

## COVID-19 and Singapore: From Early Response to Circuit Breaker

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### Abstract

Singapore, an island country with 5.6 million population and a large volume of tourists from mainland China, was one of the first countries to report imported COVID-19 cases and had the highest number of cases outside mainland China for a time in February 2020. The government responded with a series of broadscale public health measures and managed to contain this first wave of infection. Notwithstanding that, an evolving pandemic situation in other countries eventually triggered a second, and much larger, wave of infection. This case study narrates the developments, influencing factors, and outcomes related to events starting from Singapore's first response to COVID-19 and up to the point of its entry into Circuit Breaker. It serves as a reference for the understanding and analysis of developments in an evolving pandemic and a nation's response from a systems level perspective.

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**Key words:** Containment, Coronavirus, Epidemic, Outbreak, Pandemic

### Background

The COVID-19 pandemic first broke out in Wuhan, China, in December 2019, where a cluster of pneumonia cases was reported and the novel coronavirus later identified. Since then, the virus has spread rapidly across the world, registering a total of 85000 reported cases across 53 countries/territories by 29 February 2020, and more than 10 million cases across over 200 countries/territories by 30 June 2020.<sup>1</sup> Singapore is more than 2,500 kilometres from the southwest of mainland China (where Wuhan is situated), but received a large number of Chinese visitors with more than 400 flights between Singapore and mainland China per week. With

the emergence of COVID-19 cases in Wuhan a few weeks before the Chinese New Year, during which large numbers of Chinese were expected to travel, Singapore instituted a series of broadscale public health measures to contain importation and spread of the virus. Singapore was one of the first countries to report imported cases and had the highest number of cases outside mainland China for a time from 5 February 2020. However, the rise in cases plateaued towards the end of February.<sup>2</sup>

This case study traces the developments in the early weeks of COVID-19 spread in Singapore, the government's response, and containment of this first wave. It also describes the events and incremental

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measures taken in the lead-up to a second, and much larger, wave of infections that followed.

### The COVID-19 Situation in Singapore (23 January to 29 February 2020)

Singapore reported its first imported case on 23 January and registered an initial rise in imported cases in the last week of that month. The first Singaporean case was reported on 31 January, and Singapore's first locally transmitted cluster was confirmed on 4 February.<sup>3,4</sup> Early imported cases gave way gradually to locally transmitted cases. There were 5 clusters in Singapore by mid-February, 4 of which were linked to importations (Fig. 1).

As the number of new cases increased, recovered patients were, at the same time, being discharged from the hospitals. The national response in this earlier stage enabled the number of discharges to keep up with that of new admissions, so that the number of patients requiring hospital care at any one time remained manageable. The number of new admissions accelerated slightly in mid-February, disturbing this equilibrium, but levelled out again towards the end of that month.

### How did Singapore Respond

#### *Whole-of-Government Response*

Learning from the SARS experience, in 2003, that an outbreak response necessitated coordinated response across sectors, the government set up a multi-ministry task force on 22 January to oversee the national response to COVID-19. It comprised members across multiple ministries, including health, trade, communications, manpower, and transport.<sup>5</sup>

After the SARS experience, the government developed a disease outbreak response plan with response levels correlating with the WHO Pandemic Alert Response system.<sup>6</sup> The colour-coded “Disease Outbreak Response System Condition” (DORSCON) levels incorporated progressive degrees of border controls, community-based measures, infection control in hospitals, and other containment/mitigation measures. This raised awareness nation-wide, and facilitated a coordinated response, across sectors, to varying stages of infectious disease spread. On 7 February, with the discovery of several cases of COVID-19 with no links to previous cases or travel history to China, Singapore raised the DORSCON level to orange.<sup>7</sup>

