

Pandemic Preparedness in Singapore: Lessons Drawn From SARS (2003) and H1N1 (2009)

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Abstract

In the past two decades (2000-2020), Singapore has experienced two epidemics, as well as the global COVID-19 pandemic. The severe acute respiratory syndrome (SARS) outbreak in 2003 was the first and a most intense communicable disease challenge to the country, highlighting Singapore's lack of epidemic preparedness. Following the SARS outbreak, the Ministry of Health (MOH) drafted the National Influenza Pandemic Preparedness and Response Plan (PPRP), introducing the Disease Outbreak Response System (DORS). In 2009, the influenza A (H1N1) outbreak required the plan to be implemented for the first time. This report outlines Singapore's response to the SARS and H1N1 epidemics. It discusses the epidemiology of the outbreaks, measures employed, and lessons that were adopted from SARS and applied to H1N1. Suggestions to refine strategies for future pandemics are raised. Considering the current COVID-19 crisis, such reflection on lessons drawn from these two epidemics can prove useful in evaluating the sufficiency of Singapore's pandemic preparedness efforts.

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Introduction

In the past two decades (2000–2020), Singapore has experienced two epidemics, prior to the Covid-19 pandemic of 2020. The severe acute respiratory syndrome (SARS) outbreak in 2003 presented the most severe communicable disease challenge to the public health system, the government, and the people of Singapore, and thus served as a wake-up call regarding Singapore's lack of epidemic preparedness. The first case of SARS was reported on 1 March 2003 and the last case was isolated on 11 May 2003. During the outbreak, a total of 238 cases and 33 deaths were reported. In the process, a new ministerial committee was also formed for effective command, control, and coordination systems that ensured strategies and decisions were properly implemented. Many stringent control measures were introduced, profoundly affecting the healthcare system and the community. Moreover, new information technology (IT) systems were developed, greatly facilitating the isolation, contact tracing, and quarantine of affected individuals. During the mitigation phase, more measures such as the stockpiling of medications and personal protective equipment (PPE) were taken.

Following the SARS outbreak, the Ministry of Health (MOH) put in place the National Influenza Pandemic Preparedness and Response Plan, introducing the Disease Outbreak Response System (DORS). 6 years later, the influenza A (H1N1) outbreak challenged this very system. The first local imported case of H1N1 was detected on 26 May 2009 from a Singaporean who had returned from New York City. However, the virus was not contained. The first unlinked case was detected on 18 June 2009, indicating that a community transmission of H1N1 had begun locally. An estimated 415,000 people were infected with the H1N1 and at least 18 fatalities were reported in Singapore.

As this report is being written, Singapore is facing her third epidemic of the Coronavirus Disease 2019 (COVID-19). Singapore diagnosed its first case of COVID-19 from a tourist from Wuhan, on 23 January 2020. As of 19 May 2020, the number of confirmed COVID-19 has reached 28,794 cases, of which 9,835 have recovered and 22 have died. This report aims to understand the epidemiology of SARS and H1N1 and address the learning lessons that were adopted from SARS and applied to H1N1. Such information can be applied to the current COVID-19 situation or future outbreaks. Moreover, suggestions of what can be done better are also explored.

Epidemiology and Clinical Characteristics of SARS, H1N1 and COVID-19

SARS was predominantly a nosocomial infection. At the start of the Singapore outbreak, of the 13 SARS cases notified to the MOH, 7 were healthcare workers (HCWs). Out of the 206 probable cases diagnosed clinically, 155 (78%), including 84 HCWs, had been acquired in hospital. SARS is deemed not highly infectious with an average of 2 to 4 cases stemming from 1 primary case. In Singapore, 5 “super-spreaders” were thought to account directly for infection to 121 of the 206 probable SARS cases. The major clinical symptoms associated with infection include a high persistent fever sometimes associated with chills and rigors, muscle aches, malaise, headache and dry coughing.^{1,2} Other reported symptoms include diarrhoea, nausea and vomiting. Upon infection, the incubation period varies between 2 to 10 days. A review by

Donnelly et al. (2003) found that patients are usually admitted to the hospital 3-5 days after presenting symptoms.³ However, clinical presentation of SARS can be broad and non-specific. Such atypical presentation made early identification of SARS difficult and was a major factor contributing to the continued propagation of the epidemic locally.

