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Singapore's preparedness to deal with possible northern winter resurgence of SARS

Singapore was taken off the WHO list of SARS-affected areas on 31 May 03. Since mid-Jul 03, Singapore has progressively stepped down the SARS control measures in line with the improvement in the global and local SARS situation. However, an isolated SARS case occurred in Sep 03 due to non-compliance in laboratory procedures. The possibility of a resurgence of SARS in the coming northern winter is a serious one. To maintain a high level of preparedness for a recurrence of SARS, a number of measures have been put in place to strengthen Singapore's ability to prevent a SARS outbreak, to detect new cases early and to respond effectively to contain new clusters.

SARS response framework

A SARS response framework is in place to provide a clear command structure for decision making. The SARS Ministerial Committee (MC) provides policy guidance and strategic decisions. Selected Permanent Secretaries lead Crisis Management

Groups with distinct roles and responsibilities for the operational and tactical actions in the combat of SARS and they report to the SARS Executive Group (EG). A 3-level response system which corresponds to the existing level of local transmission of SARS and severity of threat to public health is in place and serves as a platform for coordinating the response measures for the various agencies.

The definition of the colour-coded alert status, known as SARS condition (SARSCON) is as follows:

- **Yellow.** No or sporadic imported cases but with no local transmissions.
- **Orange.** Local transmissions confined to close contacts in healthcare settings or households.
- **Red.** Outbreak in the community where local transmissions are no longer confined to close contacts in healthcare settings or households.

This SARSCON status correlates with the colour-coded alert status adopted by the hospitals.

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A 3-prong strategy is adopted to combat the spread of SARS: prevention, detection and effective response. Within this framework, the various measures to be implemented will be based on the SARSCON state.

At SARSCON YELLOW, the main focus is to **prevent** imported cases and detect SARS cases early. Active surveillance and enhanced protection at high risk areas in the healthcare settings underpin the prevention strategy. At the border, temperature screening of inbound visitors are instituted at all entry points. Within the healthcare setting, active surveillance of atypical pneumonia as well as fever clusters is carried out. For prevention, healthcare workers (HCWs) in high risk areas such as emergency departments and triaging areas are required to don full personal protective equipment (PPE). Workflow changes to separate febrile and non-febrile patients at hospitals, step-down facilities and primary health care clinics are enforced. Containment measures are triggered if necessary.

Moving up to SARSCON ORANGE, the focus is to **contain**. Measures that are implemented at SARSCON YELLOW will continue but additional measures will be introduced with the aim to contain the spread of SARS in Singapore as well as to prevent the export of cases. Infection control measures in healthcare institutions will be enhanced to break the local chain of transmission. Contact tracing and quarantine efforts will be stepped up. Community surveillance through daily temperature taking at workplace and school will also be instituted. Outbound screening and Not To Depart (NTD) measures will be implemented at the border checkpoints to prevent the export of cases. Health declaration will also be implemented for inbound travellers.

At SARSCON RED, the strategy is to **suppress**. More measures will be added with the aim to gain control of community spread in Singapore and prevent the export of cases. These could include selective closure of schools, foreign workers' dormitories, factories, places of mass gathering and suspension of selected public events. Contact tracing and quarantine measures will be enhanced to full capacity. NTD measures will be strictly enforced.

Prevention of SARS outbreak

At the national level, the campaign against SARS is on-going. The public is educated to adopt a healthy lifestyle so as to build body resistance, to have good personal hygiene, and to visit the doctor should they feel unwell. To ensure a high level of vigilance in healthcare institutions, regular audits on the SARS preparedness of hospitals, speciality centres, and residential step-down facilities are carried out. At SARSCON YELLOW, infection control at healthcare settings are stepped up. In high risk areas such as hospital's accident & emergency department, isolation facilities and intensive care units, HCWs handling febrile patients are required to put on N95 masks, disposable gloves and gown. This requirement is the same for isolation rooms in nursing homes. As for primary healthcare clinics, masks and gloves are required when handling patients with fever and during triage. To minimise the risk of spreading to the community, currently, each inpatient is limited to only 2 visitors out of a registered list of 4. Further restriction of hospital visitation and movement of healthcare workers between healthcare institutions would be imposed at higher SARSCON. Healthcare workers and those travelling to temperate countries were encouraged to receive influenza vaccination ahead of the northern

winter. Mandatory influenza vaccination was given to long-staying patients in nursing homes. Aside from improving public health, this would also help to limit the confusion arising from flu symptoms similar to those of SARS.