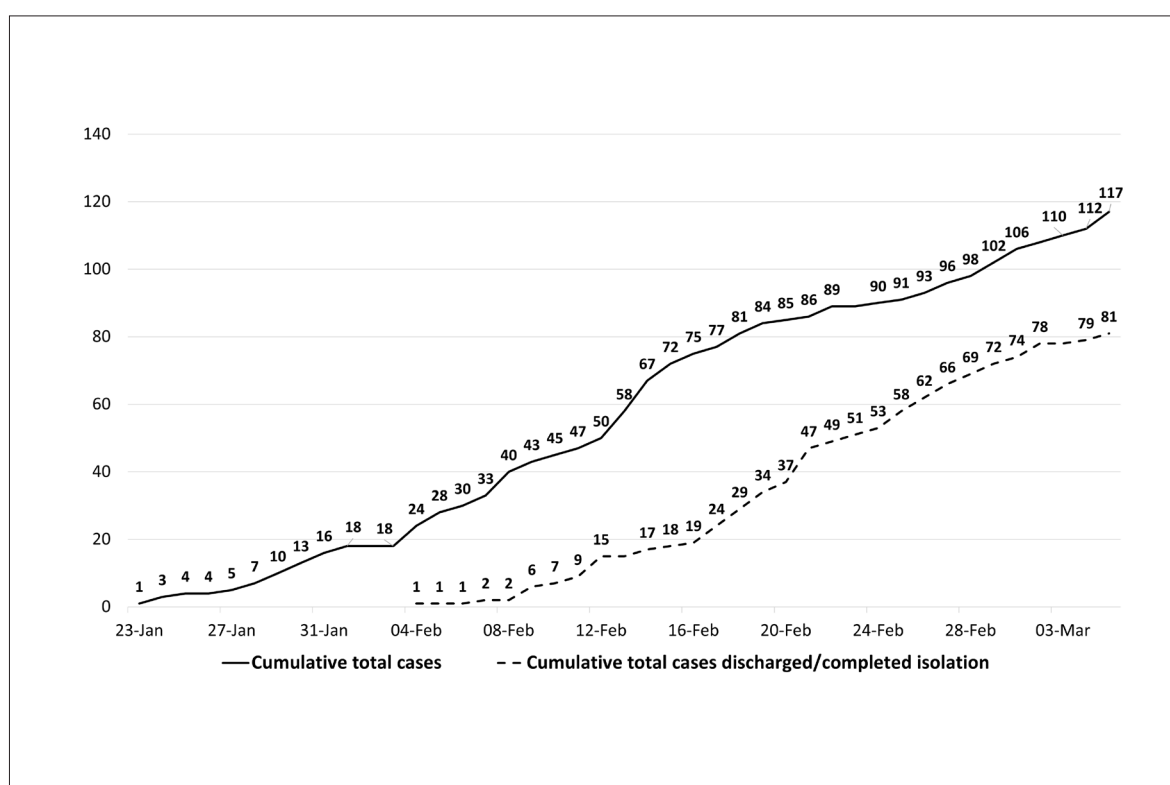


Figure 1. Total COVID-19 Cases in Singapore (as of 5 March 2020)

Data source: [www.moh.gov.sg](http://www.moh.gov.sg) and Channel News Asia

### Border Controls

Considering the volume of visitors from China into Singapore, border control measures were introduced promptly to prevent importation of the disease into the country.

As early as 2 January, temperature screening and issuance of health advisory notices were instituted for travellers on inbound flights from Wuhan. This was later extended to inbound flights from China, land and sea checkpoints, and all flights into Singapore (Fig. 2). Concurrently, travel advisories were issued to Singaporeans to avoid travelling to Hubei. Travellers from Hubei and mainland China were denied entry into, or transit through, Singapore from 29 January and 1 February, respectively. Travellers from Hubei already in Singapore and returning travellers from Hubei had to undergo mandatory quarantine. Subsequently, a

reduction in imported cases was observed and there were no reported importations from 9 February to 4 March.<sup>2,8,9</sup>

Travel restrictions were progressively adjusted as the epidemic situation in China evolved, and the source epidemic extended to secondary infections outside of Wuhan. Towards the end of February, as the disease spread moved to a stage where third generation sources were based at, and travelling from, countries outside China, denial of entry or transit was extended to travellers from Daegu and Cheongdo, South Korea.

### Contact Tracing, Detection, and Quarantine/Isolation

Alongside border control measures, rapid testing, isolation of cases, contact tracing, and quarantine of suspect cases were initiated and scaled up to identify and separate infected individuals from the larger