H1N1 is highly transmissible, mainly via respiratory droplets and direct contact with nasal or throat secretions. Cases of H1N1 are difficult to contain as individuals infected with the H1N1 virus can spread the disease to others even while asymptomatic, unlike SARS. However, when symptomatic, patients can suffer from fever, coughing and breathing difficulties, muscle aches and headaches.⁴ A South Korean study found that patients who develop pneumonia from a H1N1 infection also experience coughing and wheezing, difficulty breathing, while patients who do not develop pneumonia were more likely to experience nasal obstruction.⁵ In children, similar symptoms are observed, including sore throat, nasal discharge, abdominal pain and diarrhoea.⁶ Of the 1301 confirmed cases reported from 27 May to 9 July 2009, 36% were imported, while 64% arose from local transmission. A large number of H1N1 patients were under 30 years of age, while less than 1% of patients were 60 years and above, in contrast to seasonal influenza. H1N1 thus presented a threat to younger members of the population.⁷

Clinical progression of COVID-19 appears similar to SARS; patients develop pneumonia around the end of the first week to the beginning of the second week of illness. In a study done on 788 confirmed cases at the National Centre for Infectious Diseases (NCID), the median age was found to be 34 years of age.⁸ COVID-19 infection has a broader spectrum of severity ranging from asymptomatic to severe illness requiring mechanical ventilation. Many patients presented to primary care clinics with common and mild symptoms such as dry cough, sore throat, low-grade fever, or malaise, before worsening conditions several days later triggered attendance at hospital emergency departments.

Measures Following SARS

The SARS outbreak in Singapore sounded alarm bells for the local government, with a disruption to Singapore's economy and society.⁹ A number of measures were put in place after SARS and are relevant to the subsequent H1N1 outbreak. During the mitigation phase of the SARS epidemic, several IT infrastructural developments were part of the arsenal of novel surveillance measures put in place by the MOH. Several systems were implemented, such as the Infectious Disease Alert and Clinical Database System, the Health Check System, the Contact Tracing System and e-Quarantine Management System.¹⁰ Following the SARS period, the MOH also established a more extensive surveillance process, consisting community, laboratory, veterinary, external, and hospital surveillance.¹¹

The 2004 outbreak of avian influenza A (H5N1) in neighbouring regions drove the Singapore Government to plan extensively for an influenza pandemic, should it hit the country's shores.¹² This national strategy was drafted in the National Influenza Pandemic Preparedness and Response Plan (PPRP), conceptualised in 2004 and 2005.¹³ The plan aimed to achieve three goals: (a) keep morbidity and mortality low via suitable medical and healthcare measures, (b) reduce the spread of influenza to control the surge on healthcare services, and (c) maintain

essential services to minimize social and economic impact. The PPRP was implemented in a real-life scenario for the first time during the H1N1 pandemic in 2009.¹⁴

The DORS Condition (DORSCON) framework was introduced as a key component of the PPRP. The DORS comprises 5 colour-coded levels, corresponding to appropriate healthcare, border control, and community measures. Each DORS level was pegged to the World Health Organization's (WHO) Alert Phases, and thus to the transmissibility of the virus.¹⁵ The Singapore Government has also carried out drills simulating a pandemic to test the PPRP. These include Exercise Sparrowhawk II in July 2006, a two-day nation-wide simulation exercise to test healthcare and border control preparedness; Exercise Gateway in November 2006, as well as Exercise Raffles II in the latter half of 2008, exploring non-pharmaceutical response measures, as well as testing the financial sector's response to a pandemic for two-weeks.^{16, 17} Such nation-wide exercises served helpful for healthcare institutions to refine operational plans in the case of an influenza pandemic.¹⁸ Finally, as part of pharmaceutical response measures, the Singapore Government began stockpiling antiviral drugs such as Oseltamivir, vaccines, and PPE for frontline healthcare workers such as gowns, gloves, and masks.^{19, 20, 21}