To prevent import of SARS cases into Singapore, the various measures to safeguard the land, sea and air borders are in place. Temperature screening is conducted for in-bound travellers at the checkpoints. Febrile travellers are further assessed and may be referred to hospital for further management. The single isolated case of SARS resulting from lax control in a research laboratory underscores the need to ensure the safety measures in laboratories are strictly enforced. Follow-up actions to the recommendations of the expert panel have been implemented.

Detection of SARS cases

External linkages. Singapore continues to strengthen the linkages with international health organisations and other health authorities, and has enhanced the external surveillance for SARS and other infectious disease outbreaks.

Medical surveillance system. For patients who come down with SARS at the hospitals, the strategy is to detect them early, isolate them from others to prevent the spread of the disease, and ensure that the disease is contained by protecting the HCWs who are caring for them. A revised fever cluster surveillance system for SARS was implemented in public and private acute hospitals, nursing homes, chronic sick hospitals, community hospitals and hospices since Aug 03. This system comprises surveillance and investigations into inpatients with atypical pneumonia, unexplained fevers for more than 72 hrs with relevant

travel history, sudden unexplained deaths with acute respiratory symptoms, and fever clusters among healthcare staff and inpatients in hospitals.

Infectious disease alert and clinical database.

A new IT infrastructure is being rolled out to support the surveillance and management of SARS and other infectious diseases. Known as the Infectious Disease Alert and Clinical Database, the system allows online interface between Ministry of Health (MOH) and the public hospitals for timely and accurate collation of epidemiological findings, clinical data as well as laboratory results. This will facilitate swift decision making at the Ministry and hospital level.

Effective response

Graduated operations response system. To ensure an effective response system, all the agencies have put in place their own contingency plans. Exercises and audits have also been carried out to ensure a high level of preparedness going into the northern winter months. During SARSCON YELLOW, the medical operations response system comprising surveillance and operations control staff will manage the key functions of the system. Depending on the SARSCON level and threat assessment, additional manpower resources from within MOH would be called in to meet a surge requirement. Likewise, the various Crisis Management Groups under the direction of the MC and EG may be stood up to mount a national level response.

Containing the spread of SARS. In the last SARS outbreak in Singapore from Mar to May 03, HCWs and close family contacts formed the two major groups of SARS cases. Research also suggested that early isolation of cases would drastically cut down

the number of secondary transmissions. Hence the critical factor in containing an outbreak is the early detection and isolation of the infected patient, and the generation of a complete list of close contacts who are then put on home quarantine. Extra cautions are applied to immunocompromised patients who tend to have atypical presentations of the disease.

Hospital containment strategies. To contain a SARS outbreak in Singapore, three separate hospital containment strategies have been used successfully. These are: hospital closure, ring fencing and transfer of an exposed group to a designated SARS hospital, and management of the exposed cohort. Supporting this containment strategy are the strict enforcement of the proper use of PPE, the restrictions of movement of HCWs and patients, and the close monitoring of discharged patients from SARS affected wards. In this way, the intra-hospital transmission of SARS is contained and the risk of HCWs transmitting the infection to their family and the community is minimised. Since the last outbreak, all hospitals have either built up or developed contingency plans for additional isolation rooms. At the national level, a new isolation centre, Communicable Disease Centre 2, with 39 isolation beds and 18 ICU beds has been built beside Tan Tock Seng Hospital (TTSH). TTSH/CDC2 has been nominated as the SARS hospital to isolate and contain an outbreak when the situation requires.

Contact tracing system. A system for contact tracing has been put in place through the establishment of a contact tracing centre within MOH. The contact tracing centre will undertake all community contact tracing and coordinate and assist in the contact tracing efforts undertaken by the hospitals and government bodies. It also informs foreign governments on the movement out of Singapore of their na-

tionals who are possible close contacts. In SARSCON ORANGE, a skeletal staff man the contact tracing centre, but contingency plans are in place to call in at short notice trained contact tracers from within MOH and other ministries to augment the contact tracing centre. The objective is to be able to complete the contact tracing of all identified cases within 24 hours.