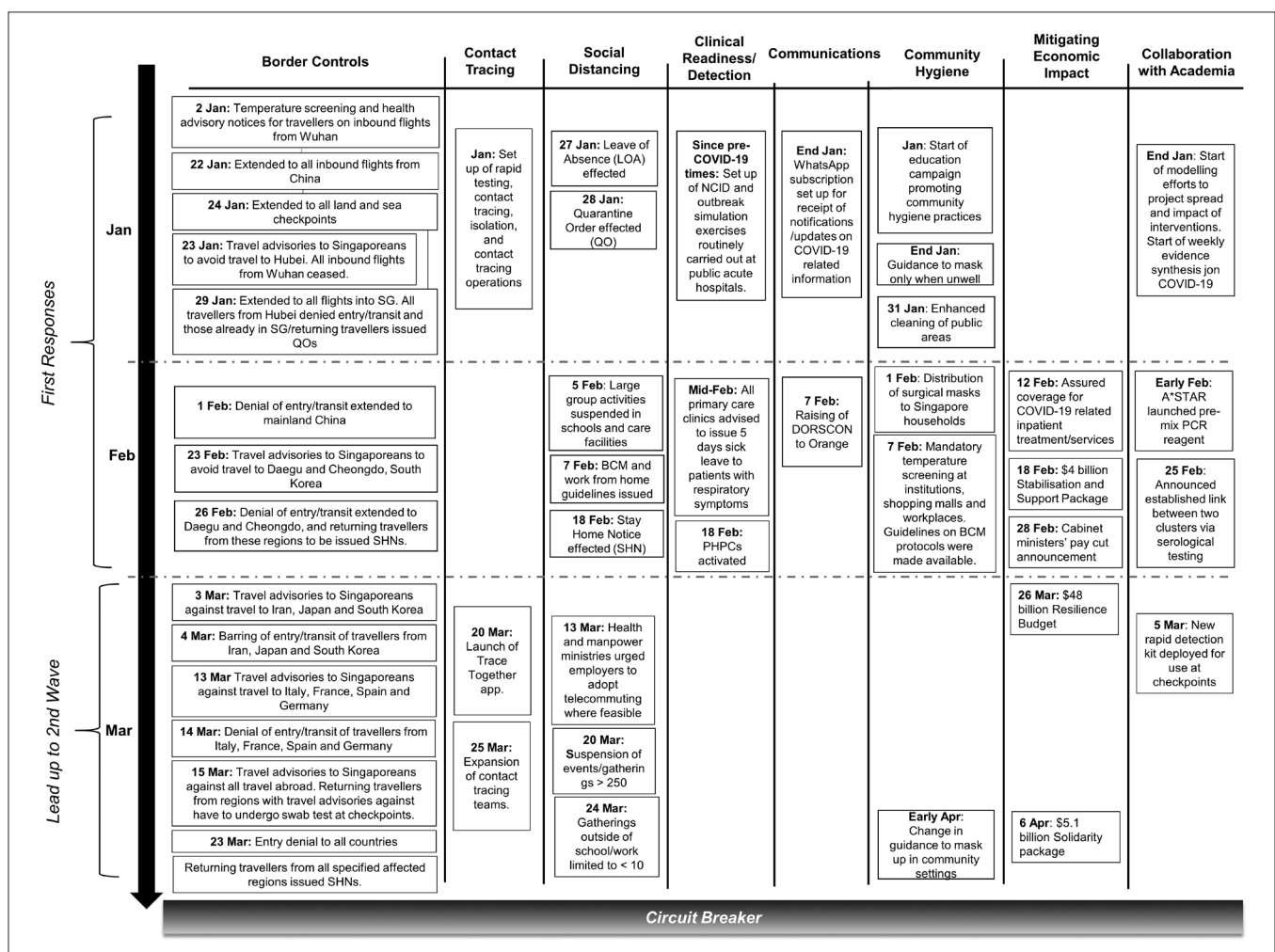


Figure 2. Key Events/Measure in Singapore's Response to the COVID-19 Pandemic (1 January to 6 April 2020)

community. Once an infected case was confirmed, contact tracers would interview the patient and map out his/her history of movements over the last 14 days. The contact tracing team under the Ministry of Health (MOH), then comprising communicable diseases and epidemiology experts, and volunteers from across various government departments/agencies, worked in 3 teams of 10 persons, 2 shifts a day, and 7 days a week, to identify close contacts of confirmed cases. Close contacts with COVID-19 symptoms were isolated and tested, while those without symptoms were quarantined up to 14 days from the date of last contact with the confirmed case.

MOH worked in partnership with the Singapore Police Force to track down contacts that could not be reached or whose identities were not known. Analytic tools helped pick out common keywords from different patients' activity logs and flagged out possible links between cases for further investigation through interviews, ground inquiries, activity mapping, and use of flight manifests and CCTV footages. Through cross referencing of attendee lists, the team also uncovered a possible link between 2 local clusters to a Chinese New Year gathering. The link was confirmed through serological testing (see section on "Collaboration with Academia and Research").<sup>10–12</sup>

Through rapid, meticulous and thorough contact tracing, strong detection capacity was achieved. As at 16 March, 40% of confirmed cases were detected via contact tracing while they were still asymptomatic.<sup>13,14</sup>

### *Mandatory Social Distancing*

Concurrently, 14-day mandatory social distancing, in varying levels of severity, depending on the risk profile of a suspected infection case, was effected (Table 1).

