

Hospital and Community Containment measures

- On 10th March after 18 HCWs reported ill, the PWH **closed the medical dept. to new admissions, patient discharge and visitors**, later the **A&E services were also suspended**. (10)(3)(4)

- On 11th March 50 HCWs from PWH, on sick leave are recalled, assessed and 23 are admitted under isolation (3)(5) The DH advises hospitals to **isolate cases**, and **monitor sick leave records of staff**.
- On 12th March the PWH set up a **disease control centre to manage the outbreak in the hospital**, and the DH also stationed a team to facilitate contact tracing and communication. (3) **Cohorting wards** were designated for new admissions of **suspected and probable cases of atypical pneumonia**, and the medical teams were divided (clean/dirty teams) to **prevent cross infection**. (3)
- On 13th March a PWH forum “cluster meeting on atypical pneumonia” was set up which met twice daily to take decisions on management, treatment and infection control. (3)
- As more hospitals started reporting atypical pneumonia outbreaks, **Outbreak management teams** were set up and **cohort wards** were designated for SARS treatment in the affected hospitals and **contact tracing initiated**. (3)
- Affected hospitals in view of the high caseload and increasing number of infections among HCWs **temporarily closed their A&E dept. and stopped new admissions**. (3)
- The education and manpower bureau issued SARS prevention **guidelines for schools**. From 23rd March students who had relatives or contacts suffering from SARS had to stay home for a week, later from 29th March – 21st April **schools were closed**. (10) After senior schools resumed students had to wear masks and undergo daily temp. monitoring. (10)
- On 24th March the HA urges the public to **avoid hospital visits**. (3) and **visitors were required to wear PPE**.
- By 26th March 15 SARS cases all from **Amoy Gardens** had been hospitalised. On 29th March **2 medical stations were set up** at the entrances of Amoy Gardens, the DH started interviewing residents, distributing pamphlets and alerting about SARS symptoms so that cases could be isolated if symptoms appear. Similar measures were taken for outbreaks in other housing areas. (3)
- Thorough **cleansing and disinfection** was carried out in Hotel Metropole, Amoy gardens, other households and buildings affected by SARS, in addition to district wide household cleansing campaigns on 30th March and 19th April. (2)(3)(8)
- The DH on its **website published a list of buildings having probable or suspected SARS cases**. (3)
- Close contacts had to undergo medical check-ups at **designated SARS medical centres** for 10 days. (12)
- From 29th March the Princess Margaret Hospital being the only hospital with infectious disease facilities was **designated as a SARS hospital** to admit all cases referred from the designated SARS evaluation medical centres while all non SARS cases were referred to other hospitals. Within a week 555 cases including the Amoy garden cases were admitted which was beyond hospital capacity. (10) Between 11th– 17th April PMH stopped admission of new SARS cases which during this time were admitted in Tuen Mun Hospital. Here too HCWs developed SARS on 27th April. (3)
- Special arrangements to **transport SARS patients** were made. (3)
- **Elderly residents discharged from SARS affected hospitals were placed under a 10 day isolation** in the hospital or the elderly residence to prevent spread to this vulnerable population group. (11) (14)
- 730 **residential care homes for the elderly** were visited by the DH to ensure compliance with infection control procedures. On 2nd May a “Visiting medical officers” scheme aiming to reduce hospital admission of the elderly was started. (3)

- The **acute wards of all public hospitals are closed to visitors** from 3rd April onwards while other wards have a restricted visiting policy. (10)
- Residents from affected communities were advised to fill up the U-traps of the drainage system and ensure proper functioning. (3)

Infection control measures for protection of HCWs

- On 13th March the PWHospital management issued infection control guidelines and started training its staff. (3)
- On 17th March the DH informed all hospitals of the Hospital Infection Control and SARS Management guidelines of the WHO. (3)
- On 24th March the DH advised institutions like nursing homes for the elderly, private doctors, community medical clinics, chinese medicine practitioners etc. on **“Infection Control Measures for Healthcare facilities”** (3)
- Starting 31st March until 30th April the HA **conducted infection control training courses** for all HA hospital workers specially before deployment to high risk areas. Training materials were also posted on the HA **e-learning platform** and distributed to cluster hospitals (30,000 VCDs). (3)
- The HA instructed all **HCWs** to stay alert about their health status and **check their temperature daily**. (3)
- On 6th April the HA **prescribed PPE standards** and worked out requirement projections. (3)
- On 8th May the HK government received the first batch of PPE supplies from the central government. (3)

Travel related measures

- On 13th March **health advice** on the acute respiratory syndrome was issued to the **travel industry council** for tourists and tourist agencies, and information was updated as it emerged. (3)
- **Health alert notices** were given to travellers **entering** Hong Kong (13)
- From 29th March onwards all **arriving passengers** had to **fill in health declaration forms** while **departing passengers** were asked questions pertaining to SARS symptoms. (3)
- Later in April **all arriving, departing and transit passengers at airports, seaports and land border crossing posts** had to fill out a **health declaration forms** and from 24th April **all passengers** (including railway stations, China and Macao ferry terminals) had to **undergo temperature screening**. (12)(3) (10)
- On 2nd April the WHO issued a travel advisory for HK and Guangdong and advised to postpone all but essential travel(10)(8)
- On 5th April the DH’s Port Health Office **informed airlines on how to proceed** in case of suspected SARS cases on board. (3)
- On 25th March the DH asks people with respiratory symptoms to avoid air travel, while from 14th April **close contacts of SARS cases were prohibited to leave HK** during the 10 day quarantine period. (10)

Guidance and information to the public on SARS

- On 19th Feb. **press releases** were issued and the **public informed** of an H5N1 case. Health information on influenza and avian flu prevention were provided by the DH to the public via a **24- hr educational hotline**, their **website** and **roving exhibitions** at shopping malls and health centres. **Health talks** were also conducted at schools. (3)
- **On 12th March the practitioners and the public were informed about the outbreak of atypical pneumonia** at PWH and infection control measures against respiratory tract infections. (10)(3)
- From **14th March daily press briefings, Radio and TV programmes, health talks, information on the internet and guidelines on SARS prevention** and precaution measures were provided to the public. (12)
- On 18th March the DH set up a **telephone hotline with up to 84 lines** and 100 nurses during peak times, for public enquiry. Over time more than 90,000 calls were attended. (12)
- From 21st March the DH also carried out **mass public health education campaigns** using posters, pamphlets, exhibition boards, advertisements etc. (3)(14)
- In May a series of roving exhibitions on effective prevention were also held at big transit railway stations. (3)

Discussion

As the SARS outbreak entered the community normal public life came to a standstill, more than 90% people wore masks when they left their homes. Provision of open and transparent information was emphasized as insufficient and at times incorrect information led to panic and weakened public compliance to come for surveillance. (2)(8)(10) International travel and business almost stopped and HK lost billions of dollars. (10)

The HK health authorities were not well prepared to counter such an explosive spread of an infectious disease the causative agent, route of transmission, incubation period and symptoms of which were not known initially. The acute shortage of masks and protective equipment particularly affected the HCWs who were already very anxious and hard hit. (2)(8) HK had no specific hospital except the PMH, designed for treating infectious disease patients and hence faced difficulties designating a hospital for treatment and isolations of SARS cases The PMH treating 34% of SARS cases in HK although initially managed to avoid infections among HCW was later overwhelmed so that 62 HCWs contracted SARS between 30.03 – 14.04.03. (10)(3)

The initially delayed information by the Chinese health authorities about the Guangdong outbreak, its high infectivity and reports by China CDC of Chlamydia Pneumoniae being the cause contributed to the spread in HK.(3)

Contact tracing, medical surveillance together with quarantine were the key measures which brought the outbreak under control in Hong Kong. (12) The mean time from symptom onset to hospitalization varied between 2 and 8 days, decreasing over the course of the epidemic. (7) As a result of a highly sensitive surveillance definition initially from March – May more than 23,000 people were covered under the contact tracing operation, only about 240 of these became probable cases making up 14% of the 1755 SARS cases in HK. (12) By implementing port health control measures Hong Kong was able to prevent the export of any SARS cases by air from April'03. (12). WHO lifted the travel advisory for HK on 23rd May. (3)

References

1. Summary of probable SARS cases with onset of illness from 1 November 2002 to 31 July 2003. (Based on data as of 31 December 2003) Available at: www.who.int/csr/sars/country/table2004_04_21/en
2. **S H Lee.** The SARS epidemic in Hong Kong . Journal of Epidemiology and Community Health 2003;57:652-654 © 2003 [BMJ Publishing Group](http://www.bmj.com)
3. Chronology of the SARS Epidemic in Hong Kong. Appendix III. Available at: www.sars-expertcom.gov.hk/english/reports/reports/reports_fullrpt.html
4. SARS: experience at Prince of Wales Hospital, Hong Kong. The Lancet 2003;361:1486-87
5. Nelson Lee, David Hui, Alan Wu et al. A Major Outbreak of Severe Acute Respiratory Syndrome in Hong Kong N Engl J Med 2003;348:1986-94
6. GM Leung, AJ Hedley, Lai-Ming Ho, et al. The Epidemiology of Severe Acute Respiratory Syndrome in the 2003 Hong Kong Epidemic: An Analysis of All 1755 Patients. Ann Intern Med. 2004;141:662-673.
7. Abdullah ASM, Tomlinson B, Cockram CS, et al. Lessons from the Severe Acute Respiratory Syndrome Outbreak in Hong Kong. Emerg Infect Dis. Sep.2003;9:1042-45.
8. S.H.Lee. The SARS epidemic in Hong Kong – A human calamity in the 21st century. Methods Inf Med 2005;44:293-8.
9. Lee Shiu Hung. The SARS epidemic in Hong Kong: what lessons have we learned? J R Soc Med 2003;96:374-78.
10. SARS: How a global epidemic was stopped. Published in 2006 by the “World Health Organization, Western Pacific Region”
11. Peiris M, Anderson LJ, Osterhaus A, et al. Severe Acute Respiratory Syndrome. Blackwell Publishing.
12. Tsang T, Lam TH. SARS: public health measures in Hong Kong. Respirology 2003;8:S46-S48.
13. Bell DM. World Health Organization Working Group on Prevention of International and Community Transmission of SARS. Public health interventions and SARS spread,2003. Emerg Infect Dis. 2004 Nov.
14. Severe Acute Respiratory Syndrome: Response from Hong Kong. Presentation by Dr. Yeoh EK, Secretary of Health, Welfare and Food, at the WHO global conference on SARS Kuala Lumpur 17-18 June 2003. Available at: http://www.who.int/csr/sars/conference/june_2003/materials/presentations/en/sarshksar170603.pdf
15. WHO - Update 92 - Chronology of travel recommendations, areas with local transmission. Available at: www.who.int/csr/don/2003_07_01/en/index.html

People's Republic of China (Mainland China)
Beijing and Guangdong Province

Facts and Figures

Date of SARS onset: 16th Nov. 2002 (9)

Date of onset of last SARS case: 3rd June 2003 (9)

Declared free of local SARS transmission by WHO: 24th June 2003 (10)

Cumulative number of cases in Mainland China: 5327 cases (9)

Number of deaths attributable to SARS: 349 cases (9)

Population of China: 1.3 billion

Beijing city residents: 14.5 million

Guangdong Province: 85.2 million (1)

Introduction

By 12th June 2003, 26 of China's 31 provinces had reported SARS cases. A total of 5327 SARS cases were reported from Mainland China, 19% of which were health care workers. (11)

The earliest SARS cases identified retrospectively occurred in Foshan a municipality of **Guangdong province**, in mid Nov. 2002, which marked the beginning of the SARS epidemic in China. By mid Jan.'03 the unknown atypical pneumonia had spread to 6 municipalities and over the course of time affected over 15 municipalities in Guangdong, the highest incidence being in Guangzhou city with 12.5 cases per 100,000 people. The epidemic was almost exclusively seen in urban areas. (1) On 11th Feb.'03 in a press conference, the Guangdong health authority informed about an outbreak of atypical pneumonia in Guangdong between 16th Nov.'02 – 9th Feb.'03 affecting 305 people 5 of whom had died. (7) By the end of the epidemic in June >1500 people had been infected. (5) On 21st Feb. the virus from Guangdong entered Hong Kong from where it spread in Hong Kong and to many countries around the World. (7)

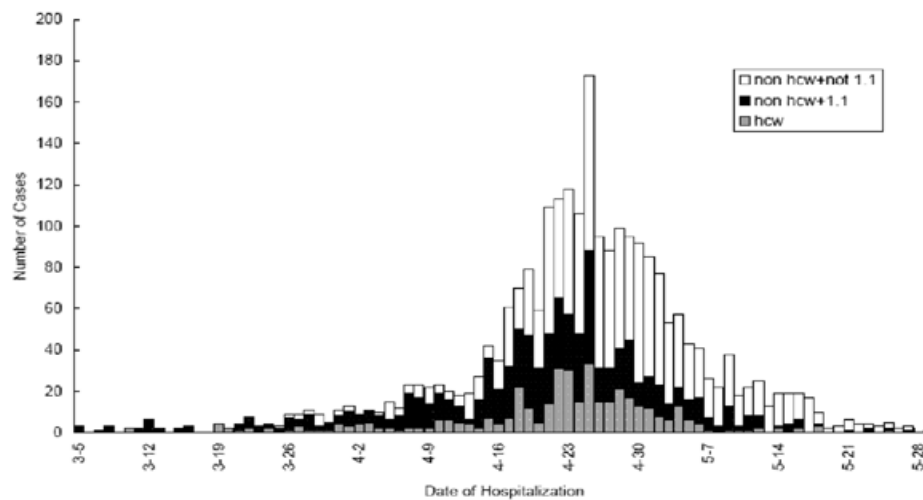
Beijing had the largest SARS outbreak both among the Chinese provinces and of the world with 2521 reported cases and 192 (7.6%) deaths until 26th June'03. In Beijing the outbreak began around 1st March'03 with the importation of several cases by travellers coming from SARS affected regions in China and outside and subsequent spread in health care facilities. (2)(3)

One person, who had been on a business trip to Guangdong, introduced the infection in Beijing on 1st March where she had gone to seek treatment. She was treated at 2 hospitals, transmitting the infection to many of her close contacts including 8 family members, friends and HCWs. (7)(2) Another superspreading event occurred with the return on 15th March of a 72 year old Beijing resident who had been to Hong Kong where he had most likely contracted the virus at Prince of Wales Hospital. He transmitted the infection to at least 59 people in Beijing and 22 passengers and 2 crewmembers on his return flight CA-112 to Beijing. (7)(2)

The epidemic was at its peak in Beijing during late April with >100 cases being reported daily. (3)(2) On 29th May the last SARS case was reported from Beijing and it was removed from the WHO list of areas with local transmission on 24th June'03. Since then sporadic laboratory

acquired cases and transmissions have occurred in Dec.'03 and between Feb. and May '04 due to improper laboratory practice.

SARS epidemic curve, China-Beijing (5th March'03 – 28th May'03)



Source: Severe acute respiratory syndrome, Beijing, 2003. Emerg Infect Dis. 2003;10:25-31

SARS Control Strategies

China being a large and populous country has provinces with different levels of health infrastructure and facilities. Since Beijing had the largest outbreak the following headings present a summarized list of containment measures implemented in Beijing. The SARS containment measures implemented in Guangdong province are briefly mentioned in chronological order under a separate heading. The “Control measures taken by the public” which was unique for China in their “Peoples War” against SARS have been stated separately.