The SARS Experience and Preparedness for H1N1

Singapore, being an open and globalised city-state, is vulnerable to global infectious outbreaks.²² In the event of a pandemic, it is imperative for the Singapore Government to act effectively in a coordinated manner to ensure that the spread of the disease is kept under control. Singapore has been through two epidemics in the past and is currently facing its third. Valuable lessons can be drawn from the experience of each outbreak and are useful in preparation for future epidemics.

In this section, we review various public health measures undertaken by the nation to combat SARS in 2003 and how the SARS experience allowed Singapore to prepare for the H1N1 outbreak in 2009. Table 1 shows a summary of these measures.

Table 1: Summary of measures implemented during the SARS and H1N1 outbreaks in Singapore.

	Measures implemented during SARS	Measures implemented during H1N1
1	Ministerial Committee by MHA	Home-front Crisis Management System for Influenza (HCMC-FLU) by MOH
2	3-level SARS response framework	Disease Outbreak Response System Condition (DORSCON) framework
3	“All-in-one” Approach	“One-In-All” approach
4	“Wide-net” Surveillance, Isolation and Quarantine Policy	Policy had limited impact on the containment of infectious diseases which are transmitted by asymptomatic individuals
5	Healthcare sector Infection Control Measures	Stringent infection control measures were implemented in all healthcare settings Used soft-handed and hard-handed approaches
6	Physical Distancing	Continued strict physical distancing
7	Temperature Monitoring	Continued strict temperature monitoring
8	Public Education and Communication	Continued with the presentation of one monolithic voice to the media

1. Coordinated Control and Command of Responses

To combat the outbreak of SARS, Singapore formed a three-tiered ministerial committee on SARS on 7th April 2003.²³ Having a strong control structure allowed the committee to have oversight of the changing situation. Committee members could then introduce appropriate measures to contain the outbreak, oversee operational response plans as well as provide guidance for policy making. Firstly, the Inter-Ministerial Committee (IMC) was spearheaded by the Minister for Home Affairs.²⁴ This committee served to design policies, approve key decisions, and mitigate the spread of the virus. Secondly, the Core Executive Group (CEG), led by the Permanent Secretary of Home Affairs, was tasked to allocate key medical resources to different areas. Lastly, the Inter-Ministry SARS Operations Committee (IMOC) coordinated interactions between the MOH and healthcare workers and led health control measures planned by the IMC. Under the effective leadership, strong coordination, and strategic plans by this three-tiered taskforce, Singapore was able to quickly manage and contain the SARS epidemic.

During H1N1, this three-tiered command taskforce was adjusted to suit a pandemic situation that was more unpredictable and evolved at a quicker pace. This led to the establishment of the Home-front Crisis Management System (HCMS).²⁵ Like the IMC, the HCMS was also key in providing political guidance during the H1N1 pandemic. The CEG and IMOC established

during SARS were combined to form the Home-front Crisis Executive Group (HCEG) to speed up their response time to the pandemic.²⁶ This revised command taskforce allowed Singapore to respond more rapidly while coordinating the implementation of health measures across different hospitals. During H1N1, the MOH also created a committee of policy makers, medical doctors and infectious disease and public health experts. This committee was key in carrying out measures to mitigate the spread of the virus while overseeing the allocation of medical resources.