Legal enforcement of these orders was strong, with a permanent resident losing his status and barred from re-entering Singapore after breaching SHN, and a couple from China charged under the Infectious Diseases Act for breaching QO and providing untrue information to MOH for contact tracing.<sup>15,16</sup>

Financial assistance was also provided to residents and work-pass holders serving social distancing orders, to alleviate concerns regarding impact on livelihood which could prevent close contacts from coming forward.<sup>17,18</sup>

### *Clinical Readiness and Response*

The 2003 SARS experience, marked by a disproportionate impact from nosocomial outbreaks, was deeply etched in the national collective consciousness and that of the healthcare sector.<sup>13,19</sup> This translated into a culture and practice of readiness for future outbreaks in the pre-COVID-19 years. The National Centre for Infectious Diseases (NCID), a 330-bed purpose-built facility designed to strengthen Singapore's capabilities in infectious disease management and prevention, was officially opened in September 2019. Since 2014, all public acute hospitals had also been undergoing national simulation exercises of outbreak situations to train for pandemic preparedness and the expansion of isolation capacity.<sup>20</sup>

Table 1. Mandatory Social Distancing Measures

Measure	Date Effected	Description
Leave of absence (LOA)	27 January 2020	A precautionary measure to prevent the possible transmission of infections. Those on LOA should stay at home, minimise contact with other people in the home, and monitor their health closely. They may leave home briefly to get meals and necessities.
Stay home notice (SHN)	18 February 2020	Stricter than the LOA, but one can stay with one's family members. Those on SHN must remain in their place of residence at all times during the SHN period and avoid interaction with other people in the home. (SHN was effected when it was found that some persons issued with LOA had continued to go out of their homes regularly and infected a number of new cases as a result.)
Quarantine order (QO)	28 January 2020	Issued to suspect cases and requiring isolation from other people in the home, or in a suitable government facility. A quarantine order is a directive with legal force. It has severe penalties for non-compliance. (Eg, from 1 to 17 February, travellers from Hubei already in Singapore and close contacts of confirmed cases were issued QOs, while returning travellers from mainland China were issued LOAs.)

Source: <https://www.gov.sg/article/everything-you-need-to-know-about-the-stay-home-notice> and <https://www.gov.sg/article/whats-the-difference-between-a-leave-of-absence-and-a-quarantine-order>

Public Health Preparedness Clinics (PHPCs) had been registered and prepared to be activated during public health emergencies to perform roles such as dispensing medications, administering vaccinations, and triaging or supporting the acute care hospitals. PHPCs were activated from 18 February to work alongside public primary care polyclinics to better detect and manage COVID-19 infections. These clinics, some of which had been routinely swabbing patients with influenza-like illness as part of regular sentinel surveillance, started including COVID-19 among the tests to detect community transmission.<sup>21</sup> PHPCs also provided subsidised treatment, investigations and medications to patients with respiratory symptoms, and were guided on the risk assessment protocols for referrals to hospitals for diagnosis.<sup>22,23</sup>

From around mid-February, PHPCs and all primary care practitioners were advised to issue 5 days of mandatory sick leave to patients with respiratory symptoms to stay at home. While this helped to filter out non-COVID-19 cases (the symptoms of which would resolve after 5 days), it also effected social distancing.<sup>24</sup>

### *Financing*

On 12 February, the government provided assurance that coverage for COVID-19 related inpatient treatment and services would be extended to all patients.<sup>25</sup> On the same day, Singapore's insurance associations issued a joint statement confirming member companies' provision of coverage for COVID-19 related hospitalisation expenses under their policies. These early assurances addressed concerns on financial affordability and reduced potential barriers to infected persons coming forward.<sup>26</sup>

### *Communication Strategies*

Throughout the period, frequent press briefings and public announcements were made by ministers and even the Prime Minister on the COVID-19 pandemic developments.

Apart from updates on policies and new measures, these communications prepared the public on what to expect in the weeks and months ahead, and urged them to make the necessary behavioural changes (hand hygiene practices, social distancing etc), to inhibit spread in the community. At critical junctures, the Prime Minister would address the nation.<sup>27</sup> Concurrently, a central source of information via WhatsApp subscription was set up from which notifications on new COVID-19 updates could be received directly from the government.