SARS Control Strategies (Beijing, China)

Organizational and Administrative Measures

- A section of the Beijing Municipal Health Bureau, “**The Beijing Centre for Disease Prevention and Control**” (BCDC) through its district centres is responsible for **disease reporting, epidemiologic investigations and contact tracing**. It heads 18 District Centres for Disease Prevention and Control (DCDC), which report to the BCDC. (3)
- On 6th April the “**Beijing Joint SARS Group**” comprising of **10 task forces** was established to manage the SARS outbreak. (2)(3) Protocols for triage, isolation, case management and administrative controls were developed. (2)
- On 15th April the **medical and public health task force in Beijing** set-up an **emergency command centre** to organize medical treatment, various public health control measures and information management. (2)

- **On 8th April** the China Ministry of Health (MOH) approved the **listing of SARS as an infectious disease** thereby requiring health authorities from all provinces to **daily report all probable SARS cases** and deaths. This action was the legal authority for health department for instituting all control measures including quarantine. (15)
- The MOH provided updates to the WHO from early April, yet the figures were not complete. (7)
- Starting **from 21st April** all institutions were required to give **an accurate count of cases** and a strong warning was issued against hiding cases. The **MOH began to report the epidemic situation** to the whole nation in a standardized form **every day**. (7)(14)
- Hospitals **designated special personnel to report on the number of SARS cases**. The disease prevention and control departments were in charge of collecting the information and reporting to the provincial and municipal health departments. All information was gathered and then reported to the MOH, which in a **daily press conference at 4 pm reported on the SARS situation**. (12)
- To ensure that the number of SARS cases reported was complete and accurate, the **MOH adopted a "zero reporting" system**, i.e., all hospitals had to report even if they had no SARS cases. (12)
- On 23rd April China decided to create a **national task force** to combat SARS, and set-up a **national fund of two billion Yuan** (243 million US dollars) for prevention and control activities. (13)
- The **central government sent supervision groups** to Guangdong, Beijing, and other affected areas, to give more effective directions for SARS prevention and control. (14)

Case detection, contact tracing

- **Case reporting was made mandatory around mid April**. A standardised **case report form** had to be completed by the physician/hospital who first diagnosed the case, and sent to the district CDC. Weekly hospital audits ensured regular case reporting. (3)
- Probable and suspect **case definitions** were formulated and distributed by the China Ministry of Health (MOH). The definition included **clinical and epidemiologic features** but **did not include laboratory testing for coronavirus**.(3) Before 3rd April close contact with a SARS case or having infected another person was essential for the diagnosis, later a history of stay or travel to an area with SARS transmission (e.g. Beijing) or contact with a health care facility was sufficient.(4) To enhance specificity China later included normal to low leucocyte count and lack of response to antibiotics to the case definition. (2)
- **SARS cases** were **interviewed** in the hospital by district CDC staff about potential close contacts during the 2 weeks before symptoms developed also to get a clue on the source of infection. The data was entered in a **close contact data collection sheet**, which formed **the district close contact databases**. Data was collected for close contacts of suspect cases as well. (3)
- Beijing Municipal government in its guidelines **clearly defined** the criteria for labelling a person as a **close contact** of a SARS case. (3) The probability of a close contact becoming a probable SARS case was calculated to be 6.3% in Beijing whereby the attack rate was highest among spouses. (3)

Quarantine

- From 8th April close contacts were to be monitored (15) and later from 21st April onwards **close contacts of SARS cases were quarantined for 14 days** from the day of last contact. (3)
- **Quarantined persons** had to check their temperature twice daily, this was **monitored by community health workers** and symptomatic persons were sent to fever clinics or mobile units for further check-up. (3)
- The **DCDC was responsible for tracing the close contacts and issuing quarantine orders** by telephone within 1 hr. About **60%** of contacts were **quarantined at home** while the others were quarantined at designated sites like hotels, universities, hospitals, etc. (3)
- **Contacts were quarantined separately or in groups**, and were not allowed to leave home or quarantine site. Public health workers who had to wear full PPE provided food and other necessities. (3) **Neighbours were asked to watch out** and report if quarantined persons did not comply with quarantine regulations. (3)
- People at 4 hospitals, 2 universities, 7 communities and 7 construction sites were placed under **collective quarantine on the site**. (3) In certain areas entire villages were sealed off. (7)
- By 19th June nearly 30,000 **close contacts of probable and suspect SARS cases had been quarantined in Beijing** alone, while 20 – 30% of the population isolated itself out of fear. (7)(2) The SARS attack rate among quarantined persons b/w 1st – 15th April was as high as 22% and decreased to 1.1% b/w 16th – 31st May (3)

Hospital and Community Containment measures

- From 8th April probable and suspect SARS cases were to be treated under isolation. (15)
- Starting from 10th April Beijing authorities recruited **>3700 public health workers** to help in outbreak management. (3)
- Additional ambulances, X-Ray equipment and mechanical ventilators were acquired in large numbers. (3)
- By 17th April a total of 123 **fever clinics were set-up for patient triage** at all secondary and tertiary care hospitals. Some of these clinics were integrated into the emergency dept. or health clinics of the hospitals and did not implement appropriate isolation and triage. Additional SARS transmission probably occurred through these clinics and hence many were closed. By 6th May 66 fever clinics were functioning, these clinics had to be **separate from the general patient care areas**, run by trained **staff wearing full PPE** and equipped with individual examination rooms with air extraction fans and rooms for overnight medical observation. (3)(4) The hospitals sent daily summaries on the number of fever clinic visits to the BCDC and DCDC.(3)
- The **fever clinics** were frequented by **patients with fever and respiratory symptoms** either **referred by community physicians** or by **the quarantine site** or people came on their own. Physical examination, leucocyte counts and chest x-rays were performed at these clinics. (3)

- **Mobile SARS evaluation vans** staffed with HCWs also assessed people in the community. (3)
- On 14th April the municipal governments issued **directives to businesses and companies for prevention and control of SARS** spread. **Employers** were asked to provide safe and hygienic workplaces, ask their staff to wear masks specially when going out, postpone or cancel travel activities, avoid large meetings and gatherings and to report SARS cases or contacts. (Personal communication Dr. Fengdan)
- Many residential communities and businesses **screened visitors for fever**. (3)
- From 24th April all **schools (2610) were closed** and 1/3rd of the universities suspended classes. (3)
- From 26th April **public places** like libraries, bars, indoor sports complexes etc. were **closed**. Over the passage of time about **3500 public places had been closed** but restaurants were not closed. (3)
- **From 27th April onwards probable and suspect SARS cases were cohorted** and admitted only to SARS **designated wards** and **hospital visits** were restricted and later **stopped** with enforcement of **strict isolation**.(3)(2)
- **A new well-ventilated 1000-bedded SARS hospital was constructed** within 1 week in Beijing for treating patients with infectious diseases. It opened on 1st May after which 40% of SARS patients were treated at this hospital. (7)(3) **SARS transmission to HCWs did not occur at this hospital**. (3)
- SARS transmission to HCWs occurred in > 70 hospitals in Beijing.(2) 5 hospitals experienced large scale spread with 20 – 88 HCWs in addition to patients and contacts, contracting SARS. (3) The **hospitals were closed**, the SARS patients were transferred to designated hospitals and the remaining patients, staff and visitors were quarantined in the hospitals for 2 weeks. (2)
- China **MOH infection control guidelines** were issued on 4th May. (3)
- **From 8th May onwards** all previously diagnosed and new SARS cases were admitted to 16 municipal **hospitals designated for probable SARS cases** while **suspect cases were admitted to 30 designated district hospitals**. (2)
- Most hospitals did not have negative pressure rooms. SARS hospitals rooms were **fitted with air exhaust fans** on windows or walls, ensuring an outward flow of air from the hospital room to the outside. (3)
- **Specially equipped ambulances** were used to transfer SARS patients to designated hospitals.(2)

Infection control measures for protection of HCWs

- From mid April Beijing Govt. started **purchasing SARS emergency supplies** (like surgical masks, gowns, gloves, chemical disinfectant etc.) both locally and abroad and also stepped-up local supply production. (3)
- Starting from 18th April >62,000 **HCWs received training courses**, videos and printed material on the management of SARS patients, infection control measures and use of PPE. (3)
- HCWs were required to wear gloves, masks (N95 and/or 12 layer cotton mask), 2 – 3 sets of gowns and goggles. The outer layer was to be removed after patient contact. (3)

Travel related measures

- **By 22nd April** both domestic and international passengers were **screened for fever** with infrared thermometers **at the Beijing Airport**. In addition fever checks were carried out at major **railway stations, on boats, buses and at checkpoints set-up at all 71 roads connecting Beijing to other areas**. (7) Only 12 probable cases were identified from more than 14 million people screened. (3)(8)
- **Health alert notices** were distributed to around 450,000 **travellers entering** China mainland. (8)
- **Health declaration cards** were filled out by more than 13 million people **entering** China mainland. (8)
- On 11th April Beijing was added to the WHO list of areas with local transmission and on 23rd April a travel advisory was issued (7)
- The Govt. **suspended the 1 week long May holidays, to prevent mass travel** and hence transmission to other areas. (7)

Guidance and information to the public on SARS

- On 3rd April the minister of health informed about SARS issues on the national television. (7)
- On 8th April with the listing of SARS as an infectious disease the **use of communication** and education as a measure to control SARS **was authorized** by the MOH. (15)
- On 8th April a 24 hr **informational hotline** was set-up by the BCDC. (3)
- In a **press conference** held by the Vice-minister of health **on 20th April, the public was informed about the extent of the SARS outbreak** in China and what was being undertaken to control the spread. From 21st April **daily press conferences** were held by the government to inform the public. (3)(14)
- Beijing **Television daily broadcasted an educational programm** on SARS.(3)
- More than 6000 SARS **seminars** were organized and **educational materials** like pamphlets and CDs distributed in the communities by the Beijing municipal health bureau. (3)
- **Banners, billboards, advertisements on buses** etc. were used to inform and motivate the people to protect themselves and fight against SARS. (3)

SARS Control Measures Adopted by Guangdong Province, China

Guangdong Province reported a total of **1512 SARS cases** from **16th Nov. 2002 – 26th June 2003**. (5) It was declared free of local SARS transmission by WHO on 7th June. (7)

- On **2nd Jan.** the Hospital of Medicine Academy of Guangzhou, **named the disease as atypical pneumonia** and **defined the clinical characteristics** for its diagnosis. (Personal communication by Dr. Fengdan)
- On **23rd Jan. '03** the Guangdong provincial health authorities produced and distributed an official document on atypical pneumonia including **a case definition and control measures**. (7) This report was circulated to hospitals in the province only.

- From **3rd Feb. '03** province wide **case reporting** of atypical pneumonia cases was made **mandatory** using a **standard case definition and reporting form**. All hospitals had to report the cases via telephone to the local centre for disease control, which in turn reported it to the provincial centre. (1)
- A **standard questionnaire** given by contact tracing personnel had to be completed by all cases within 24 hrs. of reporting. Questions covered personal and clinical details, close **contact history and exposure risk factor** for community acquired cases like travel history, hospital visits, occupational history, animal contact etc. which were entered into **databases**. (1)
- On **3rd Feb.** instructions for **hospital containment measures** including strict **isolation** of cases and **use of PPE** by HCWs were issued. (1)
- On **9th Feb.** **guidelines** on hospital admission procedures, clinical management and **infection control measures** were established. (1)
- From early March the Guangdong health authorities **stopped hospital visits** to SARS patients. (7)
- From **27th March** **home quarantine** was made mandatory for contacts in Guangdong. (1)
- From **27th March** **public announcements** in Guangdong, on SARS symptoms, to seek medical help immediately if symptoms appear and about personal protective measures were made. (1)
- On **2nd April** the WHO issued a travel advisory for Guangdong (7)
- From **30th April** all SARS patients were **treated free of charge** in Guangdong. (1)
- From **mid April** **border control measures** at all entry points into Guangdong province were introduced according to the WHO recommendations. (1)

Prevention and Control Measures taken by the Chinese Public

By late April massive efforts were made by China to mobilize its rural and urban population. Folk songs, huge wall murals and banners motivated the people to fight and succeed. HCWs were lauded as angels in white. China's president Hu Jintao declared a "People's War" against SARS. A people's surveillance was developed encouraging people to monitor themselves for fever and to ensure that SARS cases are quickly identified. (WHO Update'79) Grass root structures were revived, villagers set-up roadblocks at entrances, numerous stop-spray-screen stations for vehicles were set-up, in some provinces e.g. Yunan hotels were closed and tourists were unwelcome, neighbourhood committees and villagers checked on one another and watched out for SARS symptoms in people returning from other places, visitors from Beijing were not welcomed and returnees were isolated for 15 days and checked for fever. (7)

Irrational measures like wearing multiple layers of PPE, rumours that fumes of boiling white vinegar or smoking prevented SARS, or even riots were the other extreme. Yet this people's surveillance system helped in early case detection and eventual containment within 2 months. (7)

Discussion

China's public health infrastructure was not prepared to fight an outbreak of such proportions, in addition they failed to alert authorities within and outside the country in time about the spread of SARS (7) China faced additional difficulties on account of it being a huge, densely populated country.

On 10th Feb. the WHO country office in Beijing received an unofficial message about a "strange contagious disease" in Guangdong with more than 100 people dead.(7) Although atypical pneumonia had appeared in Guangdong in Nov.'2002, it was first officially announced in Feb.'03. (6) After repeated requests by the WHO since Feb.'03 finally on 2nd April the MOH allowed a WHO team of experts to investigate the outbreak in Guangdong Province.(7) Discussion with Guangdong authorities were open and WHO experts expressed their satisfaction on the handling of the situation there, but voiced their concern about the management of SARS in Beijing. (7) SARS cases were on the rise in Beijing since April yet only few cases were being reported. From 20th April China openly declared war on SARS and started reporting accurately, hence 295 previously unreported cases in Beijing were disclosed. (7) The initial silence and secretive policy adopted by China, in an attempt to maintain economic and social stability actually had a negative effect, giving rise to rumours, spreading fear among people and causing a delay in the implementation of control measures thereby facilitating the rapid transmission of SARS. Researchers at the military academy of medicine in China had already isolated the coronavirus on 26th Feb. but did not make their findings public. (6)

China had a decentralized system of disease surveillance and cases were reported to higher authorities only after full investigation of the source by the local health authorities, in addition the military hospitals were not linked to the state medical system. This led to delayed and limited exchange of information among the Chinese authorities. (7)

Hospitals were not equipped to deal with contagious infectious diseases nor was there an adequate stock of PPE available (7) and hospitals and fever clinics unfortunately also served as amplification sites for SARS. In addition the fact that SARS patients were initially cared for in general medical wards resulted in transmission to other patients and visitors. HCWs accounted for 18% of SARS cases, spread among HCWs was higher in the earlier phase of the outbreak and decreased as infection control measures were adopted. (3)

The fact that > 50% of cases had no known contact history specially during the later phase complicated epidemiologic investigations.(7) In Beijing during the later phase of the epidemic in May/June up to 65% of SARS cases had no history of contact with a SARS case or travel. (4) In Guangdong more than 1/3 of SARS cases before Feb.'03 were food handlers or people who had contact with or sold wild animals. Approximately 75% of new emerging infections are zoonotic in origin, which evidence suggests is also the case for the SARS coronavirus. SARS associated coronaviruses have been found in Himalayan palm civets cats, raccoon dogs and other wild animals which are popular in China for medicinal and culinary purposes. Seroprevalence of immunoglobulin (Ig) G antibody to SARS-CoV is substantially higher among traders of live animals (1)

SARS was unknown for a long time but intensive media efforts led to widespread public knowledge in a short time. In late April public life came to a standstill in a huge city like Beijing, traffic reduced by up to 75%. (7)

The SARS outbreak in Beijing evolved very rapidly, infected large numbers and 6 weeks after the peak of the epidemic the last SARS case was reported showing the drastic containment measures to be effective. (3) Training of HCWs in PPE use, introduction of strict infection-control and isolation measures in hospital, establishing fever clinics and designating hospitals led to the steepest decline in cases. (3)(5) In addition the time between symptom onset and hospitalization significantly reduced from initially 5-6 days before the outbreak was made public, to 2 days after widespread information became available thereby reducing community transmission.(3) Although control measures were introduced later in the epidemic in Beijing, the enormous participation of the public played an important role in the successful containment of SARS.