2. Disease outbreak response system

During the SARS outbreak, a three-level, colour-coded SARS response framework was formalised. This framework serves as a guide to coordinate response measures for different sectors of society. The various alert levels were - Yellow (no or sparse imported cases, no local transmission), Orange (transmission is confined to close contacts in households or healthcare settings), and Red (community transmission where cases are not confined to households or healthcare settings). The SARS alert level was Orange during the outbreak, whereby efforts were focused on containing the outbreak.²⁷

For the outbreak of H1N1, the Singapore Government implemented the Disease Outbreak Response System Condition (DORSCON) framework for the first time. There were five distinct DORSCON alert levels, each pegged to the WHO alert levels - Green (isolated animal-to-human spread), Yellow (inefficient human-to-human transmission), Orange (larger clusters but transmission is localised), Red (community transmission occurs), and Black (community transmission occurs with high rates of severe disease and deaths). During H1N1, the pandemic influenza alert was raised from 3 to 4, to 5 by the WHO and the MOH also changed the DORSCON levels from Green to Yellow, and to Orange respectively, from 27 to 30 April 2009.^{28, 29} These levels corresponded to the implementation of healthcare controls such as the use of the full PPE in all patient contact areas, H1N1 as a notifiable disease, contact tracing and Quarantine Orders (QOs) for all confirmed and suspected cases, and visitor restrictions in hospitals.³⁰

3. Management of Infected Cases

During SARS, Singapore managed infected cases with an “All-in One” approach. All suspected individuals with SARS were isolated in TTSH.³¹ Through strong support between the public and private hospitals and clinics, clinicians at TTSH were able to divert crucial medical resources to focus on treating SARS cases. This allowed the clinicians to develop specialised knowledge in the management of these patients. Patients who were uninfected with the virus were relocated to the remaining public and private hospitals to ensure resources at TTSH remained concentrated. The “All-in-One” Approach thus allowed Singapore to contain the spread of SARS effectively.

During H1N1, the “All-in One” approach was revised to the “One-in-All” approach as characteristics of H1N1 were different from that of SARS.³² Infected individuals can spread

the disease to others even when asymptomatic and hence diverting resources to only one or a small handful institutions would not be effective in stemming the spread of H1N1. To reduce the spread of H1N1, a strict, standardised measure to manage H1N1 cases was implemented in all hospitals and clinics. Through strong cooperation between healthcare providers and the public, a triage system was carried out. Confirmed cases of H1N1 were immediately isolated and quarantined. Contact tracing centres were set up to track confirmed and suspected cases. Additionally, suspected cases were issued QOs and provided with Oseltamivir as a precautionary measure. To financially support these individuals who are serving quarantine, Singapore sought the support of non-governmental organisations.³³ Through this comprehensive approach as well as the cooperation from various healthcare providers, Singapore was able to mitigate the spread of H1N1.

4. “Wide-net” Surveillance, Isolation and Quarantine Policy

The outbreak of SARS in 2003 shocked nations globally due to the unknown nature and experience combating this strain of virus.³⁴ Thus, countries worldwide lacked the expertise and measures to enforce surveillance and identification of SARS. However, with the aid of WHO, the MOH designed measures to expedite its surveillance measures. Singapore expanded on the definition utilised by WHO for SARS-infected individuals for early detection. On 24th April 2003, it became mandatory for SARS cases to be reported to MOH to facilitate surveillance. The establishment of a contact tracing centre and issuance of QOs allowed the swift isolation of suspected SARS cases. Through this policy, Singapore was able to reduce the lag time between the presentation of symptoms and isolation of individuals from 7 to 2 days. Although this policy led to a large number of individuals being quarantined without carrying the virus, it allowed Singapore to be vigilant and effectively contain the spread of SARS.

It is important to note that this “Wide-net” Surveillance, Isolation and Quarantine Policy had a limited impact on an outbreak with characteristics like H1N1. Individuals stricken with H1N1 can potentially spread the virus to their close contacts without displaying any symptoms.^{35, 36} Thus, despite carrying the virus, these individuals will potentially be missed even with “Wide-net” surveillance as they do not display the defined symptoms. Thus, during the outbreak of H1N1, this surveillance system played a limited role in containment. Thankfully, the coordination between HCWs locally and internationally allowed the MOH to obtain key information about H1N1, allowing Singapore to manage the virus more effectively.