With misinformation typically rampant in epidemics and leading to substantial public anxiety,<sup>28</sup> the government

made special efforts to counter fake news. Clarifications on inaccurate news were frequently posted on the government's website and conveyed through traditional media. Correction directions under Singapore's Protection from Online Falsehoods and Manipulation Act (POFMA) required parties communicating falsehoods to put up clarification notices or be subject to fines/imprisonment. Several POFMA correction directions were issued to online sites for dissemination of inaccurate COVID-19 related information during the period.<sup>29–33</sup>

Risk communications, however, did not take place without challenges and miscalculations in retrospect. For example, the announcement of the raising of DORSCON to orange sparked an episode of panic buying of groceries in the supermarkets. The Prime Minister assured the public that Singapore had sufficient stock of necessities in his address to the nation the day after, and purchase limits per person were subsequently imposed by the country's largest supermarket chain to prevent unnecessary panic buying.<sup>27,34</sup> An explanation of what the various DORSCON levels meant and entailed prior to the announcement might have prevented the panic buying episode. Since the raising of DORSCON to orange on 7 February, no subsequent references or changes to DORSCON had been made, even as the severity of the situation improved and then intensified beyond February's levels.

### *Community Hygiene and Infection Control*

The broader communications strategy also involved a national campaign advocating social responsibility and precautionary hygiene measures. Personal/hand hygiene instructions and socially responsible behaviour were communicated through posters and comics island-wide via newspapers or at strategic locations (eg lift lobby areas, common commute points). Local celebrities further advocated for them on social and traditional media (Fig. 3.)

As public education with a participatory approach tends to encourage voluntary compliance with community hygiene measures,<sup>35–37</sup> the government took pains to address community feedback. For example, from January to March, because the evidence for facemask use at the population level was uncertain (largely due to high variability in proper use and compliance), the limited supplies had to be prioritised for healthcare workers, and there was as yet no widespread community transmission, the national guidance was to don masks only when one was feeling unwell. This prompted public concern, followed by several rounds of explanation by ministers





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relevant information that could inform policymaking. The School conducted rapid and weekly evidence synthesis on the key topics of vaccines, diagnostics, therapeutics, clinical characteristics and containment measures to support the government.<sup>51</sup>

On diagnostics and surveillance, the Agency for Science, Technology and Research launched a pre-mix PCR reagent which could reduce laboratory test time by 30%.<sup>52,53</sup> A rapid detection kit launched by a biotechnology company was used to test travellers entering Singapore with COVID-19 like symptoms.<sup>54</sup> The use of new serological testing from the Duke-NUS Medical School, which uses antibody tests and is able to confirm earlier infection in asymptomatic persons, also helped uncover a missing link between 2 clusters in late February.<sup>55</sup> Such collaborative efforts facilitated the mounting of a scientific and evidence-guided national response.

### Enabling Factors

After the broadscale implementation of measures, the number of newly reported cases started to decline from mid-February, and Singapore reported between 0-3 new cases each day from 19 to 28 February.

A number of factors unique to Singapore's situation enabled its effective response to this first wave of infection. The small size of the island nation meant that there were limited points of entry for travellers without the added complexity of inter-state travel and coordination of policy implementation across states or provinces. Singapore's populace has also been accustomed to national campaigns, for example those encouraging behavioural changes (such as speaking good English, or being courteous), being regular features in the country's history.

As a democratic republic with a one-party dominant system since the country's independence, the people and the government have a longstanding relationship with a reasonable degree of trust.<sup>56</sup> In addition, Singapore has sufficient resources to provide the fiscal response that helped cushion economic impact to businesses.

### Start of a New Wave (1 March to 14 April)

Despite the success of Singapore's first responses, continued vigilance and preparation for new infections was necessary in the evolving pandemic situation. In early March, the government was already warning that Singapore needed to be prepared for new spikes in COVID-19 cases. Shortly after, daily reported new cases shifted into the double-digit range, driven mainly by a dinner function event which became Singapore's largest cluster of 43 cases by 12 March (Figure 4).<sup>57-59</sup>