References

1. Xu RH, He JF, Evans MR, et al. Epidemiologic clues to SARS origin in China. *Emerg Infect Dis.* 2004;10:1030-37.
2. Liang W, Zhu Z, Guo J, et al. Severe acute respiratory syndrome, Beijing, 2003. *Emerg Infect Dis.* 2003;10:25-31.
3. Pang X, Zhu Z, Xu F, et al. Evaluation of control measures implemented in the severe acute respiratory syndrome outbreak in Beijing, 2003. *JAMA.* 2003;290:3215-21.
4. Wu J, Xu F, Zhou W, et al. Risk factors for SARS among persons without known contact with SARS patients, Beijing, China. *Emerg Infect Dis.* 2004;10:210-16.
5. Breiman RF, Evans MR, Preiser W et al. Role of China in the Quest To Define and Control Severe Acute Respiratory Syndrome. *Emerg Infect Dis.* 2003;9:1037-1041
6. Zhong N, Zeng G. What we have learnt from SARS epidemics in China. *BMJ* 2006;333:389-91
7. SARS: How a global epidemic was stopped. Published in 2006 by the “World Health Organization, Western Pacific Region”
8. Bell DM. World Health Organization Working Group on Prevention of International and Community Transmission of SARS. Public health interventions and SARS spread, 2003. *Emerg Infect Dis.* 2004 Nov
9. Summary of probable SARS cases with onset of illness from 1 November 2002 to 31 July 2003. (Based on data as of 31 December 2003) Available at: www.who.int/csr/sars/country/table2004_04_21/en
10. WHO - Update 92 - Chronology of travel recommendations, areas with local transmission. Available at: www.who.int/csr/don/2003_07_01/en/index.html
11. Consensus document on the epidemiology of severe acute respiratory syndrome (SARS). May 2003. World Health Organization. Department of Communicable Disease Surveillance and Response.
12. Construction of Public Health Reporting System After SARS. By staff reporter Chen Shan, translated by Wang Qian September 15, 2003. Available at: www.china.org.cn/english/features/sars/60970.htm

13. China creates SARS task force, special fund (23.04.03) Available at: www.china-embassy.org/eng/zt/zgrq/t36680.htm
14. China holds press conference on SARS. (20.04.03) Available at: http://news.xinhuanet.com/english/2003.04/20/content_840713.htm
15. Rothstein MA, Alcalde GM, Elster NR, et al. Quarantine and isolation: Lessons learned from SARS. A Report to the Centers for Disease Control and Prevention Institute for Bioethics, Health Policy and Law, University of Louisville School of Medicine. November 2003

Taiwan, Republic of China

Facts and Figures

Date of SARS onset: 25th Feb. 2003 (8)

Date of onset of last SARS case: 15th June 2003 (8)

Declared free of local SARS transmission by WHO on: 5th July 2003 (6)

Cumulative number of cases: 346 (positive serology or PCR for SARS Co-V) (8)

Number of deaths attributable to SARS: 37 (11%) (8)

Population of Taiwan: 23 million

Introduction

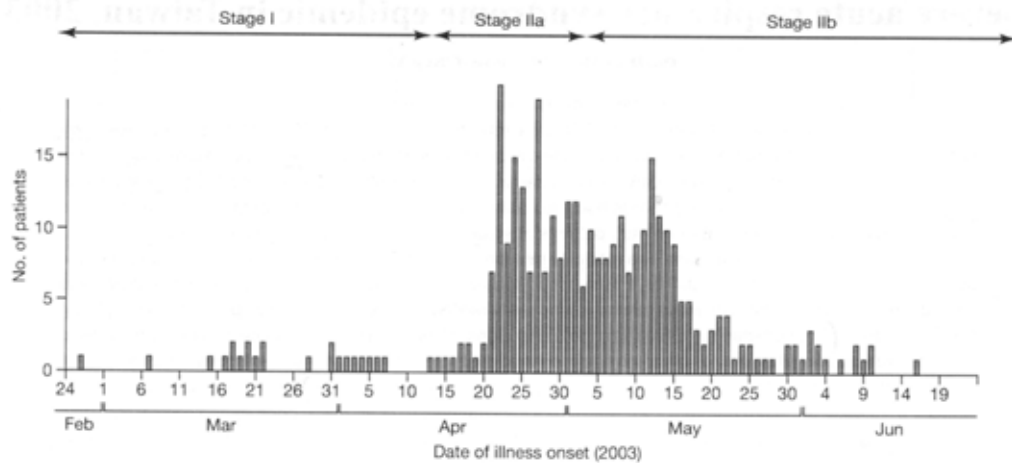
SARS was introduced into Taiwan by a businessman who had returned from Guangdong Province, China and developed febrile symptoms on 25th Feb.'03 He was hospitalized on 8th March. Soon after his wife developed similar symptoms and was hospitalised on 14th March. Taiwan reported its first suspected SARS case on 10th March'03. (4)

The SARS epidemic in Taiwan occurred in two phases. (3)(2) During the first phase lasting from late Feb. – mid April, 23 people developed SARS, 19 (71.4%) being imported cases and 4 having a history of contact with the index case including HCWs and family members. (1)

The second phase lasting from mid April to mid June was much graver resulting in a nationwide spread, mainly (83%) attributable to nosocomial transmission. (4) It began on April 22nd with an unrecognised SARS patient (hospital laundry worker) who had been symptomatic for 6 days before developing respiratory symptoms and being isolated. During this phase he had multiple contacts resulting in a cluster of 7 cases among HCW's in the Taipei Municipal Heping Hospital and subsequent further spread, infected patients had been discharged before the presence of an outbreak was realized. This led to secondary clusters in further 8 hospitals resulting in the temporary closure of 4 of these hospitals. (2) (6) 137 probable cases were associated with exposure to this first hospital cluster in Taipei. (2) The potential number of people exposed was estimated at 10,000 patients and visitors and 930 staff members (2)(6)

The SARS epidemic in Taiwan became the third largest with 346 positive cases. Of these only 6.1% were imported cases, 41% were inpatients who acquired SARS during hospital stay and 30.3% were health care workers. (3)

SARS epidemic curve, Taiwan-China (25th February – 15th June 2003)



Source: SARS epidemic in Taiwan, 2003, J Microbiol Immunol Infect. (3)

SARS Containment Strategies

The following list highlights the major control activities undertaken by Taiwan in their effort to contain the SARS epidemic.

Organizational and Administrative Measures

- Taiwan **reported** appearance of **SARS cases to the WHO** as soon as they were detected in mid March. (4)
- Initially a **SARS advisory committee** was formed by the Department of Health (DOH) (2)
- From March 16 the **U.S. CDC worked with** officials of the **SARS Expert Committee of Taiwan CDC** to formulate and implement a framework for SARS control strategies (1) (6)
- On March 17th the Department of Health (DOH) set up a **SARS Coordination Centre** to integrate resources from the academic, medical, private and administrative sectors to fight SARS (4)
- **Legislative amendments** were made in the public-health code to provide a **legal basis for** the implementation of isolation and **quarantine**. (4)
- From March 27th onward **SARS** (as defined by the WHO) was classified as a **notifiable communicable disease** and daily case reporting was assured. (4) (6)
- On 28th April the “SARS Prevention and Relief Committee” was established to coordinate government activities. (4)
- From 3rd May after China’s approval **WHO staff also joined** the SARS team in Taiwan. (6)

- Since mid April **real time PCR was used for SARS detection** (4)(1) Two systems were run in parallel and cases were confirmed only when both produced similar results.

Case Detection, Contact Tracing

- **Active contact tracing** among exposed healthcare workers and patient contacts was carried out. (1)
- Special organizations and groups, had the task to report cases with fever and unusual clusters were followed up. (4)
- A very **broad definition of close contact was formulated**, it included HCWs having had unprotected exposure, family and office contacts, schools contacts etc. (5)
- Active surveillance and monitoring of fever clusters in health care facilities and other institutions was undertaken. (6)
- **Fever-screening clinics were set-up at 136 health care facilities through out the Island.** (4)(2)

Quarantine

- **Hospital workers and patients** having had contact with a SARS case were usually **quarantined in the hospital** while the others were placed under **home quarantine.** (5)
- From March 18th all **suspected and probable cases discharged from hospital** as well as **close contacts of suspected cases** or those who came in contact with an infected environment were **placed under home quarantine** for initially 14 days and later 10 days. This **also included airplane passengers seated within 3 rows** of a SARS patient, persons who had been in closer contact (> 1 hr.) with a SARS case for e.g. at school, in the elevator, same public transport etc. (5) (4)
- **All patients, visitors and staff of Hoping Hospital** estimated at 10,000 patients and visitors and 930 staff members **were placed under home or hospital quarantine** from 24th April. (6)
- People under quarantine were registered and **followed up by either daily visits, telephone calls and occasionally e-cameras** as well as monitoring of temperature recordings. People under strict quarantine were provided with food and other necessities. A daily report on the status of the quarantined persons was given to the DOH (5)
- Quarantined persons were required to **monitor their temperature thrice daily** and seek medical attention for fever or respiratory symptoms, wear masks when outside quarantine area, not use public transport or go to hospital or crowded public places. (5)
- Quarantine rules were sub-divided into a **more strict Level-A & a less restricted Level-B Quarantine** (mostly for travellers from SARS affected areas). (5)
- **Failure to comply** with quarantine rules was **punishable** with fines up to US\$ 1800 and incarceration. (5) Compensation of (U.S. \$ 147) was given to those who did follow the quarantine regulations (4) (5)
- Overall > 130,000 people were quarantined including >50,000 close contacts (level A quarantine) and >80,000 travellers from SARS affected areas, yet it was difficult to monitor the adherence to quarantine regulations and hence many skipped. (6)

Hospital and Community Containment measures

- Taiwan CDC **implemented strict infection control measures** in the hospitals with SARS cases ensured by **monitoring teams**. (1)
- Infection control nurses **monitored absenteeism among HCWs** at the hospitals caring for SARS patients. (1)
- Treatment protocols for SARS cases were established in early March including respiratory care, anti-virals for all probable cases, oral and intravenous steroids and immunoglobulins. (3)(4)
- From mid March onwards, **all suspect and probable patients were to be placed under isolation**. Taiwan had a total of 764 negative pressure rooms (mostly equipped with HEPA- filtered air system) (1) Construction of additional negative pressure rooms was undertaken. (2)
- On 23rd April an **emergency task force** was set up to plan the development of an adequate response to **stop transmission in Hopping Hospital**. (2)
- On 24th April the Hopping Hospital was sealed off and **all patients, visitors and staff were placed under quarantine**. Patients and visitors were **quarantined at home** while the **hospital staff** was mainly **quarantined in designated government housing**. (6)
- The SARS patients were cared for in 15 hospitals across the island (initially there were no designated SARS wards or hospitals) (1) During the second stage in an effort to stop nosocomial transmission, **specific hospitals were designated for the treatment of SARS patients** throughout the island (2)(3)
- **Hospitals were assigned different medical care levels and responsibilities**. While medical centres treated severe SARS cases and provided guidance to the 69 regional hospitals, the regional hospitals in turn supervised the local hospitals thereby establishing an epidemic check and control network (2) Health clinics and local hospitals did fever screening and referred cases accordingly. (4)
- **Hospital visits** by family members were **largely prohibited** (1)
- **Public fever screening** of all persons **entering hospitals, public buildings and restaurants** etc. was carried out. (4)
- Distribution of free bleach to **households** for **disinfection** purposes (4)
- The government issued **guidelines for SARS infection control in Business venues** which were very extensive covering issues like disinfection, ventilation and air-conditioning, use of lifts etc.
- Procedures and measures for the **management and control of community transmission** were formulated to effectively handle SARS transmission (4) People were asked to **wear masks in closed public places**, e.g. while using the public transport, entering a hospital, working in restaurants etc.
- 4 activation protocols of the “Communicable Disease Medical Network” were developed and could be activated to provide medical care according to the severity of the epidemic (4)
- A **national campaign of temperature checking** was initiated. (4)
- **Larger public gatherings** and events like plays at The National Theatre in Taipei **continued** although people avoided visiting public places and used masks if they did. (6)

Infection Control Measures for protection of HCWs

- Beginning mid March all health care workers were **provided with enhanced personal protective equipment**, its proper use being monitored. It included gowns, gloves, masks (N95 or greater) and eye protection. Mostly a second disposable layer of protective clothing including head and foot covering was also used. (1)
- Frequent **handwashing** and barrier precautions were recommended for HCWs (1)
- **HCWs treating SARS cases not using PPE were quarantined in the hospitals** as were other patients who had contact (5)
- **Education and training of healthcare workers** on infection control practices using written guidelines, posters and direct demonstrations was conducted. (1)
- A DOH, SARS education and infection control training program for professional staff on patient care, self protection measures and clinical procedures was formulated and made available on the internet and CDs were distributed to all medical care institutions Training teams coached and monitored HCWs (2)(4)

Travel related measures

- **Health alert notices** were distributed to travellers **entering** the country. (7)
- **Passengers arriving** in Taiwan were required to **complete a SARS survey form** and were **checked for temperature**. (4)
- **Exit screening** was undertaken in response to WHO recommendations. **Passengers leaving** Taiwan had to **complete health declaration questionnaires** and undergo **thermal screening**. (7)
- From April 14th aircrafts carrying **suspected SARS cases on board** had to be disinfected according to operational procedures for **aircraft disinfection**. (4)
- From 28th April – 3rd July **all people arriving from SARS affected areas** were subject to **a 10 day quarantine (level B)**. (4) Quarantine could be observed at the airport hotel, at home or at a designated site. From 9th June onwards an exception was made for people from Taiwanese companies returning for business (5)
- Generally from 24th June onwards, instead of home quarantine passengers were asked to be vigilant about fever or respiratory symptoms. (5)

Guidance and information to the public on SARS

- A **toll-free telephone hotline “177”** operated by the Taiwan Medical Association was set-up to give professional advice on SARS prevention and control. (4)
- A **SARS website: www.cdc.gov.tw/sars/** was set-up to provide updated information to the public. (4)
- Information and **public education programmes** were disseminated using TV, radio, newspapers, leaflets and posters. (4)
- **Daily press conferences** and a SARS prevention TV program were broadcasted at regular hours informing on the status of the outbreak (latest numbers), preventive measures and government actions to counter the epidemic (4)

Discussion

Initially the efforts to control SARS seemed effective but the nosocomial spread due to unrecognised cases in the second phase demonstrates that SARS could spread despite knowledge about its epidemiology and transmission. (2) Factors contributing to this situation were many fold including inadequate triage and pre-existing infection control policies, improper and lenient infection control practice among some HCW's and private personal attendants of patients (2)(3) and shortage of personnel and protective equipment. The need for training of all HCW's in the proper application of infection control procedures seems an effective and feasible measure. (2)

Taiwan implemented quarantine on a large scale. Of the more than 131,000 people quarantined only 133 i.e. 0.1% were subsequently diagnosed as probable or suspect SARS cases and only 21 persons (0.016%) had laboratory confirmed SARS. (3)

Among the >80,000 quarantined travellers entering Taiwan from SARS affected areas, probable or suspected SARS was diagnosed in 21 (0.03%). No cases were detected as a result of entry or exit thermal scanning. Of the 1.1million health declaration cards completed by exiting passengers, only 1 probable case was detected. (7) Visitor arrivals in Taiwan fell by >80% during May'03, which had massive affects on the tourist industry and economy.

The initial lack of reliable information and unsuccessful attempts of public officials to hide information, led to fear among the Taiwanese public. (6)

Finally with effective SARS containment Taiwan was removed from the WHO list of countries with recent local transmission on 5th July. (6)

References

1. Twu SJ, Chen TJ, Chen CJ, et al. Control measures for severe acute respiratory syndrome (SARS) in Taiwan. *Emerg Infect Dis* 2003 June Vol.9, No.6
2. CDC. Severe Acute Respiratory Syndrome – Taiwan, 2003. *MMWR* 2003;52:461-466
3. Hsueh PR, Yang PC. Severe acute respiratory syndrome epidemic in Taiwan, 2003. *J Microbiol Immunol Infect* 2005;38:82-88
4. Prevention and Control of SARS in Taiwan. Available at: www.cdc.gov.tw/Website_En/health%20topics/communicable%20diseases%20&%20prevention/sars/SARS_web_En_11.pdf
5. CDC. Use of quarantine to prevent transmission of severe acute respiratory syndrome – Taiwan, 2003. *MMWR* 2003 July;52, No. 29
6. SARS: How a global epidemic was stopped. Published in 2006 by the “World Health Organization, Western Pacific Region”
7. Bell DM. World Health Organization Working Group on Prevention of International and Community Transmission of SARS. Public health interventions and SARS spread, 2003. *Emerg Infect Dis*. 2004 Nov.
8. Summary of probable SARS cases with onset of illness from 1 November 2002 to 31 July 2003. (Based on data as of 31 December 2003) Available at: www.who.int/csr/sars/country/table2004_04_21/en

Vietnam

Facts and Figures

Date of SARS onset: 23rd Feb. 2003 (7)

Date of onset of last SARS case: 14th April 2003 (7)

Declared free of local SARS transmission by WHO: 28th April 2003 (8)

Cumulative number of cases: 63 (7)

Number of deaths attributable to SARS: 5 (HCWs) + 1 (index case died in Hong Kong) (2)

Population of Vietnam: 85 million

Introduction

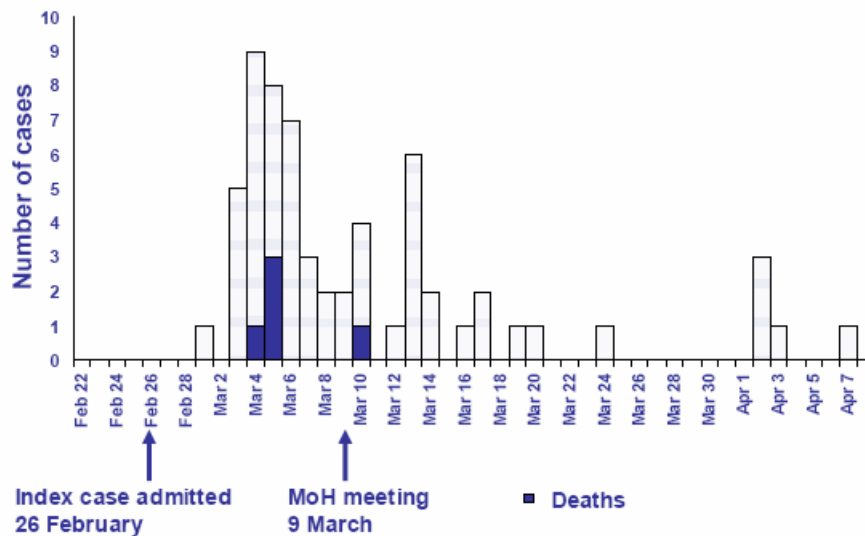
Vietnam was one of the first countries to be affected by SARS. A 48 year old Asian-American businessman who had been infected with the virus during his stay at the Hotel Metropole in Hong Kong introduced SARS into Vietnam. He was admitted on 26th Feb. to a small private hospital the Hanoi-French Hospital (HFH) with symptoms of atypical pneumonia. Dr. Carlo Urbani a communicable disease specialist working for the WHO in Vietnam had been asked for assistance, he voiced his concern on 3rd March and emphasized the need for strict infection control. Until then there had only been some reports about a fatal pneumonia, which was spreading in Guangdong in China and some cases of avian influenza in Hong Kong. (6) By 5th March 7 HCWs from the hospital fell ill all having had contact with the said patient. Nosocomial spread in the HFH led to the development of around 40 cases among HCWs, patients and visitors. Dr. Urbani was the first to identify the spread of a dangerous contagious respiratory disease which later came to be known as SARS. He first described its signs and symptoms, laboratory and x-ray findings to the international community. He informed the WHO which led to the announcement of a global alert by the WHO on March 12th. 3 weeks later he died of this disease himself. (6)

From March 11th onwards the 1400 bedded Bach Mai Hospital (BMH) was designated as the only SARS hospital and all SARS cases were admitted here. In all 33 cases were treated at BMH including 10 cases which had been transferred from the HFH. In the BMH no nosocomial spread occurred (5), which fortunately for Vietnam led to a rapid containment of the epidemic.