Quarantine system. MOH centrally manages all matters related to the conduct of quarantine operations which encompass the issue and enforcement of Home Quarantine Orders (HQOs), phone surveillance, ambulance services, HQO allowances, appeal board and alternate housing facilities for those on home quarantine. The HQO is a measure to minimise the risk of the spread of SARS to the community. Persons on HQO are well and therefore not infectious. They are however at risk of becoming ill with SARS due to prior close contact with a SARS patient. Close monitoring of those on HQO for early signs of SARS, including twice-daily temperature taking, is carried out by officers designated by MOH. If they develop a fever, an ambulance will be sent immediately to fetch them to TTSH/CDC2 for a medical evaluation and for treatment if necessary. This will break the chain of transmission and control the spread of SARS.

IT support. The SARS IT infrastructure is intended to provide the MOH and other agencies with the ability to access integrated information to all SARS cases in Singapore in a timely fashion. For medical surveillance, there is the Infectious Disease Alert and Clinical Database System which integrates critical clinical, laboratory and contact tracing information on SARS. In addition, the Health Check System allows health-care professionals in hospitals and clinics to identify patients who may have been exposed to

SARS. It also provides customized advisories for precautionary measures as well as follow-up actions to be taken. For contact tracing and quarantine operations, the Contact Tracing System is in place to capture SARS cases, contact history and HQO status. This in turn allows speedier generation of the HQO report, contact listings, and listings for external agencies automatically. An e-Quarantine Management System (eQMS) has also been developed for the better management of processing and enforcement of HQO by Commercial and Industrial Security Corporation of Singapore (CISCO), the executive agent for HQO. The eQMS also facilitates the data exchange between MOH and CISCO.

Medical and logistics resources. MOH has stock-piled up to 6 months of critical medical supplies

such as PPE items. An emergency procurement system to support the preparedness for outbreaks of SARS and new infectious disease has been established.

Conclusion

Singapore is committed to combat SARS in order to safeguard the country, its neighbours and the rest of the world. The strategy of prevention, early detection and effective response has worked in containing and eventually eradicating SARS during the last outbreak. By maintaining a high level of vigilance in the high risk areas, and a high level of preparedness to step up all the containment measures, Singapore is ready to meet the possible resurgence of SARS.

Incubation period of severe acute respiratory syndrome in Singapore

Severe acute respiratory syndrome (SARS) is a novel emerging infectious disease, which rapidly spread worldwide in 2003. The aetiological agent is the SARS-coronavirus, and its main mode of transmission is through close contact via the respiratory droplets of a symptomatic infected person. As there is no known effective treatment or vaccine, the only effective method of control is early identification and isolation of cases and their contacts. A critical parameter needed for these activities is the incubation period; ie. interval between exposure and onset of ill-

ness, as this is the duration that contacts must be kept under observation, isolation or quarantine. Based on available data, WHO has stated that the incubation period is usually 2 to 7 days with a maximum of 10 days.

In Singapore, the main components of the control measure to contain SARS are identification and isolation of symptomatic cases early, quarantine (for a period of 10 days) of contacts exposed to a patient with SARS, and prevention of imported cases. Using the WHO case definition, a total of 238 cases of probable SARS were reported in Singapore.

To determine the incubation period of the Singapore SARS cases, the individual records of these reported cases were examined.

Results

Fifty cases reported a single and specific close contact history, prior to onset of symptoms, with a person who had been diagnosed with SARS. The median age of this sample was 42 years (range 22 years – 84 years) and 56% were females.

Of these 50 cases, 15 had contact with a SARS patient during a hospital visit at a known date. Another 20 cases involved healthcare workers who were infected while looking after or treating undiagnosed SARS patients at a specific date. The other 15 cases were infected outside healthcare settings.