5. Healthcare Sector Infection Control Measures

The need for stringent measures to minimize transmission within healthcare settings was recognised during the SARS outbreak. The MOH enforced the use of PPEs for all HCWs.³⁷ Restrictions were also placed on movement with HCWs in public hospitals. Visitors were advised against entering high-risk areas of the hospital. To ensure a high level of compliance, the MOH conducted regular audits alongside usual internal audits.³⁸ However, these strict measures were enforced earliest in TTSH, but not in a number of healthcare settings until 8

April 2003. This delay led to intra-hospital infections in institutions such as TTSH, SGH and NUH but was quickly brought under control with continued enforcement of controls.³⁹ The last date on which a HCW was recorded to be infected with SARS was 13 April 2003.⁴⁰

From this experience, these infection control measures were enforced across all healthcare settings during the H1N1 outbreak in 2009. Using a combination of soft-handed and hard-handed approaches, the MOH worked to limit the transmission of H1N1 within the healthcare sector.⁴¹ Examples of soft-handed approaches included reminders of HCWs' social responsibility to minimise transmission risk. Hard-handed approaches saw the movement of HCWs between hospitals strictly controlled. The only HCWs who were allowed to move between hospitals were those performing essential services. For patients, movements were restricted to medical transfers only. Visitor numbers were minimised and their particulars were recorded for contact tracing purposes.

6. Strict Physical Distancing

During SARS, physical distancing measures were carried out to reduce the risk of transmission of the virus. Lessons at pre-schools, tuition centres, primary and secondary schools as well as junior colleges were halted for two weeks.⁴² Students who had infected family members were also quarantined at home for 10 days. Additionally, leave-of-absence (LOA) was issued to students who visited SARS-affected countries. Furthermore, various e-learning programmes were introduced by the Ministry of Education (MOE) to ensure learning is not disrupted and co-curricular activities (CCAs) were suspended. Suspected individuals and their close contacts were issued QOs and isolated in public hospitals. Local contacts would be quarantined at home while foreigners would be isolated in different government isolation facilities. Meanwhile, senior doctors were given the authority to issue compulsory quarantine orders.

Similar physical distancing practices were carried out during the H1N1 outbreak.⁴³ During the containment period, there were 148 class closures from June to August 2009 to break the chain of transmission. Students who had visited affected countries were similarly issued LOA. During the mitigation period, businesses were advised to implement measures such as remote working or splitting their team into smaller groups at the workplace.⁴⁴ Individuals who had a higher risk of being infected with the virus were also transferred from front-line work to other departments for safety. Like SARS, the approach of issuing QOs for individuals infected with the H1N1 virus was implemented to control the spread of the virus. To financially support individuals affected by these quarantine orders, a Home Quarantine Order Allowance Scheme was drawn out. Social support services such as housing, technological devices and ambulance transport services were also provided.

7. Strict Daily Temperature Monitoring

During the outbreak of SARS, HCWs were mandated to undergo thrice-daily temperature monitoring as a fever is a symptom of SARS. This was initially rolled out only in TTSH, but subsequently expanded to all other hospitals. Individuals who were quarantined were also

expected to monitor their temperature and would be immediately transferred to TTSH for isolation should they develop a fever. Twice-daily temperature monitoring was carried out in all schools during the SARS pandemic.⁴⁵ Additionally, thermal thermometers were designed by the Defence Science and Technology Agency (DSTA) to screen individuals at points of entry into Singapore.⁴⁶ Despite these efforts, temperature monitoring in schools, airports and seaports did not detect any SARS cases. This helped to reassure members of the public that institutions and communities were safe.