A rumour in the beginning of April of a cluster of about 90 cases in Ninh Binh Province 90 km off Hanoi eventually turned out to be 6 SARS cases, which were also linked to HFH. These were the last transmissions. (6)

All 62 SARS cases in Vietnam were epidemiologically linked to the index case. (2) In all 36 HCWs were infected with SARS during the course of the epidemic which constituted 57% of SARS cases. (7)

SARS Epidemic Curve, Vietnam (February – April 2003)



Source: Presentation, WHO Global Conference on SARS, Kuala Lumpur 17 – 18 June 2003

SARS Containment Strategies

Organizational and Administrative Measures

- The first meeting between the WHO and the Ministry of Health (MOH), Vietnam took place on 9th March, which soon led to decisive action including the **formation of a local team** to review the outbreak in the HFH. (1)(6)
- As one of the earliest measures on 12th March a **special SARS task force** was established at the MOH and **WHO** was officially requested for **expert assistance** (1) (6)
- The **WHO Vietnam team** with 9 international experts was **divided into task groups** comprising of epidemiology, rumour surveillance, laboratory testing, infection control and contact tracing. These groups worked in close collaboration with the MOH teams (6)
- **Guidelines for case definitions, case management and treatment** were agreed upon together with the WHO team.
- On March 19th a **National Intersectoral Steering Committee** was formed to integrate resources from sectors like defence, aviation, information, immigration, tourism etc. and responsibilities like **surveillance and containment, logistics, clinical management**, etc. were assigned. Daily meetings were held until mid April (1)(6)
- Shortly after the Provincial governments were informed of the outbreak and **provincial steering committees** were established. SARS surveillance and control guidelines were given to the provincial and district medical centres. **Training of the local medical staff was initiated.** (6)
- A budget of 5.3 million US\$ was allocated for various measures associated with the SARS epidemic control including purchasing of protective equipment, medicines, staff training and support etc. SARS patients were treated free of cost and HCWs involved in their care were given upto 5 times extra allowance (1)

Case detection, contact tracing and isolation

- Starting from 10th March **surveillance and contact tracing of close contacts** was carried out in Hanoi and Hung Yen.(1)
- On 20th March a **24 hrs. SARS reporting hotline was established** (6)

Quarantine

- Strict **quarantine procedures were enforced** and their **execution monitored**. (5)
- Quarantine areas and isolation rooms were set – up at airports, seaports and border crossings (6)

Hospital and Community Containment measures

- From 5th March onwards as the infectious nature of the disease became clear, Dr. Carlo Urbani initiated laboratory testing of samples taken from the HCWs of the HFH and insisted upon HCWs adopting **personal protective measures** like masks and practicing an increased level of **infection control**. He initiated **cohorting of patients** and contact tracing. The **sick HCWs were isolated** in a section of the general ward (6) (4) (3)
- On March 8th HFH closed its outpatient services and **visitors were not allowed** to enter the hospital. **The HCWs were advised not to go back to their homes**. (4)
- On March 12th the **HFH** transferred or discharged all patients except those suffering from respiratory symptoms and **was closed for new admissions** except HCWs from the hospital itself (2) (6) Strict isolation measures were enforced. (4) From March 18th the hospital was temporarily closed and all SARS patients were transferred to BMH. (3)
- From 12th March onward special wards at the **BMH** were **designated solely for the treatment of suspected and probable SARS cases**. (6)
- In contrast to the initial phase (12 – 19th March), from 19th March onwards entry of visitors to the BMH was extremely restricted, enforced by entry guards. (Yet the doors were not just closed or barricaded shut) (6)
- The **Nosocomial Infection Control Committee** of the **BMH** treated the epidemic as a highly infectious new type of pneumonia and **reorganized its infection control practice** from the very beginning, cases were isolated in a special ward and hospital staff was warned. (5)
- As negative pressure rooms were not available (3)(5), the windows of the patient rooms were kept open ensuring ample circulation of fresh air. (5)
- Well equipped SARS **mobile teams** were set up. (1)
- **SARS patients were generally discharged 5 – 6 weeks after hospital admission** thereby ensuring that they would no longer transmit the virus (2)

Infection control measures for protection of HCWs

- **N95 respirators, eye protection and face shields** were provided to the HFH staff on March 12th. (3)
- **Hand washing** before and after having contact with a patient was specifically recommended as droplet and contact precaution (4)
- From March 19th onward **guidelines for infection control training** were drafted and put into practice. (2) (5)
- **External resources and technical support** for outbreak investigation, management and infection control etc. by the WHO, US CDC, Medecins Sans Frontieres (MSF), Australia, Japan etc. were mobilized (1) From 19th March technical support and personal protective equipment supplies started arriving in Vietnam(2)
- Advisors of MSF distributed **PPE including N95 masks** (during the early phase only paper or cloth masks were available), **gloves, gowns and disinfectant for hands** and **monitored its proper use** according to internationally agreed protocols. (2). In addition the staff was instructed to wear face shields or goggles. (5) Infection control practice greatly improved after these interventions (2)
- Since Jan. 2000 “The Bach Mai Project for Functional Enhancement” a technical co-operation project aided by the Japanese government was running in the BMH, it also included guidance on nosocomial infection control. This project featured, the establishment of a system for surveillance and reporting, formulating an infection control manual, developing teaching material and organizing training of the hospital staff. Thus the staff at BMH was more familiar with the technique and knowledge of precautionary measures and could rapidly implement them and they had better technical facilities.(5)

Travel related measures

- **Pamphlets** in English, French and Vietnamese language **informing passengers about the symptoms** of this **new respiratory disease** and about its status in Hanoi were distributed **to all passengers leaving Vietnam**. The initial suggestion of making a similar announcement on board all airplanes leaving Vietnam was turned down by the airlines for fear of terrifying the passengers. (6)
- **Passengers at the airport were screened**, this led to one physician from HFH who was symptomatic and suffering from SARS to be stopped from leaving Vietnam, on the other hand a French doctor who had been at the HFH and was returning to Paris was not detected subsequently introducing SARS into France and leading to further transmission to three passengers on the flight. (6)

Guidance and information to the public on SARS

- On March 14th the presence of SARS in Vietnam was **announced on the national television** and other mass media **and recommendations for prevention measures were given**. The public was informed daily on the SARS status and **educational SARS prevention programmes** were **broadcasted** (1)

Discussion

Vietnam was lucky to have only one super spreading patient, i.e. the HFH index case, non of the 33 patients treated at BMH were superspreaders and as most SARS patients did not transmit the virus, the transmission chain was interrupted.(2) The correct intuition and early warning voiced by Dr. Urbani, his insistence upon implementation of strict infection control measures along with the effective prevention of reintroduction of the virus into the community from the hospital helped in the rapid containment. In addition the immediate involvement of the government authorities, reciprocated by the relatively quick response of the MOH, their consent to accept international assistance and rapid initiation of necessary administrative and infection control steps to deal with the situation led to Vietnam being the first country, on 28th April'03, 20 days after the onset of the last case, to be removed from the WHO list of countries with recent local transmission. (6)

References

1. Strong political commitment and speed of action – Key to success in SARS Containment in Vietnam. Presentation by Prof. Thuong NV, Vice Minister of Health of Vietnam at the WHO global conference on SARS Kuala Lumpur 17-18 June 2003. Available at: http://www.who.int/csr/sars/conference/june_2003/materials/presentations/sarsvietnam170603.pdf
2. Le DH, Bloom SA, Nguyen QH, et al. Lack of SARS transmission among public hospital workers, Vietnam. *Emerg Infect Dis* 2004;10:265-268
3. Reynolds MG, Anh BH, Thu VH et al. Factors associated with nosocomial SARS-CoV transmission among healthcare workers in Hanoi, Vietnam, 2003. *BMC Public Health* 2006, 6:207. Available from: www.biomedcentral.com/1471-2458/6/207
4. Nishiura H, Kuratsuji T, Quy T, et al. Rapid awareness and transmission of severe acute respiratory syndrome in Hanoi French Hospital, Vietnam. *Am J Trop Med Hyg* 2005, 73:17-25
5. Hiroshi Ohara. Experience and review of SARS control in Vietnam and China. *Trop Med and Health* Vol.32 No.3, 2004:235-240
6. SARS: How a global epidemic was stopped. Published in 2006 by the “World Health Organization, Western Pacific Region”
7. Summary of probable SARS cases with onset of illness from 1 November 2002 to 31 July 2003. (Based on data as of 31 December 2003) Available at: www.who.int/csr/sars/country/table2004_04_21/en
8. WHO - Update 92 - Chronology of travel recommendations, areas with local transmission. Available at: www.who.int/csr/don/2003_07_01/en/index.html

Canada

Facts and Figures

Date of SARS onset: 23rd Feb. 2003 (1)

Date of onset of last SARS case: 12th June 2003 (1)

Declared free of local SARS transmission by WHO: 2nd July 2003 (12)

Cumulative number of cases in Canada: 251 cases (43% HCWs) (1)

Number of deaths attributable to SARS: 43 cases (1)

Population of Canada: 32.3 million

Greater Toronto Area: 4.7 million (located in the Province Ontario) (11)

Vancouver: 2 million (located in the Province British Columbia) (11)

Introduction

In Canada 2 urban areas, Vancouver located in the Province British Columbia and Greater Toronto Area located in the Province Ontario, were mainly affected by SARS. It began on 23rd March with the return of a 78 year old woman who had stayed at the Hotel Metropole in Hong Kong where she had become infected with SARS. She transmitted the virus to her son and 4 other family members and died on 5th March at home. Her son was admitted with complaints of cough, fever and shortness of breath to the Grace division of Scarborough Hospital in east Toronto on 7th March and died on 13th March.(12) He was not recognized as having a communicable disease and was placed in the general observation area and received nebulized medication. Droplet and contact precautions were started on 13th March, yet full precautions were not in place until 25th March, hence many HCWs had contracted SARS. (11)(5)(9) The 4 infected family members were admitted to 4 other Toronto hospitals under isolation. (5) Nosocomial transmission from this case at Scarborough Hospital was the epidemiological root of most SARS cases in Toronto and resulted in at least 128 probable and suspect cases within this hospital.(9)(12) Institution of infection control measures stopped transmission within the hospital yet hospital transfers of infected inpatients, HCWs working at multiple health facilities and transmission to household members resulted in further spread. (5)(9) In addition a cluster of 33 cases occurred among a close-knit religious community, which required 500 members of this community to be quarantined. (5)

About 2000 passengers arrive in Vancouver daily from Hong Kong and mainland China alone. **Vancouver** had 5 SARS cases 4 of which were imported. The first 2 cases were a couple who had also contracted SARS at the Hotel Metropole in Hong Kong, the husband was referred by the physician to hospital immediately after return on 7th March. Full respiratory precautions were taken within 15 min. of his arrival at the emergency room and within 3 hrs. the patient was transferred to a negative pressure isolation room. The other 2 imported cases who had also contracted SARS in Hong Kong were already aware of the risk, one presented while still asymptomatic, while the other observed self isolation and once hospitalised these cases were isolated. The only local case was a nurse who contracted SARS while caring for one of the patients. Luckily no further local transmission occurred. (11)

The fact that several cases of severe atypical pneumonia had occurred in the same Toronto family created suspicion. A telephone conference on **13th March'03** between Toronto and the British Columbia CDC helped to link the Toronto and Vancouver cases to the atypical pneumonia events in Asia. This realization led to enhanced awareness and institution of infection control precautions in Canada and hence further importations did not result in transmission (11), however local transmission occurred.

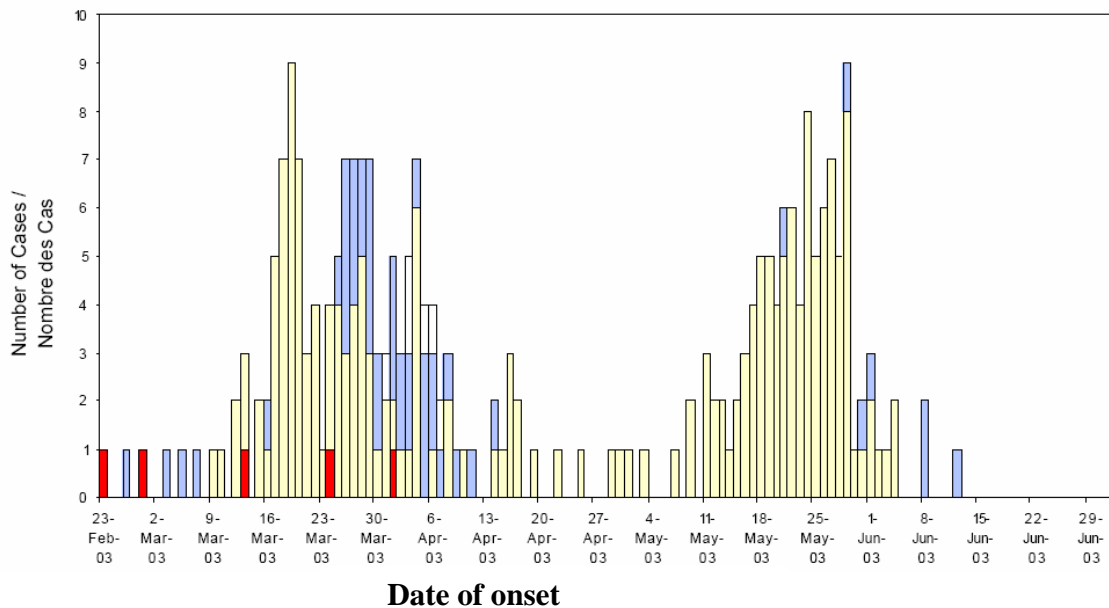
On 14th May, 20 days after the last SARS case had been reported, Canada was taken of the list of countries with recent local transmission, only to be added again on 26th May. Starting from early May barrier precautions were down graded e.g. hospital staff were not required to wear masks routinely in hospital or during contact with non-SARS patients. (7) Hospital visiting restrictions were relaxed slightly. On 20th May a cluster of 5 patients having a febrile illness were reported from a Toronto rehabilitation hospital, with 2 patients having been transferred from the North York General Hospital (NYGH). Investigations revealed 8 other cases of pneumonia among patients and visitors at that hospital. (7) Due to use of PPE among staff, initially no SARS cases were seen among HCWs, resulting in delayed identification of the outbreak. (3) (7) On 23rd May Toronto experienced a second wave of SARS with 90 confirmed cases, > 620 potential cases, > 9000 contacts. (3)

Greater Toronto Area had 3 imported SARS cases, yet SARS transmission occurred in 11 (58%) of Ontario's acute care hospitals, ultimately resulting in 247 SARS cases and 43 related deaths. (11)(5) In Ontario most SARS cases occurred due to transmission in the hospital setting and to household contacts, specially the resurgence during the 2nd phase where 88% cases were attributed to hospital transmission. (3) (5)

SARS epidemic curve, Canada (23rd February'03 – 2nd July'03)

N=250

excludes 1 for whom onset date is unknown



Source: Epidemiological Curve, <http://www.phac-aspc.gc.ca/sars-sras/sars.html>

SARS Containment Strategies

As the province of Ontario was mainly affected by the SARS outbreak in 2003, the following is a list of control measures, which were mainly implemented in the Greater Toronto Area in Ontario, Canada. The points in italics (grey) pertain to Vancouver only.