Concurrently, with the spread of COVID-19 across other countries, the number of imported cases started to rise. The first imported case since 9 February was reported on 4 March, and this grew to a peak of 42 by 24 March (Fig. 5). A series of extended border control measures was implemented over this period, with travel advisories to Singaporeans to avoid travel to specific countries, and the barring of entry of travellers from these countries. These started with Iran, northern Italy, Japan and South Korea from 3 March, then extended to Italy, France, Spain and Germany, ASEAN countries, Switzerland, and the UK, and then to all countries by 23 March (Fig. 2). At the same time, returning travellers from these specified regions were issued SHNs and had to undergo a swab test (from 15 March). Noting that the largest share of imported cases was from the UK and US, those returning from these countries also had to serve their SHNs at designated hotels from 25 March.<sup>2,60</sup> The peak of 48 imported cases started to come down from 23 March and tapered off to 0 by 10 April.

However, with the huge number of returning residents, and family members of persons under SHN continuing to interact with the community, subsequent local spread took hold. Local transmission cases rose and overtook imported cases from end March (Fig. 5). By 31 March, there was a total of 16 detected local clusters, and the cumulative number of COVID-19 cases reached 1,000 on 1 April.<sup>61,62</sup>

### *In the Lead Up to 'Circuit Breaker'*

As the number of local cases climbed, social distancing measures were stepped up. Events and gatherings with 250 or more participants were suspended, and this was later extended to gatherings with 10 or more people.<sup>63,64</sup> Initial urging by the government for employers to facilitate telecommuting by staff, where possible, eventually became compulsory under the Infectious Diseases Act. Retailers and food and beverage operators had to put in place markings (for example, on the floor, or on tables and chairs) and limit the number of patrons to ensure sufficient space (at least 1 metre apart) between them.<sup>65-67</sup> Singapore's contact tracing teams were also expanded from the hitherto 3 (when daily new cases were mostly in single digits and cumulative cases were below 200) to 20, to prepare for an expected surge in COVID-19 cases as daily new cases moved into double digit numbers and cumulative cases crossed 500.<sup>12</sup> A contact-tracing application (TraceTogether), which allowed contact tracers to easily identify other users a patient has been in close contact with, was also launched on 20 March.<sup>68</sup>

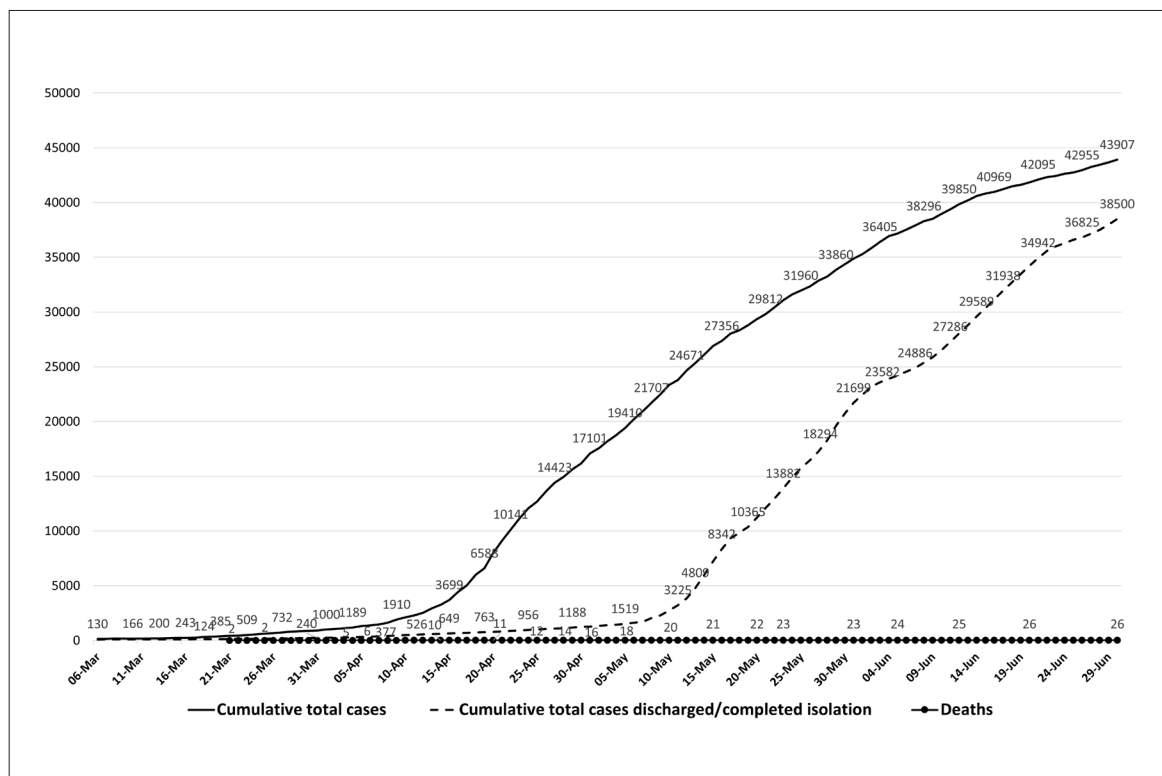


Figure 4. Total COVID-19 Cases in Singapore (6 March 2020 to 14 April 2020)