The incubation period, calculated from the date of exposure to onset of symptoms, is shown in *Fig. 1*. As expected, the distribution of incubation periods

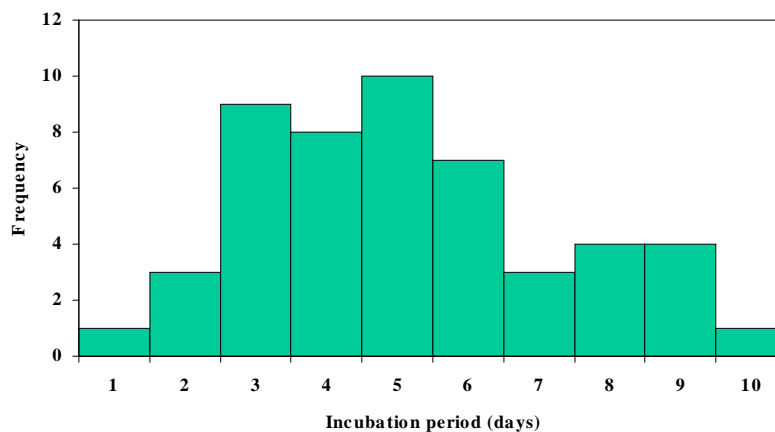
showed a positive skew. The mean (SD) and median incubation periods were estimated to be 5.1 (2.2) and 5 days, respectively. The 95th percentile of incubation periods was 9 days. All incubation periods were within 10 days.

Comments

Although the calculation of incubation period was based on a specific and single date of contact, the recall-bias of each individual case cannot be ruled out. The definition of onset of symptoms could also vary from person to person. However, data from Singapore, Hong Kong and Canada showed that most SARS patients presented with typical clinical features with a sudden onset of high fever.

The estimated incubation period of SARS cases in Singapore corresponds closely with that of findings in Hong Kong and Canada and is also consistent with that of WHO.

Figure 1
Incubation period based on point exposures to probable cases of SARS, Singapore, 2003 (n=50)



[Based on an unpublished paper by Ma S[†], Chen M^{*}, Leo Y S^{*} and Chew S K^{*}, Epidemiology and Disease Control Division, Ministry of Health[†], and Communicable Disease Centre, Tan Tock Seng Hospital^{*}]

**Cases of specified notifiable diseases, Republic of Singapore,
December 2003**

Diseases	Month ending			Cumulative, first 53 weeks		
	03 Jan 04	28 Dec 02	Median 1998-02	2003	2002	Median 1998-02
Cholera	1	0	0	2	2	10
Plague	0	0	0	0	0	0
Yellow fever	0	0	0	0	0	0
Chickenpox	1286	2317	1983	15270	27144	26596
Dengue						
a) Dengue fever	368	338	119	4785	3937	2366
b) Dengue haemorrhagic fever	1	0	0	3	8	10
Diphtheria	0	0	0	0	0	0
Enteric fevers						
a) Typhoid fever	4	3	3	32	47	56
b) Paratyphoid fever	1	2	1	9	27	23
Leprosy	0	0	1	2	8	18
Malaria	9	11	13	118	175	266
Poliomyelitis	0	0	0	0	0	0
Venereal diseases						
a) Chancroid	3	1	2	29	24	27
b) Gonorrhoea	217	132	132	2041	1896	1800
c) Non-specific urethritis	195	126	124	1933	1728	1538
d) Syphilis						
i) Infectious	21	17	17	212	189	159
ii) Non-infectious	52	48	59	644	573	803
AIDS	14	15	15	143	146	143
Tuberculosis	192	166	174	2134	2068	2274
Viral hepatitis						
a) Hepatitis A	4	7	5	52	236	88
b) Hepatitis B	4	3	10	49	64	117
c) Others	2	3	2	8	23	19
Viral encephalitis	1	0	0	17	17	15
Measles	5	2	3	31	57	65
Mumps	69	56	115	873	1091	1399
Rubella	10	7	12	88	152	242
Hand, foot and mouth disease	1144	245	-	5605	16228	-
Legionellosis	2	4	-	45	40	-
Nipah virus infection	0	0	-	0	0	-
Severe acute respiratory syndrome*	0	-	-	239#	-	-

* notifiable as from 17 March 2003.

additional probable SARS cases due to retrospective reclassification.

The data in this Bulletin are provisional, based on reports to the Communicable Diseases Division, Ministry of Health and the Department of Clinical Epidemiology, Tan Tock Seng Hospital. Any comments or questions should be addressed to:

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