Organizational and Administrative Measures

- *The British Columbia (Vancouver is located), Centre for Disease Control (BC CDC) had an electronic distribution system in place, which regularly informed health care institutions across the province on communicable diseases. On 20th Feb. '03 an alert was given out through this system asking HCWs to be vigilant about influenza like symptoms in people returning from Hong Kong or China as atypical pneumonia had been reported in China and H5N1 influenza in Hong Kong. These alerts were repeated in Feb. and March. (11)*
- Health Canada **immediately notified all provinces** and territories about cases of atypical pneumonia after WHO issued a global alert **on 12th March'03**. Toronto Public Health **reported its first case on 13th March**. (5)(6) British Columbia also reported the first cases of SARS (6)
- On 25th March **SARS was declared a reportable, communicable disease**. (5)(10)
- By **26th March a provincial emergency** was declared in Ontario, and the provincial operations centre for emergency responses activated. A **SARS Provincial Operations Centre**, for management of the outbreak in Greater Toronto Area was set up. They issued guidelines and directives, which were regularly updated. (10)
- Health Canada (federal level), The Ontario Ministry of Health and Long Term Care (OMHLTC) (provincial level) and Toronto Public Health (local level) were the main institutions involved in the SARS outbreak management in Ontario. From 13th March onwards their experts held daily information sharing teleconferences. (10)
- **National case definitions** for suspect and probable SARS cases were **developed and modified over time**. It did not include Canada-Toronto in the list of affected areas, in the end of March contact to a setting associated with SARS clusters was added to cover exposure to sites in Toronto. (10)(21)
- From mid March **enhanced surveillance** for detection of SARS cases was instituted. In addition laboratories were alerted to follow special testing protocols to identify the cause of SARS. (17)
- On 28th March the **hospital infection control guidelines** were issued, to be followed by hospitals in Ontario Province. (5)
- A **SARS surveillance system** was developed by the OMHLTC. Toronto public health developed a **software for tracking SARS cases and contacts**. Data handling systems and protocols were developed. (10)
- The Government of Canada made regulatory changes in mid June'03 **adding SARS to the Quarantine Act's Schedule** of infectious diseases, an incubation period of 20 days was prescribed and quarantine officers at Canadian ports would be authorized to compel a person to undergo medical examination and detain a person suspected of having SARS if necessary. (18)
- **Public health outbreak management teams** assisted the hospitals and were responsible for **communication and information exchange**, rapid contact tracing and quarantine. (3)

Case detection and contact tracing

- A **SARS screening tool (questionnaire)** was developed and updated as information became available. Directives were issued to all acute and non-acute health care facilities to restrict the number of entrances, assess all people entering the facility with the SARS screening tool (questionnaire) and to employ a high index of suspicion. Patients seeking hospital admission were to be asked for all hospitals visited during the last 10 days.
- **All SARS cases were reported centrally.**
- **Toronto Public Health** followed up and **traced close contacts** of potential cases and instructed asymptomatic contacts to **observe home quarantine**, while symptomatic contacts were referred for medical assessment. (5)
- From 13th March **contact tracing** and follow-up of **airplane passengers** seated within 2 rows of a probable and later also of a suspected symptomatic case was carried out.
- From 31st March all passengers of a flight having a probable or suspect symptomatic case on board were traced. (2)
- More than 23,000 contacts were traced in Toronto area (5)
- The following **SARS screening tool was used on people (patients, staff, visitors) entering healthcare settings in Ontario**, to detect and separate out SARS cases.

Version Date: April 13, 2003

SARS Screening Tool

| | |
|--|---|
| SECTION A: | |
| 1. Have you had unprotected contact with a person with SARS in the last 10 days? OR 2. In the last ten days have you been to a health care facility that is closed due to SARS? OR 3. Are you under quarantine, or have you been contacted by public health and put on home isolation? | checkbox <input type="checkbox"/> No checkbox <input type="checkbox"/> Yes -> Quarantine applies, notify Public Health |
| SECTION B: | |
| Have you been to China, Hong Kong, Vietnam, Singapore or Taiwan in the last 10 days? | checkbox <input type="checkbox"/> No checkbox <input type="checkbox"/> Yes |
| SECTION C: Are you experiencing any of the following symptoms? | |
| Myalgia (muscle aches) OR Malaise (severe tiredness or unwell) OR Severe headache (worse than usual) OR Cough (onset within 7 days) OR Shortness of Breath (worse than what is normal for you) OR Feeling feverish, or have had a fever in the last 24 hours | checkbox <input type="checkbox"/> No checkbox <input type="checkbox"/> Yes |
| SECTION D: Please record the temperature if answer to C is yes. | |
| Temperature: _____ °C | (Is the temperature above 38°C?) checkbox <input type="checkbox"/> No checkbox <input type="checkbox"/> Yes |
| checkbox <input type="checkbox"/> PASS | a If the response is NO to all Sections A through C, then the person <u>passes</u> . a If the response is YES to only Section B, or only to Section C, then the person <u>passes</u> . Provide education materials about SARS if the answer to Section B is YES. |
| checkbox <input type="checkbox"/> FAIL | X If 2 or more of sections B, C or D are answered "YES", then the person <u>fails</u> . [A clinical evaluation, using droplet precautions, is required. If the response to A or B is yes, and the person has symptoms as in Sections C or D, then give the person a mask and direct them to an Emergency Department (not by public transportation) for this assessment. If C and D alone are positive, this assessment may take place in an outpatient setting .] |
| Interviewee: _____ Signature: _____ Date: _____ | |
| Interviewer: _____ Signature: _____ Date: _____ | |

Source: www.oma.org/phealth/sarsscreeningtool.htm

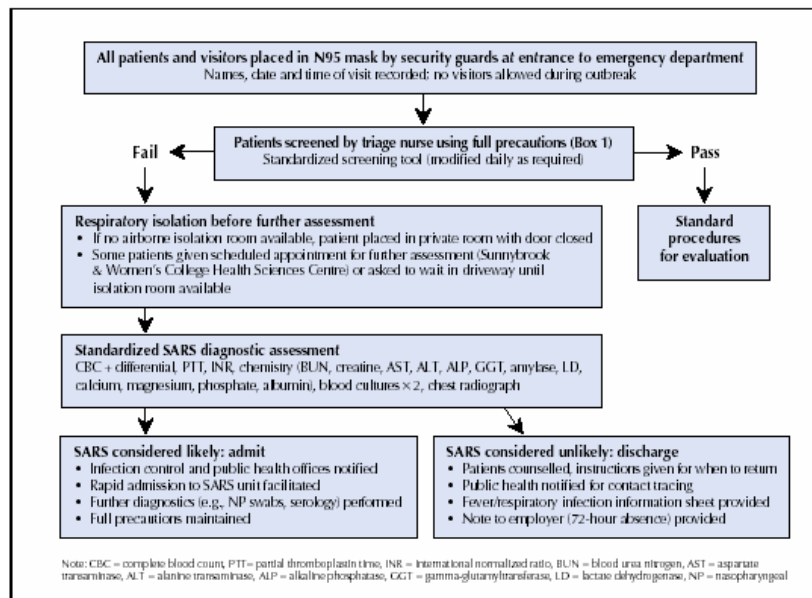
Quarantine

- People who had come in **contact with a SARS patient or a setting** where SARS had been transmitted were asked to **voluntarily observe home quarantine**. Clear instructions on the nature and procedure of the home quarantine were given. This included not leaving the home **for 10 days**, wearing a mask when other household members were present, sleep in separate rooms, measuring temperature twice daily and calling the Telehealth Hotline if symptoms develop. Household members of contacts were not quarantined. (16)
- In Toronto, due to shortage of public health staff sometimes quarantined individuals were called up only once every three days. (10)
- **Health care workers for e.g. those working in category 3** (see below) **hospitals** where local transmission had occurred were **placed under a 10 day work quarantine**. Work quarantine required all staff members to wear N95 respirators at all time while at work, practice strict hand hygiene, eat separately, commute to work in private vehicles, not enter other hospital sites and monitor their temperature twice daily, to wear a mask when public contact was unavoidable and to observe the rules of home quarantine when off work. This helped in preventing shortage of personnel. (3) (16)
- More than 13,000 SARS contacts in Toronto area were traced in time, advised quarantine and complied with the regulations. (5)

Hospital and Community containment measures

- *In Vancouver on account of the alerts **barrier precautions** were to be applied for all acute onset respiratory illnesses and hence the first case, which was admitted to hospital on 7th March, was managed accordingly, even before the WHO alert was issued on 12th March. The hospitals participated in periodic infection control audits, to be prepared for such situations. (11).*
- From 13th March droplet and contact precautions were observed by staff caring for known SARS cases. Strict **infection control measures** were **implemented** throughout **Ontario Province on 25th March**, the day the first SARS affected hospital (Scarborough) was closed. (5)(9) In early May the barrier precautions were down graded but re-instituted on 23rd May as the second SARS outbreak was recognized. (3)
- The Ontario Ministry of Health and Long Term Care required **all hospitals to be prepared and create properly equipped SARS units** for isolating and treating SARS cases, hence building capacity in multiple institutions. (10)
- The SARS units had separate ventilation systems and negative pressure rooms. The rooms were maintained at negative pressure compared to the corridors. (4)(3)
- The emergency departments involved in the assessment of SARS developed **procedures to triage patients** and thereby prevent SARS transmission. As soon as patients were identified as **suspect or probable SARS cases** they were asked to wear a surgical mask, separated from other patients and **placed in private (single) negative pressure isolation rooms in the emergency department** if possible and then sent to the designated SARS wards. (3)(8)

Emergency Department Triage process for SARS during an outbreak



Source: SARS outbreak in the Greater Toronto Area: the emergency department experience. Public Health CMAJ • NOV. 23, 2004; 171 (11) 1342-44

- Guards posted at the entrance of **emergency departments restricted entrance** to staff and patients (family members and visitors were not allowed), recorded names for contact tracing and ensured that **everyone wore a mask**. (8)
- Certain Toronto hospitals for e.g. NYGH constructed **separate SARS clinics to assess and triage patients** with SARS symptoms. They were equipped with negative pressure rooms, X-ray areas, administrative area and changing rooms for donning PPE. (3)
- Shortage of **personnel** was a major problem faced during the outbreak. Primary care physicians, infectious disease consultants, epidemiologists, public health physicians, radiologists, nurses, housekeeping staff etc. were **recruited** by the hospitals managing SARS cases.(3)
- **Physicians were trained** in SARS procedures and management. (3)
- At NYGH the infectious disease consultant was responsible for reviewing the SARS cases, advising on patient management and communicating information to the public health and outbreak management teams, i.e. had a co-ordinating role. (3)
- **Healthcare institutions were classified** on the basis of the presence of SARS cases and transmission into **4 categories**, category 0 (no SARS cases) – **category 3** institution being those where SARS transmission to HCWs had occurred through unprotected exposure. **Control measures for staff, patients and visitors were instituted according to the category of the institution. Transfer of patients** from category 2 or 3 facilities was **restricted** . (3)(15)
- The hospitals where SARS transmission occurred through unprotected exposure immediately instituted **respiratory and barrier precautions** and **closed their emergency departments and ambulatory and out patient clinics, suspended elective surgeries** and stopped admissions but remained open for hospital staff and recently discharged

- patients. **Hospital staff was not allowed to work at other institutions. Visitors were generally not allowed** in these hospitals (3)(4)(15)
- **Directives** were issued by the SARS provincial operations centre to acute care hospitals on the administrative and **infection control precautions** to be taken in **designated SARS units**. (13) Public health teams assisted the hospital staff in the implementation of these measures. (5)
 - Instructions were given to **minimize patient contact** and that patients were to wear a surgical mask at all times when anyone else was in the room.
 - Directives for performing **high risk aerosol generating procedures** like intubation and bronchoscopy were given. (13) These procedures were to be **avoided** and if necessary to be performed by a minimum number of the most experienced staff with full PPE and special respiratory filter systems in a controlled environment.(3)
 - Clear **instructions and training** was given to the **housekeeping personnel** on proper cleaning procedures on SARS units, in and outside the patient rooms, and on the use of PPE. (3)
 - **Directives to health care professionals practicing in community and outpatient settings** were issued. This included placement of SARS notices and surgical masks at entrances, asking people with cough or fever to wear masks and screening all persons with the most current SARS Screening tool (questionnaire). Patients were urged to make a prior appointment on telephone. Patients with symptoms suggestive of SARS were to be referred to the nearest Emergency Department. (14)
 - **Recovering SARS** patients who were discharged were required to either stay in **isolation at home** or in the hospital if to be discharged to a non-acute health care facility, for a period of **10 days** after resolution of fever and resolving cough. (13) **Non-SARS patients discharged home from a category 3 hospital** were to stay under **home quarantine for 10 days**, patients to be discharged to a non acute health care facility were reviewed individually for suitability. (13)
 - In all **5 schools were closed in Toronto** before the outbreak was over. (10)

Infection control measures for protection of HCWs

- **All hospital staff working in patient care areas of acute care hospitals had to wear full PPE including gowns, gloves, N95 masks and eye protection.** (13)
- In a category 3 hospital staff had to **observe full droplet and contact precautions (gowns, gloves, N95 mask or equivalent and protective eye wear)**, strict **hand washing and stay on the same hospital unit**. N95 masks and gowns had to be worn at all times in the hospital. (15)
- **Clear instructions on how to apply personal protective equipment (PPE)** prior to entering a SARS patients room and how to stepwise remove PPE on leaving the room were given. Changing rooms for staff were present outside SARS wards and a table with all required PPE was placed outside the SARS patients rooms to be worn before entering the rooms. (3)(13)
- Staff applying the SARS Screening Tool (questionnaire) had to wear N95 masks.
- During the 2nd outbreak phase the N95 masks used were to be fit-tested before use. (3)
- To avoid transmission the nursing **staff was trained** in the care of SARS patients and the proper use of PPE, general infection control practices and the risk involved for themselves

and their families. In addition they were also trained to deal with the associated psychological impact and high levels of stress. (3)

Travel related measures

- Health Canada **issued travel advisories** for affected areas, which at times were stricter than those issued by the WHO. (10)
- **From March 18th** “Health Canada” distributed **Health alert notices “Yellow Notice”** to **passengers arriving** from SARS affected areas. The notice informed on the signs and symptoms of SARS, advised to consult a physician if symptoms developed and listed key telephone numbers from where to find help. The yellow cards were also provided to inbound passengers at land border crossing between Canada and USA. (2)(19)
- As SARS transmission in Toronto was identified, in order to prevent its export **Health alert notices “Cherry Notice”** were distributed to **passengers departing** from Toronto for international destinations asking those with signs and symptoms of SARS to postpone travel. **Posters** at the airport reminded passengers to collect these notices. (2)(19)
- Later **3 questions** were **added to the yellow and cherry Health alert notices** which had to be answered by all passengers. The questions enquired about **fever**, symptoms like **cough or shortness of breath** and about having had **contact with a SARS patient** during the past 10 days. Passengers answering yes were referred to a screening nurse for further evaluation according to standard protocols. (2)(19)
- **In-flight videos** and **announcements** were made, informing about signs and symptoms of SARS and about the Yellow Health alert notices to be filled in. (19)
- SARS prevention and management protocols were also issued to cruise ships. (20)
- From 8th May **infrared thermal scanners** were used in selected areas at the Toronto International and Vancouver International Airports to detect passengers having temperatures above 38°C. (2)
- **Passengers arriving** in Canada were required to **complete a travel contact information form** informing about their location to facilitate contact tracing. (2)
- Infection control guidelines on how to take adequate protective measures were issued to air flight cabin crew staff, airport staff, airport quarantine officers and aircraft cleaning personnel and were updated as information became available. (19)

Guidance and information to the public on SARS

- A **press conference** was held on 13th March officially announcing the first SARS case in Canada. (5)
- A **SARS telephone hotline** was started on 14th March which received >300,000 calls over the passage of time. (5)
- A **SARS medical support line** and an on call Physician at the Provincial Operations Centre also provided information.
- The public community was kept informed of the SARS situation by **daily televised press conferences** and national news casts. (5)(10)
- Health Canada, the OMHLTC, and Toronto Public Health all issued regular SARS updates on their web-sites (10)