Similarly, temperature monitoring measures were also implemented during the outbreak of H1N1. Students were required to monitor their temperature frequently. Passengers entering Singapore had their temperatures checked through thermal scanners and were required to complete a Health Declaration Card (HDC). Furthermore, Health Alert Notices (HANs) were issued to these individuals to instruct them to monitor their temperature and be aware of the symptoms of H1N1.⁴⁷ These control measures at the airport were effective in sieving out 25% of the nation's H1N1 cases. However, unlike SARS, the measure of temperature monitoring is noted to have a reduced effectiveness as individuals stricken with H1N1 can transmit the virus to their close contacts even in the asymptomatic phase of infection. Despite this, temperature monitoring still helped to raise the awareness of the H1N1 pandemic and the importance of monitoring oneself.

8. Public Education and Communication

To allay fears and quickly dispel the spread of any misinformation, the government made communications with the public timely and transparent during SARS. Updated information was relayed to the public through every possible channel, with the purpose of educating and reassuring the public. On 13 March 2003, the WHO issued a global alert concerning SARS. The same day, a government information channel was created to provide timely updates.⁴⁸ A new television channel named "SARS Channel" was set up and MOH also took to purchasing advertising space in local newspapers.^{49, 50} The information broadcasted included the symptoms and transmission of SARS, strategies employed by the government in efforts to contain the spread, reminders of each individual's social responsibility, and what one could do and who to contact if they were concerned. Popular television channels Channel 8 and Channel U also hosted live call-in forums in local dialects such as Hokkien and Teochew to reach a wider audience, especially the elderly who were familiar with these dialects.⁵¹ A study conducted in 2004 showed that in general, the public had a high opinion of how the crisis was handled. More than 80% reported that the official information was "accurate, clear, sufficient and trustworthy".⁵²

During the SARS crisis, a single representative from MOH provided information to the media. Similarly, this key component was maintained during the H1N1 outbreak - a single monolithic voice conveyed information from the authorities to the public.⁵³ Throughout both outbreaks, MOH worked closely with the media to deliver unambiguous messages that assured the public, preventing panic. The same strategy of public education was continued - information on how to minimise the risk of contraction and transmission, reminders to wash hands and take one's

temperature regularly, as well as how to identify symptoms of influenza were widely publicised.

Applications to COVID-19

The improvement of measures implemented during the H1N1 outbreak from those carried out during SARS have proven to be effective. Considering the current global COVID-19 pandemic and outbreak in Singapore, lessons learnt from SARS in 2003 and H1N1 in 2009 can similarly be adapted to the present crisis. To elaborate, the Singapore Government has adopted a “whole-of-government” response to the COVID-19 pandemic, forming a Multi-Ministry Taskforce (MTF) early on.^{54,55} This is similar to that of H1N1. Border controls such as temperature taking, Health Declaration Alert Notices and Quarantine Orders were also elevated in January 2020, as has been done for both SARS and H1N1.^{56,57,58} Such controls possibly help to keep the number of imported cases low - imperative for a global pandemic. Physical distancing was strictly enforced by law during the COVID-19 outbreak in Singapore, with the clinical characteristics of infected persons being that they are infectious even when asymptomatic.⁵⁹ Notably, public education and communication was aggressively stepped up during the COVID-19 pandemic period, with the Singapore Government using multiple online social media platforms to broadcast public health advisories. A great number of infographics and online resources were made available to residents to allow them to keep abreast of fast-evolving policies at the time.⁶⁰

At the time of writing, the fight against COVID-19 continues. In light of the measures that have been implemented by the Singapore Government in the early stages of the local COVID-19 outbreak, we suggest two ways in which interventions can be adjusted.