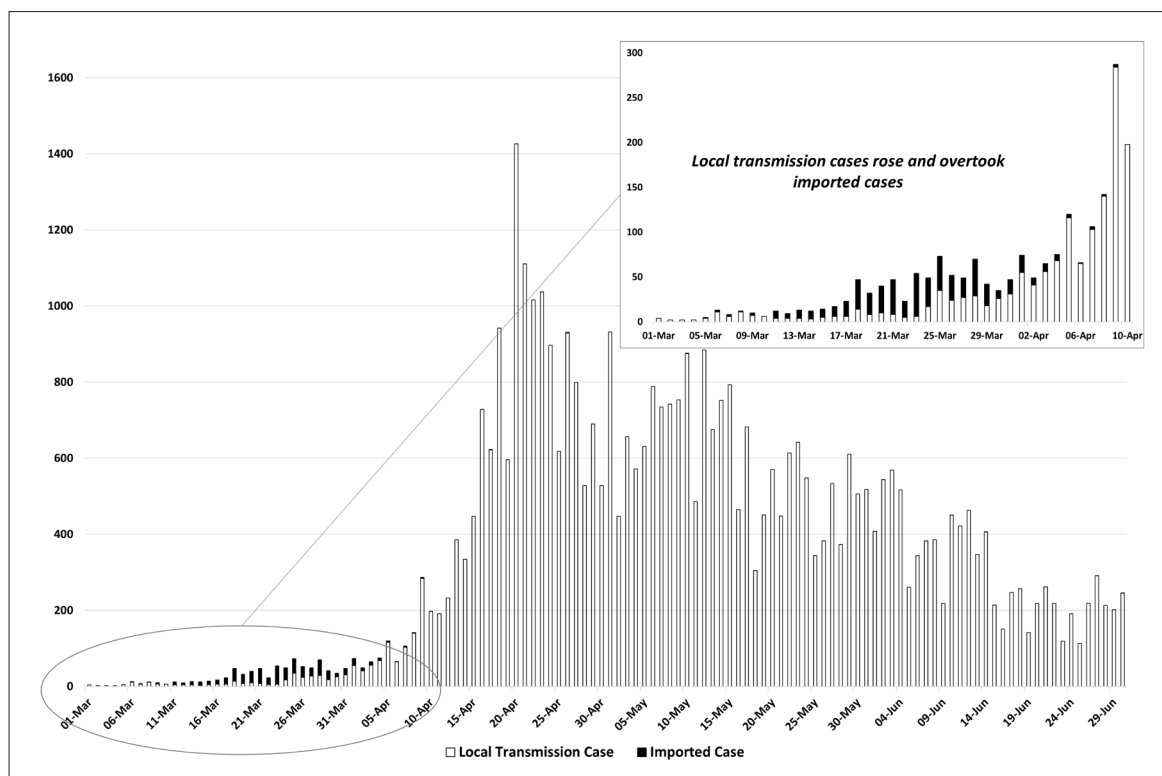
Data sources: <https://www.moh.gov.sg/COVID-19/situation-report>

Figure 5. Daily imported and local transmission cases (1 March 2020 to 14 April 2020)

Data source: [www.moh.gov.sg](http://www.moh.gov.sg)



At the same time, the second set of fiscal measures (a SGD48 billion Resilience Budget) was introduced to further alleviate the deepening impact to businesses on 26 March. Earlier fiscal measures were enhanced with higher co-funding (up to 75%) of wages, extended corporate tax treatments, enhanced financing schemes (with government risk-sharing) for Singapore-based enterprises, and additional rebates for the tourism, land transport and aviation sectors.<sup>69</sup> Meanwhile, opportunities were created for airline crew to be directed to appropriate jobs in supporting roles in hospitals, and for taxi drivers to take on grocery delivery work (see Fig. 2 for a summary of key events/measures in Singapore's response to the COVID-19 pandemic).<sup>70–72</sup>