- During the SARS outbreak in **SARS Fact Sheets and information** was posted on several **web-sites** to inform the public about SARS symptoms, risk factors, home quarantine and other precautions. Fact sheets on proper hand washing and disinfecting methods were also posted. The web-sites are as follows
- Toronto Public Health: <http://www.toronto.ca/health/sars/index.htm>
- Public Health Agency of Canada: <http://www.phac-aspc.gc.ca/sars-sras/sars.html>
- Ministry of Health and Long Term Care, Ontario:
http://www.health.gov.on.ca/english/public/pub/disease/sars_2.html
- Health Canada: http://www.hc-sc.gc.ca/dc-ma/sars-sras/index_e.html
- SARS support centre: <http://www.sarssupportcentre.net>

Discussion

The SARS epidemic affected Canada's urban areas having a good infrastructure and ample health care resources, yet it tested and greatly burdened the public health and health care systems, and identified several areas requiring improvement to be better equipped for handling future outbreaks in Canada. The major issues included the improvement of surveillance mechanisms and a better co-ordination among the federal, provincial and local government levels and institutions involved in outbreak management. (10) The responsibility for communicable disease management in Ontario was decentralized and lay with local health boards in contrast to British Columbia where a central agency the BC CDC was responsible resulting in better co-ordination. (11) The preparedness of health care facilities, timely public alert and well co-ordinated response along with luck resulted in the quick containment of SARS in Vancouver. (11)

The lack of a coherent communication strategy with too many "talking heads" with sometimes divergent opinions was felt to cause confusion. In addition a need to have more experts in all fields concerned with outbreak management was felt. (10)

In spite of intensive screening activities of arriving and departing passengers, no SARS cases were detected through these measures which cost Canada around Can\$ 7.5 mill. Canada had a total of 5 imported cases none of whom had symptoms during travel. Detecting a rare disease with non-specific tools like health alert notices or thermal scanners is very unlikely and hence of limited value. (2)

References

1. Summary of probable SARS cases with onset of illness from 1 November 2002 to 31 July 2003. (Based on data as of 31 December 2003) Available at: www.who.int/csr/sars/country/table2004_04_21/en
2. St. John RK, King A, de Jong D, et al. Border screening for SARS. *Emerg Infect Dis.* 2005 Jan. Available from <http://www.cdc.gov/ncidod/EID/vol11no01/04-0835.htm>
3. Loutfy MR, Wallington T, Rutledge T, et al. Hospital preparedness and SARS. *Emerg Infect Dis.* 2004 May. Available from: <http://www.cdc.gov/ncidod/EID/vol10no5/03-0717.htm>

4. Dwosh HA, Hong HL, Austgarden D, et al. Identification and containment of an outbreak of SARS in a community hospital. *CMAJ* 2003;168(11):1415-20.
5. Svoboda T, Henry B, Schulman L, et al. Public health measures to control the spread of the severe acute respiratory syndrome during the outbreak in Toronto. *N Engl J Med* 2004;350:2352-61
6. Epidemiology, clinical presentation and laboratory investigation of severe acute respiratory syndrome (SARS) in Canada, March 2003. *Canada Communicable Disease Report*. Vol. 29-08 15 April 2003
Available at <http://www.phac-aspc.gc.ca/publicat/ccdr-rmtc/03vol29/dr2908eb.html>
7. Update: Severe Acute Respiratory Syndrome - Toronto, 2003. *Canada Communicable Disease Report*. Volume 29-13, 1 July 2003
8. SARS outbreak in the Greater Toronto Area: the emergency department experience. *Public Health CMAJ* 2004;171(11)
9. Varia M, Wilson S, Sarwal S, et al. Investigation of a nosocomial outbreak of severe acute respiratory syndrome (SARS) in Toronto, Canada. *CMAJ* 2003;169(4):285-92
10. Learning from SARS. *Renewal of Public Health in Canada*. Health Canada. A report of the National Advisory Committee on SARS and Public Health October 2003
11. Skowronski DM, Petric M, Daly P, et al. Coordinated response to SARS, Vancouver, Canada. *Emerg Infect Dis*. 2006 Jan.
Available from: <http://www.cdc.gov/ncidod/EID/vol12no01/05-0327.htm>
12. SARS: How a global epidemic was stopped. Published in 2006 by the “World Health Organization, Western Pacific Region”
13. SARS notices and directives. *Acute Care Hospitals*. Available at:
http://www.health.gov.on.ca/english/providers/program/pubhealth/sars/sars_ar.html
14. SARS notices and directives. Available at:
http://www.health.gov.on.ca/english/providers/program/pubhealth/sars/docs/dir_community_042303.pdf
15. Description of Activity for Acute Care Facilities by SARS Categories, April 14.
http://www.health.gov.on.ca/english/providers/program/pubhealth/sars/sars_ar.html
16. Toronto Public Health: <http://www.toronto.ca/health/sars/index.htm>
17. Summary of Severe Acute Respiratory Syndrome (SARS) Cases: Canada and International 18 March 2003 available at: http://www.phac-aspc.gc.ca/sars-sras/eurae/sars20030318_e.html
18. Public Health Agency Canada. www.phac-aspc.gc.ca/sars-sars-gen/fact_sheet.html
19. Public Health Agency Canada. <http://www.phac-aspc.gc.ca/sars-sras/arc-cra/index.html>
20. Public Health Agency Canada. <http://www.phac-aspc.gc.ca/sars-sras/sars.html>
21. Public Health Agency Canada. http://www.phac-aspc.gc.ca/sars-sars/sarscasedef_e.html

**Inventory of SARS control measures implemented in
countries affected by imported SARS cases**

United States of America

Facts and Figures

Date of SARS onset: 24th Feb. 2003 (1)
 Date of onset of last SARS case: 13th July 2003 (1)
 Cumulative number of cases in the USA: 27 cases (1)
 Number of deaths attributable to SARS: 0 deaths (1)
 Population of the USA: 299 million

Introduction

1,460 cases of unexplained respiratory illnesses were reported to the Centers for Disease Control and Prevention [CDC] by various state and local health departments of 41 American states and Puerto Rico, between 17th March and 30th July 2003. 27% [398] cases fulfilled the case criteria before a negative SARS test was an exclusion criterion. Of the 27 cases only 2% i.e. 8 cases were laboratory-confirmed SARS-coronavirus infections. All eight confirmed SARS case-patients had a recent history of travel, five to Hong Kong, two to Toronto and one to Singapore. Local transmission of SARS within the United States was not reported and no HCWs developed laboratory confirmed SARS infection despite of unprotected exposure to confirmed SARS cases. No SARS related deaths occurred. (2)

In the U.S. under the constitution, the individual states are responsible for public health control measures including quarantine and isolation within their borders, the CDC does not have regulatory powers to implement prevention and control measures outside the national quarantine system. (5) The CDC which acted as the leading federal agency, worked closely with state and local governments, the health care delivery industry, and other federal institutions, to inform travellers about SARS, to prepare the health care delivery system to identify, isolate and treat SARS patients, and to reassure the public. (3)

SARS Containment Strategies

Considering the few cases in the United States, tremendous efforts were made by the federal, state and local authorities to prevent the spread of SARS spread. The following list gives a brief overview of the measures undertaken.

Organizational and Administrative Measures

- On **14th March**, 2003, the U.S. Centers for Disease Control and Prevention (CDC) initiated **national surveillance activities** for SARS to identify case-patients in the United States and determine if secondary domestic transmission was occurring. (2)
- More than **800 CDC staff members were organized into 13 domestic teams** which focused on various **SARS response activities** including clinical care and infection control, epidemiology of the outbreak, diagnostics, quarantine issues, information

- management, communication, and community outreach programs providing information to special groups such as immigrants and the Asian community. (3)
- A **sensitive case definition** incorporating clinical, epidemiologic, and laboratory criteria was used for surveillance resulting in a large number of suspect cases. Initially CDC's case definition was **based on the WHO case definition** for suspect cases only, later from 29th April '03, CDC adopted WHO's suspect and probable classifications and laboratory confirmation of SARS-CoV was added. From 18th July a confirmed negative test for SARS-CoV infection was an exclusion criteria. (2)
 - On **4th April '03**, on recommendation by the Secretary of Health and Human Services and the request of the CDC, President Bush signed an **Executive Order, adding SARS to the list of reportable, communicable diseases** for which federal isolation and quarantine is authorized although public health law generally is a state function. (4)(5)
 - **CDC assisted in the international response** in areas like coordination of response, science, communications, capacity building and preparedness. 84 CDC employees from different disciplines either directly assisted SARS-affected countries in outbreak management for e.g. Taiwan-China or worked as part of the WHO-coordinated Global Outbreak Alert and Response Network. (3)(5)
 - Over 120 **CDC laboratory scientists** worked on different aspects of SARS at the national and international level, to search the pathogen responsible for SARS, to develop and validate diagnostic reagents, to examine specimens, and to provide training and technology transfer to other affected nations. (8)(5)
 - **Video conferences** between the Director General of WHO, the Secretary of Department of Health and Human Services, and the Director of CDC served as a forum for dialogue and information exchange at international level. (3)
 - A **large number of interim guidelines and documents** covering many areas like **isolation and quarantine**, transport of patients, laboratory testing, infection control etc. addressing clinicians, HCWs, patients, contacts, travellers, Americans living abroad, special groups etc. were posted on the CDC website www.cdc.gov/ncidod/sars/index.htm (8)
 - **Cases were regularly reported to the WHO.** (2)
 - A **paper-based data collection system** was used by both the health departments and CDC. Epidemiologic data was then entered at **CDC into an electronic database** along with the laboratory data. (2)
 - CDC held weekly **teleconferences with state and local health departments** to discuss and advise on surveillance and response activities. (2)
 - Diagnostic testing was initially centralized at CDC. Later, reagents for SARS-CoV antibody and nucleic acid testing were made available to state public health laboratories and the Laboratory Response Network. (2)

Case detection and contact tracing

- CDC **requested** the health departments **to report all unexplained respiratory illnesses** requiring evaluation for SARS. The health departments in turn relied on **passive reporting from clinicians.** (2)
- **Case definitions were distributed** to state and local health departments through CDC's Epidemic Information Exchange (Epi-X) network for public health professionals, and

- through the Health Alert Network. In addition they were also available on the CDC SARS website. (2)
- **Intensive laboratory investigations** of suspect cases, including nasopharyngeal swabs, PCR testing, acute and convalescent phase serum test and testing for other respiratory pathogens was undertaken. (8)
 - A **case report form** distributed through Epi-X, was used **to collect data** on demographic and clinical details and epidemiologic links. The form was updated as required. State and local health department personnel collected completed case report forms, and **determined case status in consultation with CDC. Patients who met the case definition, were added to a “line list”** which was updated daily. (2)
 - The CDC generally recommended **passive surveillance** for people who had **contact to suspect or probable SARS cases**, as well as **travellers returning from areas with SARS transmission**. They were asked to monitor their health for 10 days and seek medical attention immediately if fever or respiratory symptoms developed. (3)
 - Only **probable or laboratory confirmed SARS cases** and **high-risk close contacts** were placed under **active surveillance**, which was carried out by staff of the local or state health departments. (3)
 - Close contact was defined as having cared for or lived with a person known to have SARS or having a high likelihood of direct contact with respiratory secretions or body fluids of a patient with SARS. (2)

Quarantine

- As the United States had a limited number of suspect and confirmed cases, they relied on **“voluntary” home quarantine and isolation** to contain the outbreak.
- The U.S. CDC **only recommended quarantine for health-care workers who had a high-risk exposure to a SARS patient**, some US states also sent exposed HCWs on leave for a certain a time period. (3)
- **Fact sheet on isolation and quarantine** was posted on the CDC website. (8)

Hospital and Community containment measures

- In the United States, **most people with suspected or probable SARS were isolated at home**; hospital isolation was reserved for those who required such care or had no suitable home environment. (3) About 1/3rd of the 398 patients who met the case definition were hospitalised. (2)
- CDC recommended **suspected SARS cases to voluntarily limit interaction and stay under home isolation** until 10 days after symptoms resolved. (3)(5)
- A special 24 hr. **clinical hotline** was established for physicians inquiring about SARS. (3)
- CDC organized **specialized conference calls** with health care providers to keep them informed. (3)
- Emergency operations centers coordinated SARS response activities at the **Community level which focused on informing and educating the public** through press releases and conferences, travel alerts and advisories, meeting with communities who were experiencing stigmatisation etc. (3)

- **Infection control recommendations for SARS patients and their household contacts** included strict hand hygiene, use of disposable gloves during direct contact with SARS patients, asking SARS patients to wear a surgical mask during close contact and avoid sharing utensils, towels, and bedding. (6)
- The CDC has issued a **number of interim guidelines** for the management of SARS cases available through the CDC website. Guidelines on **infection control precautions**, for suspected SARS cases, for close contacts, for aerosol generating procedures, guidelines for **triage** of suspected SARS cases, for transporting cases, recommendations for **cleaning and disinfection**, for management of exposure to SARS in health care settings, for handling human remains, for the **workplace** and for businesses whose employees return from SARS affected areas, etc. were formulated. (8)

Infection control measures for protection of HCWs

- The CDC organized 3 SARS **video presentations broadcasted via satellite**, directed to **inform health care workers** on patient management, diagnostic testing and other health-care related issues. (3)(8)

Travel related measures

- In the United States, **CDC issued several travel alerts and advisories** for areas where evidence of documented or suspected community transmission of SARS existed. The alert was removed, when the area reported no new cases of SARS for 30 days. (2)
- Travel related SARS information including alerts and advisories were posted on the CDC's travellers health website (www.cdc.gov/travel) which recorded > 4 mill. visits during the outbreak. (7)
- 2.7 million SARS specific **yellow, health alert notices**, which asked travellers to monitor themselves for fever and respiratory symptoms for 10 days and immediately seek medical attention if the symptoms occurred, were distributed to **passengers arriving** directly and indirectly by air or ship from affected areas, over a three month period. (3) (5)
- **Health alert notices** were also distributed at 13 **land border crossings between USA and Canada**, and in the pre-departure area at the Toronto airport. (3)
- During the SARS outbreak number of **quarantine stations were increased** and 150 additional **staff were recruited** to provide information to travellers arriving from SARS-affected countries. (5)
- When **an ill passenger was reported on board a flight** arriving in the United States, it was **met by the CDC quarantine staff**, which triaged and evaluated the affected passenger for possible SARS. In addition information from the other passengers on these flights was collected to facilitate localization of contacts if needed. (3)
- Many **travel related guidelines** and updates in different languages were issued including guidance for personnel dealing with passengers arriving from SARS affected areas, for **flight crew members**, for aircraft cleaning, for cruise ship passengers and crew, for people travelling to or coming from SARS affected areas etc. (8)
- **Pre-departure screening** of passengers for temperature and SARS symptoms **was not done** in the United States. (3)

Guidance and information to the public on SARS

- At the national level, the CDC set up a **public response telephone hotline**, which answered nearly 35,000 public inquiries. (3)
- The CDC set up a **SARS information websites** with guidelines and fact sheets, which were regularly updated. More than 17 million visit to the SARS website were recorded during the outbreak. (3)(8)
- The CDC handled more than 10,000 news media calls, published 12 SARS **news releases**, provided many **in-depth interviews** and held multiple **tele-briefings and news conferences**, which were broadcast. (3)
- The CDC publication “**Morbidity and Mortality Weekly Report**” had **weekly SARS updates** and summaries from SARS affected countries throughout the epidemic. (8)

Discussion

In the U.S. the principal strategies of containment were education of high-risk populations like international travellers and health-care workers; enhanced national surveillance for early detection of suspected and probable cases; and rapid implementation of isolation and other infection control tools (3)

The communications burden faced by CDC was enormous. Information was sought for by the general public on the recent status, the travelling public on the risk and whether they should travel, the health care delivery community, federal agencies, businesses, multinational companies, media etc. The Division of Global Migration and Quarantine developed more than 125 documents including updates on travel related information and industry guidelines. As the outbreak progressed stakeholders like Americans living abroad, businesses etc. were identified and information tailored to the need of the target audience developed. (7)

CDC has developed a SARS preparedness plan for the United States and also a web-based surveillance module for SARS-CoV disease reporting. (2)

References

1. Summary of probable SARS cases with onset of illness from 1 November 2002 to 31 July 2003. (Based on data as of 31 December 2003) Available at: www.who.int/csr/sars/country/table2004_04_21/en
2. Schrag SJ, Brooks JT, Beneden CV, et al. SARS Surveillance during Emergency Public Health Response, United States, March–July 2003. *Emerg Infect Dis.* 2004 Feb. Vol.10, No.2
3. Knobler S, Mahmoud M, Lemon S, et al. Learning from SARS: preparing for the next disease outbreak. Forum on microbial threats, board of health. Institute of Medicine of the National Academies. Washington: National Academics Press;2004.
4. Executive Order No.13295. Available at : www.cdc.gov/ncidod/sars/executiveorder040403.htm

5. Rothstein MA, Alcalde GM, Elster NR, et al. Quarantine and isolation: Lessons learned from SARS. A Report to the Centers for Disease Control and Prevention Institute for Bioethics, Health Policy and Law, University of Louisville School of Medicine. November 2003
6. CDC: Interim Guidance on Infection Control Precautions for Patients with Suspected Severe Acute Respiratory Syndrome (SARS) and Close Contacts in Households <http://www.cdc.gov/ncidod/sars/ic-closecontacts.htm>
7. Arguin PM, Navin AW, Steele SF, et al. Health Communication during SARS. *Emerg InfectDis.* Feb. 2004;10:377-380.
8. Peiris M, Anderson LJ, Osterhaus A, et al. Severe Acute Respiratory Syndrome. Blackwell Publishing.