Suggestion 1: Substituting “Social Distancing” with “Physical/Safe Distancing”

In the early stages of the COVID-19 pandemic, Singapore adopted the term “*social distancing*” on social media to encourage citizens to keep a distance from one another to contain the spread of the outbreak. However, in several press conferences, ministers started to use the term “*physical/safe distancing*” instead, with the realisation that the term “social distancing” could be a double-edged sword. Although “social distancing” correctly implies staying at least 6 feet away from others, it can also be interpreted as the avoidance of social connections. “Social distancing”, when implied literally, may lead some people to socially isolate, potentially causing further stress and impairing their bodies’ immune system, which may cause further burden on healthcare. Differentiating “physical distancing” from “social distancing” propagates the notion of the virus’s malignant ability to be transmitted through physical contact without the unwanted concept of social isolation. The use of appropriate terminology in the case of COVID-19 is also important considering its prolonged nature as a global pandemic, whereby elevated distancing measures would have to be carried out for a longer period of time. Social isolation in such a context can have unintended consequences. As such, Singapore

should name its national strategy as “physical/safe distancing” rather than “social distancing” and emphasize the need for human connection.

Suggestion 2: Revised DORSCON Scale

As mentioned previously, the DORSCON framework was conceptualised to coordinate response measures undertaken by different sectors of society during an infectious disease outbreak. With the DORSCON system decoupled from the WHO alert levels in H1N1 in 2009, the Singapore Government is in full control of the declaration of DORSCON alert levels. The DORSCON framework serves only as a guide and needs to be reviewed in the face of any new infectious agent, taking into account its epidemiology and clinical characteristics.

Currently, the Singapore Government is reluctant to change its DORSCON alert level from Orange to Red. Singapore remains in DORSCON Orange because the outbreak has not reached an uncontrollable phase and contact tracing is still possible.⁶¹ However, the government introduced “Circuit Breaker” measures in an attempt to contain the virus. The Circuit Breaker, which consists of elevated social distancing measures that discourage citizens from having gatherings and are required to work from home if they are not in essential services, are in fact measures to be taken during DORSCON Red. Therefore, to address this grey area between the DORSCON alert level and the corresponding interventions taken, we propose a revision in the DORSCON scale, adding more levels to achieve a more comprehensive system. The current DORSCON framework is shown in Figure 1. Our proposed framework is shown in Table 2. In the revised DORSCON scale, a new colour-coded alert level of Blue is added, where measures are adopted from alert level Yellow. Measures in alert level Yellow are adopted from Orange. DORSCON Orange includes new temporary measures and a change of terms from “social distancing” to “physical/safe distancing”.

Figure 1: Current DORSCON alert levels, as of July 2020. Source: Gov.sg.⁶²

	GREEN	YELLOW	ORANGE	RED
Nature of Disease	Disease is mild OR Disease is severe but does not spread easily from person to person (e.g. MERS, H7N9)	Disease is severe and spreads easily from person to person but is occurring outside Singapore. OR Disease is spreading in Singapore but is (a) Typically mild i.e only slightly more severe than seasonal influenza. Could be severe in vulnerable groups. (e.g. H1N1 pandemic) OR (b) being contained	Disease is severe AND spreads easily from person to person, but disease has not spread widely in Singapore and is being contained (e.g. SARS experience in Singapore)	Disease is severe AND is spreading widely
Impact on Daily Life	Minimal disruption e.g. border screening, travel advice	Minimal disruption e.g. additional measures at border and/or healthcare settings expected, higher work and school absenteeism likely	Moderate disruption e.g. quarantine, temperature screening, visitor restrictions at hospitals	Major disruption e.g. school closures, work from home orders, significant number of deaths.
Advice to Public	<ul style="list-style-type: none"> • Be socially responsible: if you are sick, stay at home • Maintain good personal hygiene • Look out for health advisories 	<ul style="list-style-type: none"> • Be socially responsible: if you are sick, stay at home • Maintain good personal hygiene • Look out for health advisories 	<ul style="list-style-type: none"> • Be socially responsible: if you are sick, stay at home • Maintain good personal hygiene • Look out for health advisories • Comply with control measures 	<ul style="list-style-type: none"> • Be socially responsible: if you are sick, stay at home • Maintain good personal hygiene • Look out for health advisories • Comply with control measures • Practise social distancing: avoid crowded areas

Table 2: Proposed revised DORSCON Scale, with additional alert level Blue.