### *Circuit Breaker*

Local transmission cases continued to rise, and a decisive move was made with the Prime Minister announcing the closure of most workplaces and full home-based learning for schools from 7 April (part of a suite of significantly stricter island-wide measures termed a 'Circuit Breaker' (see Table 2)). In view of the widespread community transmission, and more definitive evidence of asymptomatic transmission, a change was made to the national guidance on masking, which became a requirement by law when one stepped out of one's home from 14 April.<sup>73</sup>

Meanwhile, the Solidarity package (third set of fiscal measures amounting to SGD5.1 billion) was announced on 6 April (Table 2).<sup>74</sup>

### *Foreign Worker Dormitories*

Perhaps most worryingly, just as Singapore shifted into 'circuit breaker' mode, large clusters emerged in foreign worker dormitories. There are about 300000 migrant workers employed in low-wage jobs living in purpose-built dormitories and factory-converted dormitories across the island.<sup>77,78</sup> On 5 April, 2 purpose-built dormitories were gazetted as isolation areas to stem transmission of COVID-19 in the community. Such gazetted dormitories grew to 25 by 24 April.<sup>79,80,81</sup>

The government set up an inter-agency taskforce to provide support to foreign workers and dormitory operators during this period. The frequency of cleaning and disinfection of the dormitories was increased, and teams of government personnel were sent in to help the dormitories implement safe distancing measures. Doctors, nurses, and swab testing teams were also progressively deployed to the dormitories to tend to workers who were unwell, to swab those with symptoms, and to manage cases that needed to be sent to other facilities. In addition, workers involved in essential services were moved out to alternative types of accommodations to minimise the risk of healthy workers getting infected and disruption to essential services.<sup>82,83</sup>

### **Concluding Points**

On 14 April, there were more than 40 detected clusters in Singapore, and the cumulative number of COVID-19 cases had reached 3,252, with daily new cases in the range of hundreds and foreign worker dormitory cases comprising the large majority.<sup>84</sup>

Table 2. Brief Summary of 'Circuit Breaker' Measures (as at 3 April 2020)<sup>74–76</sup>

Sectors	Measures
Education	Schools and Institutes of Higher Learning will move to full home-based learning. Preschools and student care centres will suspend services. (Schools, preschools and student care centres will provide limited services for children of parents who are workers in essential sectors.)
Public	Members of the public strongly advised to stay home except to purchase daily necessities, or seek essential services or urgent medical care. Reusable masks to be distributed to all Singapore residents.
Businesses/social activities	All such activities that cannot be conducted via telecommuting from home to be suspended.
Attractions/recreation facilities	All attractions, theme parks, museums, casinos, and sports and recreation facilities will be closed. Restaurants/cafes/dining outlets will operate only for takeaways.
Essential sectors	Essential services and those in economic sectors critical for local and global supply chains (eg. food, health, transport/storage, infocomms and banking/finance sectors) will remain open.
Across sectors	Solidarity Package announced on 6 April extended 75% co-funding of wages to every local employee for 1 month, increased government risk-share of financing loans to businesses to 90%, and issued cash payouts to Singaporeans, among others.

These went on to new highs, and cumulative COVID-19 cases were over 40,000 by June. Despite extensive efforts, Singapore ended up experiencing a higher number of new cases per day during the Circuit Breaker than before.

While efficient contact tracing and a broad and multi-sectoral approach mitigated and contained rising cases in February, yet maintaining societal and economic functioning, some policy decisions made in a rapidly evolving pandemic with limited information may have inevitably permitted the more extensive spread after March. Earlier border closures might have reduced the extent of imported and subsequent community cases. A more pre-emptive national masking advice might have slowed community transmission that led to Singapore's second wave. SHNs for all returning residents could have been served at designated facilities instead of in their own homes, and preventive measures could have been instituted early at foreign worker dormitories as an identifiable setting with higher transmission risk. It is also worth reflecting on how the DORSCON, based on Singapore's SARS experience, which was similar but different in some key aspects, actually performed as a guide to systemic policy responses across varying degrees of outbreak severity.

After successful containment of a first wave originating from Wuhan and mainland China, the returning of residents from other countries in an evolving pandemic situation had triggered the start of a second and much larger wave of infections. The circuit breaker and measures deployed at foreign worker dormitories marked the start of a second and even more challenging phase of national responses to the COVID-19 pandemic.

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