Thailand

Facts and Figures

Date of SARS onset: 11th March 2003 (1)
Date of onset of last SARS case: 27th May 2003 (1)
Cumulative number of cases: 9 cases (1)
Number of deaths attributable to SARS: 2 deaths (1)
Population of Thailand: 64.3 million

Introduction

On 11th March 2003, Dr Carlo Urbani, the WHO expert who had been handling the atypical pneumonia outbreak in Hanoi arrived in Bangkok, Thailand. The Department of Disease Control had been informed about the arrival and made arrangements for hospital admission and isolation under strict infection control precautions. Since the admission of this first case, The Ministry of Public Health (MOPH) rapidly initiated surveillance and response activities to prevent the introduction and spread of SARS. Of the hundreds of case reports received from different sources, only 34 cases matched the WHO definition of suspect and 9 of probable SARS case.

All the probable and suspect SARS cases in Thailand were imported cases. None of the contacts of these cases developed SARS, hence no local transmission occurred. Two of the nine probable SARS cases died, one was Dr Carlo Urbani, who first identified SARS and the other was an elderly man who had arrived from Hong Kong. (7)

SARS Containment Strategies

SARS control activities in Thailand focused on three main areas namely surveillance, infection control and public information. (2)

Organizational and Administrative Measures

- In mid March 2003 **the Ministry of Public Health (MOPH) set up a special task force** at Department of Disease Control (DDC) to co-ordinate the SARS control activities. (2)
- In early April, on account of the increasing workload the **SARS control management and co-ordination was put under ministerial responsibility**. An Executive Committee for response and 7 subcommittees each looking after specific tasks was set-up. In addition a larger war-room at the MOPH headquarters and a full time SARS task force were established. (2)
- The **provincial health offices set up a SARS response system**, similar to that at the national level, comprising of a co-ordinating committee and an operation centre (war room). Each province was required to establish two response teams to investigate suspect cases and their contacts, and to co-ordinate community control activities. (2)

- Thailand hosted the **ASEAN + 3 leaders meeting** on SARS in **Bangkok** on 29th April'03, resulting in a "**Joint Statement of ASEAN Leaders**" that has provided foundation for comprehensive collaborations among ASEAN member countries to fight against SARS. (2)
- **WHO** representatives and epidemiologic experts from **US Centres for Disease Control and Prevention**, worked closely with **MOPH technical staff** in several key areas, like preparation of technical guidelines, surveillance and situation monitoring, taking part in SARS war-room meetings, training of epidemiologic investigation teams and laboratory investigation. The Thailand MOPH had been collaborating for two years with the US CDC under the International Emerging Infections Program. (2)
- Information and **data from SARS surveillance and investigation were compiled, at the provincial and central levels**. The National SARS Response Centre was responsible for **reporting to the WHO** and for informing the public. (3)
- All sectors including the public were **encouraged to report suspected SARS cases within 24 hours** to the health authority incharge.(4) Later the MOPH declared SARS a **reportable communicable disease** under the Communicable Disease Act. (3)

Case detection and contact tracing

- In late March, **guidelines for national SARS surveillance, case detection and investigation** in accordance with **WHO recommendations** were developed and distributed to all **provincial health offices and health care providers**. (2)
- This resulted in **hundreds of cases being reported**. The reported suspect and probable SARS cases were investigated by trained **epidemiologic investigation teams** and contacts identified. (2)

Quarantine

- Over 1000 **contacts** of the suspect and probable cases were identified. They were asked to observe **voluntary home quarantine and kept under close surveillance for 10 days**. (2)(3)
- **Overseas students** from SARS affected areas were required to **observe a ten day home quarantine** before joining the class. (2)

Hospital and Community containment measures

- In Thailand **all public and private hospitals** were required to be **prepared** for handling and treating SARS cases, they **did not designate specific hospitals** for this purpose. (2)
- All **probable and suspect SARS cases** were to be **hospitalized under isolation**, observing stringent infection control measures. (3)
- Many probable and suspect SARS cases were detected and taken care of in **private hospitals**, which **worked alongside public hospitals to respond to SARS**. (2)
- By mid March **guidelines for case management, hospital infection control** and personal protection for medical staff were developed and distributed to all hospitals. (2)

- The task forces **arranged medical equipment and supplies** for surveillance and infection control. (2)
- The use of **high quality protective masks** in hospitals was emphasised. MOPH provided some masks to hospitals, but due to **limited supplies priority was given to staff at high risk**. Use of surgical masks was recommended other wise. (2)
- The Ministry of Education worked out **SARS surveillance and quarantine regulations to prevent SARS transmission in schools**. (2)
- A large number of **health care workers, decision makers and other staff were recruited** during the SARS outbreak at the cost of other programmes and services that had to be suspended. (2)
- **Patient transfer** was to be carried out in **ambulances applying appropriate infection control measures** before, during and after the transfer. (4)
- Special SARS information and advice **leaflets for travellers and hotel guests** informing on regulations and where to seek medical check-ups, were prepared and distributed by the SARS Operations Centre. (2)
- Information on **adoption of sanitary practices** like for e.g. regular hand washing, using a serving spoon when having meals with other people, covering mouth and nose when coughing or sneezing, using protective mask when catching cold, avoid sharing utensils, towels etc. was **distributed and posted on the website**. (4)

Infection control measures for protection of HCWs

- **Hospital staff in public and private sectors are trained and supervised** on effective management of SARS cases, and appropriate **personal protection** and hospital **infection control practices**. (3)

Travel related measures

- By mid March **arrival screening of passengers** from SARS affected areas was started at Bangkok airport and at other main **international airports and checkpoints**. (2) Since early April travellers entering the country through **sea ports and land checkpoints** were also screened. (3)
- **Health alert notices** were distributed to travellers entering the country, Thailand reported printing 1 million notices. (9)
- **Pre-departure screening of passengers** before boarding the flight in a SARS affected country was **conducted in co-operation with the airlines** along with in-flight announcements about arrival screening in Thailand. (2)
- **Residents returning to Thailand from areas with local SARS transmission** were asked to take leave and **stay home for 10 days** and limit interaction with family members and friends. If this was not possible, they were required to have a medical check-up every 3 days and obtain certification of the absence of SARS symptoms. (5) (4)
- Tourists coming from areas with recent transmission of SARS were required to wear a protective mask or undergo a medical check-up every 3 days for the first 10 days. (5)
- The Ministry of Public Health had developed a **stepwise protocol**, which required passengers coming from areas affected by SARS transmission to undergo “**Arrival Health Screening**”. This included **filling out a health questionnaire** and undergoing a

temperature check, following which a “**Health Passport**” was issued. Tourists were required to **get their health status checked every 3 days for the first 10 days** of stay, which was certified in the health passport. Passengers having a temperature of 38°C or higher were isolated and treated in hospital. (8)

- People who develop fever and cough or difficulty in breathing were asked to wear a protective mask and seek medical attention immediately and inform the doctor about their travel history. (5)(4)
- The **general public was recommended to avoid travel to SARS affected areas** as defined by the WHO. (4)

Guidance and information to the public on SARS

- The **public media continuously informed** on international SARS outbreaks and detection of suspected cases among travellers and the local population. In certain instances lack of knowledge also led to spread of incorrect news on cases and rumours. (2)
- By mid April, **the National SARS Response Centre** of the MOPH took a proactive approach and **informed the public daily through official media updates**, on the SARS situation, national response activities, updated prevention measures and travel advisories. The official media release was centralised so as to avoid confusion and panic among the population. (3)
- A **24-hour SARS telephone hotline** was established which received about 15,000 calls. (6)
- All MOPH announcements, recommendations, situation updates and technical information on SARS were also posted on **MOPH’s SARS website** (http://www-ddc.moph.go.th/SARS_center_en.html). (2)

Discussion

Surveillance of travellers was one of the major control strategies in Thailand. During the outbreak more than 300,000 travellers from areas with local transmission of SARS were screened at international airports, seaports and land checkpoints, yet only 1 probable and 3 suspect SARS cases were identified. (2)

During the early outbreak phase, lack of clear knowledge led to confusion, the local media came up with unfounded news about SARS cases occurring in several places in the country. This caused widespread confusion and panic among the people, and had considerable impact on social and public life. The proactive approach of the MOPH to deal with the media and inform the public eventually led to stabilisation of public sensitivity to the situation. (2)

References

1. Summary of probable SARS cases with onset of illness from 1 November 2002 to 31 July 2003. (Based on data as of 31 December 2003) Available at: www.who.int/csr/sars/country/table2004_04_21/en
2. Supamit Chunsuttiwat. SARS policy response in Thailand. Ministry of Public Health. Available at: http://www-ddc.moph.go.th/module/webadmin/download_module/pdf/SARS_Policy_Response.pdf
3. SARS Response in Thailand. A situation report. May 2003. Available at: http://www-ddc.moph.go.th/module/webadmin/download_module/pdf/SARS_Response_20May03.pdf
4. Announcement of the Ministry of Public Health. Subject: Severe Acute Respiratory Syndrome Outbreak. Available at: http://www-ddc.moph.go.th/module/webadmin/download_module/pdf/MOPH5_en.pdf
5. Health Advice for Travelers. Available at: http://www-ddc.moph.go.th/SARS_traveler_advice.html
6. Daily Report : 9 July 2003. Available at: http://www-ddc.moph.go.th/SARS_daily_en.html
7. BBC News. SARS: Global hotspots. Available at: <http://news.bbc.co.uk/2/hi/health/2969247.stm>
8. Arrival Health Screening for Travelers from Areas with Recent Local Transmission of SARS. Ministry of Public Health of Thailand. Available at: http://www-ddc.moph.go.th/module/webadmin/download_module/pdf/SARS_Arrival_Screening.pdf
9. Bell DM. World Health Organization Working Group on Prevention of International and Community Transmission of SARS. Public health interventions and SARS spread,2003. Emerg Infect Dis. 2004 Nov.

Malaysia

Facts and Figures

Date of SARS onset: 14th March 2003 (1)
Date of onset of last SARS case: 22nd April 2003 (1)
Cumulative number of cases: 5 cases (1)
Number of deaths attributable to SARS: 2 cases (1)
Population of Malaysia: 25.4 million

Introduction

Malaysia did not experience any local SARS transmission. A total of 5 SARS cases including 2 deaths were reported. Despite the few cases, on account of being close to SARS affected countries enormous efforts were made to prevent the entry of SARS into the country and to detect cases as early as possible. Singapore, which was affected by local SARS transmission, is separated from Malaysia only by a narrow strait and linked by a 1 km. long causeway used by 90,000 people daily.

SARS Containment Strategies

SARS control in Malaysia focused on early case detection, screening activities, contact surveillance and isolation in designated SARS hospitals. (5) The following list highlights the major control measures implemented.

Organizational and administrative measures

- The Ministry of Health, Malaysia set up a **National SARS Operations Room** on 16th March '03 for coordination of SARS management and communication related activities. (2)
- Under the Prevention and Control of Infectious Diseases Act, **all suspected or probable SARS cases, had to be notified** to the **nearest health department** immediately by phone or fax followed by a written notification. A specific **notification form** was provided for this purpose by the SARS Operations room. (2)
- Representatives from different ministries of the Malaysian government set up a “**National Committee for SARS Control**” which jointly developed policies and coordinated SARS control strategies. (5)
- The **WHO case definition was used** to identify suspect and probable SARS cases. (2)
- From 13th March surveillance activities were stepped-up. (5)
- Malaysia hosted several **ASEAN + 3 meetings** to enhance co-operation and information exchange and develop joint action plans and resolutions for SARS prevention and control. (5)
- The **Singapore-Malaysia Technical Working Group** comprising of health, immigration and other officials agreed on **bi-lateral cooperation** between the two countries. Areas of

- cooperation included measures such as pre-departure checks, contact tracing and exchange of medical information on SARS between the health ministries. (3)
- **Laboratory testing was centralised** at a high level P3 bio-safety laboratory. (5)

Case detection and contact tracing

- After **identification of a suspect or probable SARS case** a **detailed clinical, travel and contact history** including occurrence of respiratory disease in contacts during the last 10 days was to be obtained and the case notified to the state health department. (2)
- Close contacts were defined as people who cared for, lived with, or had direct contact with respiratory secretions or body fluids of a suspect or probable case of SARS. (2)

Quarantine

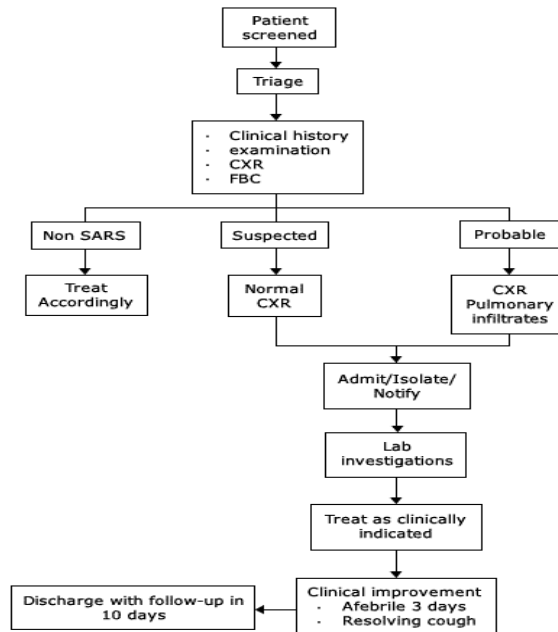
- The **contacts of probable SARS cases** were placed under **active surveillance** for 10 days and recommended **voluntary home isolation**. Active surveillance included daily telephone calls or visits by public health workers. The contacts were asked to monitor their temperature daily. (2)
- The contacts of **suspect SARS cases** were placed under **passive surveillance** and asked to inform about their condition daily to the health authority by phone call.
- **HCWs** had to observe a **10 day home quarantine** if they had **unprotected contact** with a probable SARS case before the case was diagnosed as one. (2)

Hospital and community containment measures

- Malaysia **designated 21 hospitals for the treatment of suspected or probable SARS cases**, these were generally the main government hospitals (not private hospitals) in each state. (2)(5)
- **All suspected cases and probable cases** were to be **admitted in designated SARS hospitals in isolation facilities** including negative pressure rooms, single rooms or cohort wards if several similar cases present. (2)
- **Suspected and probable SARS cases were to be separated from each other** and isolated in separate hospital wards. (5)
- Negative pressure rooms were available in many hospitals to isolate cases. (5)
- SARS cases were **not allowed** to have **visitors**. (5)
- **17 sets of guidelines were formulated for SARS prevention and control measures** in hospital and clinic settings, for HCWs, for respirator use, in educational institutions, for employers and employees, **for airlines and shipping lines**, for the tourist industry, for public transport providers etc. (5)
- **Strict barrier nursing precautions** for airborne, droplet and contact transmission were to be employed while attending to SARS patients. (2)
- **Hospitals** were required to **select a SARS staff team** of physicians and nurses, who would manage and treat SARS cases in the hospital and review SARS cases in the hospital A & E. (2)

- A special triage counter/ corner was to be set up in the A & E of all hospitals for suspected SARS patients. All patients coming to the A & E dept. were to be screened for SARS symptoms, and if **suspicion arises were to wear masks** and separated in special examination rooms for further investigation. (2)
- The following chart is a schematic representation of how patients were to be managed once identified as probable or suspect SARS cases. (2)

Flow chart for the management of SARS cases



Source: Guidelines on Hospital Management of SARS. (4th Version - 3rd April 2003, Ministry of Health, Malaysia) (2)