Colour	Nature of Disease	Impact on Daily Life	Advice to Public
Green Level 0	This is a situation where the public health threat to Singapore is low because there are no novel influenza virus outbreaks anywhere in the world.	No disruption e.g. border screening, travel advice.	Be socially responsible. If you are sick, stay home. Maintain good personal hygiene. Look out for health advisories.
Green Level 1	Disease is mild <u>AND</u> does not spread easily.	Minimal disruption e.g. border screening, travel advice.	Be socially responsible. If you are sick, stay home. Maintain good personal hygiene. Look out for health advisories.
Blue	Disease is severe and spreads easily from person to person but is occurring outside Singapore. <u>OR</u> Disease is spreading in Singapore but is (a) typically mild i.e. only slightly more severe than seasonal influenza. Could be severe in vulnerable groups (e.g. H1N1 pandemic) OR (b) being controlled.	Minimal disruption e.g. additional measures at border and/or healthcare settings expected, higher work and school absenteeism likely.	Be socially responsible. If you are sick, stay home. Maintain good personal hygiene. Look out for health advisories.
Yellow	Disease is severe <u>AND</u> spreads easily from person to person, but disease has not spread widely in Singapore and is being contained (e.g. SARS experience in Singapore).	Moderate disruption e.g. quarantine temperature screening, visitor restriction at hospitals.	Be socially responsible. If you are sick, stay home. Maintain good personal hygiene. Look out for health advisories. Comply with control measures.

Orange	Disease is severe <u>AND</u> spreads easily from person to person, but disease has not spread widely in Singapore and is being contained (e.g. SARS experience in Singapore) BUT cases of infection are high (e.g. COVID-19 experience in Singapore).	Temporary major disruption e.g. school closures, work from home orders, certain number of deaths.	Be socially responsible. If you are sick, stay home. Maintain good personal hygiene. Look out for health advisories. Comply with control measures. Practise physical/safe distancing: avoid crowded areas.
Red	Disease is Severe <u>AND</u> is spreading widely.	Major disruption e.g. school closures, work from home orders, significant number of deaths.	Be socially responsible. If you are sick, stay home. Maintain good personal hygiene. Look out for health advisories. Comply with control measures. Practise physical/safe distancing: avoid crowded areas.
Black	Morbidity and mortality rates are exceedingly high, and emergency measures are needed to bring the situation under control. The healthcare and other social support systems are overwhelmed by the pandemic. Economic activities are severely disrupted, as panic sweeps through the community.	Full disruption. Suspension of all public gatherings, school and Institutes of Higher Learning (IHL) closures.	Maintain good personal hygiene. Look out for health advisories. Comply with control measures. Advisory to the public to stay home or even consider imposing curfew.

Conclusion

The rapid containment of the 2003 SARS outbreak involved the unprecedented introduction of multiple stringent control measures. Each of these controls had a profound and wide-ranging impact on the healthcare system and the local community. The disruptions to normal life, business, and social interactions associated with the implementation of these measures were generally well-accepted by the community, in the interest of containing the outbreak. Singapore's effective response to the 2009 H1N1 pandemic, founded on the experience in managing SARS, saw a whole-of-government approach towards pandemic preparedness planning. Although Singapore has experienced two epidemics before COVID-19, measures are constantly revised to adapt to novel characteristics of each outbreak. It is evident from novel and unprecedented interventions during the COVID-19 pandemic period that the Singapore government acknowledges the need to understand the nature of each outbreak and the relative value of different management strategies to inform decisions in the face of emerging epidemics. Therefore, suggestions provided aim to more comprehensively cover different types of outbreaks and situations in time to come.

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