- **Hospital discharge criteria were formulated** according to which the patient had to be afebrile for 72 hrs, resolving cough, and improving chest x-ray and laboratory parameters. (2)
- **Convalescent patients after discharge** were asked to monitor their temperature twice daily and report back to the same hospital if fever develops. They were instructed to **stay at home for 10 days** and minimize contact. (2)
- Hospitals were to **maintain a register** with the personal details and contact dates of **HCWs who worked with the SARS patients**. HCWs were to **monitor** and note their **temperature twice daily**, if they developed fever within 1 month they were to report to the team leader incharge of the SARS staff team. (2)
- Dead bodies of SARS cases were to be handled according to the guidelines for handling HIV/AIDS bodies. (2)
- Disinfection of surfaces and spillage in hospital was recommended with sodium hypochlorite. (2)
- **Guidelines** required a **designated ambulance service** with personnel wearing full PPE, to transport SARS cases and bring discharged convalescent patients home. (2)

- The Ministry of Education issued guidelines and asked **schools to monitor their students** and staff daily, for SARS symptoms and to close for 10 days if a suspected SARS case was detected. (3)

Infection control measures for protection of HCWs

- **Staff** involved in the **triage** process was instructed to wear **gloves, N95 masks** and **wash hands** frequently. (2)
- All HCW attending to SARS cases were to follow the “**infection control policy**” **guidelines** and **receive training in the infection control practices** required for the care of SARS patients. (2)
- **Personal Protective Equipment was to be worn by all staff and visitors** entering the **isolation area**, this included N95 mask, gloves, disposable gown, apron and footwear that could be disinfected. Strict and regular hand washing was instructed. (2)

Travel related measures

- In early April the Malaysian authorities had **briefly prohibited entry of tourists from China, Hong Kong, Vietnam, Taiwan and Canada** but lifted the ban a week later.(6)
- Visitors from **China and Vietnam** before applying for a visa were required to **submit medical reports** certifying that they did not have symptoms of SARS in the past seven days. (4)
- **Entry screening using thermal scanners** was carried out at all international entry points for passengers coming from SARS affected areas. (5)
- If a passenger having SARS symptoms was reported on board, the passenger was to be referred to the airport health authorities on arrival, the other passengers and crew informed and their contact details of the subsequent 14 days obtained. (7)
- The Ministry of Health of Malaysia required airlines coming from affected countries to ensure that all passengers undergo **pre-departure screening before boarding the flight**. In addition announcements were to be made on board and passengers informed that upon arrival they will be subjected to health screening. (7)
- All **arriving passengers** had to **fill in health declaration cards** asking about the country of departure and about presence of SARS symptoms. (5)
- People coming from SARS affected areas and developing flu like symptoms or fever were advised to seek medical attention and inform the doctor about their travel history. (7)
- **Guidelines** were formulated for SARS prevention and control measures for **airlines and shipping lines**. (5)

Guidance and information to the public

- The Government also launched a **national campaign** to **provide more information** on SARS, using pamphlets, posters etc. (3)
- Both **local and foreign media and press were briefed daily by the government** on the decisions made and the measures taken to prevent and control SARS. (5)

- **Information materials on SARS** were to be provided to all who came to **clinics/hospitals**. (2)
- The Ministry of Health and the Association of Private Hospitals of Malaysia provided and updated information on SARS on their **website** <http://www.hospitals-malaysia.org/index.cfm?menuid=49>.
- The SARS Operations Room had set-up a **telephone hotline**. (2)

Discussion

The Malaysian government instituted strict visa and immigration policies for SARS affected countries. They briefly also stopped the entry of visitors from certain SARS affected areas but soon lifted the travel ban. Both Singapore and Malaysia put in place health screening measures at both ends of the causeway linking the 2 countries.

References

1. Summary of probable SARS cases with onset of illness from 1 November 2002 to 31 July 2003. (Based on data as of 31 December 2003) Available at: www.who.int/csr/sars/country/table2004_04_21/en
2. Information on Severe Acute Respiratory Syndrome (SARS). Ministry of Health Malaysia. Available at Association of Private Hospitals of Malaysia (APHM): <http://www.hospitals-malaysia.org/index.cfm?menuid=49>
3. United Nations Economic and Social Council. Health and development: Selected issues: SARS: Lessons for Public Health. E/ESCAP/CESI/6. 22 July 2003
4. Malaysia reports 7th 'probable' SARS case. [Asian Economic News](#), [May 13, 2003](#)
5. World Health Organization. Speech of Dato` Chua Jui Meng, Minister of Health, Malaysia. Available at: http://www.who.int/csr/sars/conference/june_2003/materials/presentations/meng/en/index.html
6. BBC News. SARS: Global hotspots. Available at: <http://news.bbc.co.uk/2/hi/health/2969247.stm>
7. Advisory Ministry of Health. Available at: www.2SARS/advisory.com

Australia

Facts and Figures

Date of SARS onset: 26th Feb. 2003 (1)
 Date of onset of last SARS case: 1st April 2003 (1)
 Cumulative number of cases: 6 cases (1)
 Number of deaths attributable to SARS: 0 deaths (1)
 Population of the Australia: 19 million

Introduction

The Australian states and territories reported suspicious pneumonia cases to the Australian governments Department of Health and Aging. From 17th March – 31st July 2003, 138 atypical pneumonia cases of all the reported cases were further investigated for SARS, yet only 5 probable SARS cases were identified, which were reported to the WHO. One additional case was detected by laboratory testing abroad. Australia had a total of 6 probable SARS cases all of which were imported. Three of the six cases were hospitalised. None of the 5 cases in Australia had a positive SARS serology or PCR and no local SARS transmission or SARS associated deaths occurred. (2)

SARS Containment Strategies

Australia had very few cases yet multiple measures were undertaken to be prepared for the appearance of SARS. This included development of guidelines, establishing a surveillance system and instituting different border screening activities. The following list gives a brief overview of the measures undertaken.

Organizational and Administrative Measures

- The Australian Government's Department of Health and Ageing together with the "Communicable Disease Network Australia" coordinates surveillance, prevention, management and control of communicable diseases in Australia.
- On 16th Mach'03 a "**Joint Executive Group**" comprising of members from the different states and territories of the "Communicable Disease Network Australia" (CDNA) was established, to mainly **focus on the prevention of SARS importation**. (2)
- On 28th March'03 an Australian government **interdepartmental "task-force"** for SARS was set-up. (2)
- On 4th April'03 an "**Incident Room**" was formed by the **Dept. of Health and Ageing**, which had the task of **coordinating the national public health response**. (2)
- The **SARS case definition** as issued by the **WHO** was used for labelling cases as, suspect or probable cases under investigation. (2)(7)

- The cases under investigation were excluded if an alternative diagnosis and/or response to antibiotic treatment was found. In addition some **Australia-specific exclusion criteria** were applied which included the **lack of convincing exposure** as for e.g. transit airport stay of <8 hrs. in a SARS affected area or contact with a suspect case whose **disease was mild**. (2)
- **SARS notification was made mandatory** in most jurisdictions, clinicians had to notify the local public health authorities, which in turn reported all cases to the Dept. of Health and Ageing. (2)
- **Cases were reported** by the local public health authorities to the Dept. of Health and Ageing by telephone and in form of a **nationally developed reporting questionnaire**, which was submitted by email or fax. (2)
- Cases that **met the WHO probable case definition** after investigation, **were reported to the WHO** via their website. (2)
- An Australian SARS case register recorded all probable and suspect cases and those under investigation. (3)
- The Department of Health and Ageing together with the Communicable Disease Network of Australia developed many **SARS related protocols and guidelines**, for **infection control** in health care and community settings, for **tracing and management of close contacts** of SARS cases, for **surveillance and management of possible SARS cases**, for **general practitioners** and for **travel and border screening** measures. These were updated as information became available. (7)
- Laboratory guidelines for collection and handling of suspected SARS specimens were also formulated. (7)
- As a member of the Global Alert Outbreak and Response Network, Australia participated in epidemiologic investigations, field teams and supported WHO logistic activities for a coordinated supply of protective equipment to affected areas. (8)

Case detection and contact tracing

- **Contact tracing** was undertaken for **close contacts of probable SARS cases** only and was coordinated by the CDNA. (5)(2)
- **Health authorities** of the states and territories used different mechanisms to **inform and alert health care providers about SARS**. This included directly contacting hospitals and sending health alerts to general practitioners. (2)
- A **close contact was defined** as a person who lived, worked or dealt with a SARS case coming within a metre of the case or who had direct contact with respiratory secretions of a case while not wearing personal protective equipment (PPE). (5)
- **Symptomatic close contacts** were to be **isolated for 10 days either in hospital** under respiratory isolation **or placed under active surveillance and isolation at home** if appropriate facilities like visiting nurse etc. are available. (5)
- Management of **asymptomatic close contacts** ranged from **passive surveillance for 10 days**, to **active surveillance and/or quarantine** depending upon the degree of exposure and probability of the original case actually having SARS. (5)
- Aircraft exposure to **symptomatic** case was placed under passive surveillance for 10 days. (5)

Quarantine

- **Home quarantine** was only recommended for **close contacts** when the original case had a **high probability** of actually being a **SARS case**. (5)
- **Quarantine and isolation is generally voluntary** however the governments have authority to compel quarantine to protect the public from SARS. (5)
- If health care workers had a high risk, unprotected exposure with a SARS case they were to be placed under home quarantine for 10 days with active surveillance. (5)

Hospital and Community containment measures

- **Probable and suspected SARS patients in hospital** were to be managed in a respiratory **isolation** room, while suspected or probable SARS with moderate illness could alternatively also be **managed under home isolation** if resources for surveillance were available. (5)
- The states and territories had **designated hospitals** for the assessment, management and treatment of suspect and probable SARS cases. (3) In addition **health care facilities were to identifying** and establish **respiratory isolation rooms**, according to recommendations. (6)
- **Guidelines for infection control measures to be applied in health care facilities**, by **general practitioners**, in other out patient settings and for vulnerable communities like **aged care facilities** were formulated. (2)(7)
- The infection control guidelines in health care facilities required the facilities to **identify** a competent **SARS team** for taking care of SARS patients. (6)
- Members of the SARS team were to work for one health care facility only. (6)
- Health care facilities were required to establish **protocols for surveillance of staff** that have contact with SARS cases. All workers in a SARS care team were to **record their temperature** twice daily. (6)
- **Guidelines for performing high risk** aerosol generating **procedures** like aerosolised medication etc. were issued. (6)
- **Visiting SARS patients was not allowed** and if necessary they had to wear full PPE. (6)
- Ambulance services were given **guidelines for transporting** suspect and probable SARS cases and how to disinfect the vehicle. (6)
- Suspected case were to be **discharged from hospital** preferably after being **afebrile** for 48 hours and having stopped coughing, but earlier discharge under home isolation was possible. **Convalescent cases were to remain at home for 7 days**. (6)
- **Protocols were developed for preventing the introduction of SARS into health care facilities**, like asking new admissions and patients arriving in the emergency departments targeted screening questions concerning fever, respiratory symptoms and recent travel, stopping symptomatic visitors with a history of travel to a SARS affected area from entering etc. (6)

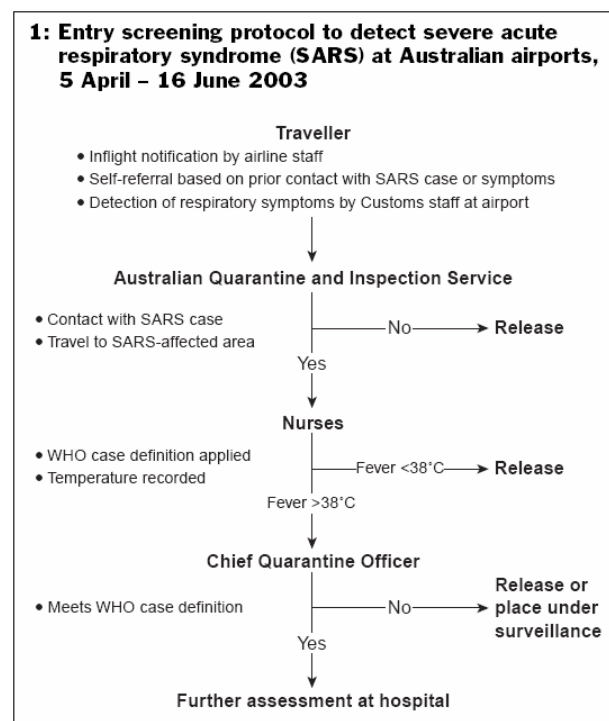
Infection control measures for protection of HCWs

- Members of the SARS team were to be **trained in SARS infection control and isolation and management** of SARS cases. (6)

- Infection control measures for staff caring for cases included hand hygiene and use of PPE including N95 masks. **Protocols on the proper use of PPE**, how to apply and remove it, were developed. (6)
- Establishing protocols for **observation of infection control practice like audits** with feedback were recommended. (6)

Travel related measures

- **Passengers arriving** at Australian airports and seaports were given **“Health Alert Notices”** informing about SARS and where to seek medical assistance if symptoms develop. (3)
- **Entry screening** of travellers at **international Australian airports** based on self-reporting and visual screening was started from 5th April’03. This was divided into 3 levels, as seen in the protocol below. Symptomatic travellers were referred to the quarantine and inspection service who in turn referred identified symptomatic passengers for clinical assessment to **nurses at the airport** (3)
- **Only symptomatic passengers underwent clinical assessment** and were checked for exposure history based on the WHO case definition, if considered suspicious the passenger was referred to the chief quarantine officer for further assessment. (3)
- **Inflight announcements** asking passengers to report SARS symptoms or history of contact were made by the airlines. (3)



Source: Border screening for SARS in Australia: what has been learnt? MJA 2004;180:220-223

- **Entry screening** was also carried out at **Australian seaports**. (3)

- From early June public health nurses at airports had to follow a standardised protocol while screening passengers and fill in a “**Quarantine nurse assessment form**”. (3)
- From mid June all arriving passengers had to complete “**Health Declaration Cards**”. (3)
- Guidelines on cleaning of passenger aircrafts were issued. (4)
- **Recommendation for air cabin crew and ship crew** on how to proceed if an ill passenger/staff is on board were issued. (4)

Guidance and information to the public on SARS

- The Commonwealth Department of Health and Ageing set-up a web site: <http://www.health.gov.au/sars.htm> informing the public on SARS related issues and affected areas etc. (4)
- For general information on SARS a telephone hotline “the **Commonwealth Government's Hotline**” was available.
- The Public media informed about the worldwide SARS situation.

Discussion

Enhanced surveillance was one of the key areas in Australia’s SARS control strategy. The Australia specific exclusion criteria were used to increase specificity as the chances were low. One study criticizes that the SARS case definition was very broad which was essential for SARS affected areas, but not specific enough for non-SARS affected countries. This is reinforced by the fact that while SARS was serologically verified in 79% of probable cases from SARS affected countries, it could only be identified in 26% of probable cases reported from non- affected countries. (2)

Need for a more uniform and streamlined electronic reporting of cases was recognized, as under reporting of cases might have occurred, along with a better communication between clinicians and public health authorities (2)

References

1. Summary of probable SARS cases with onset of illness from 1 November 2002 to 31 July 2003. (Based on data as of 31 December 2003) Available at: www.who.int/csr/sars/country/table2004_04_21/en
2. Fielding JE, Yohannes K, Vally H, Spencer JD. Severe acute respiratory syndrome surveillance in Australia. *Commun Dis Intell* 2004;28:181-186.
3. Samaan G, Patel M, Spencer J, Roberts L. Border screening for SARS in Australia: what has been learnt? *MJA* 2004;180:220-223
4. Interim Australian Infection Control Guidelines for SARS. Section 1: During Travel and at Australian Borders. Available at: <http://www.health.gov.au/internet/wcms/Publishing.nsf/Content/health-sars-guidelines-index.htm>

5. Recommendations for Tracing & Managing Contacts of SARS Cases. 22 May 2003.
Available at: <http://www.health.gov.au/internet/wcms/Publishing.nsf/Content/health-sars-guidelines-index.htm>
6. Australian Infection Control Guidelines for SARS Section 2 Health Care Facilities.
Available at: <http://www.health.gov.au/internet/wcms/Publishing.nsf/Content/health-sars-guidelines-index.htm>
7. Severe Acute Respiratory Syndrome (SARS) Guidelines and Protocols Page. Available at: <http://www.health.gov.au/internet/wcms/Publishing.nsf/Content/health-sars-guidelines-index.htm>
8. WHO: The operational response to SARS. Available at: www.who.int/csr/sars/goarn2003_4_16/en/