Supplementary Material - Report 25: Response to COVID-19 in South Korea and implications for lifting stringent interventions

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Timeline of events and interventions

Table S1: Timeline of significant COVID-19 events and interventions for South Korea. Table adapted from [1] with additions from [2] and the MOHW, MOE and KCDC press releases. Dates are in 2020, unless stated explicitly.

Date	**Event or Intervention**
Dec 30, 2019	Cluster of cases of pneumonia of unknown origin was reported to China National Health Commission
Jan 3	Korean government raised the alert level to Blue (level 1 out of 4-level national crisis management system). Special immigration measures were implemented for those arriving from Wuhan.
Jan 12	Coronavirus was named as 2019-nCoV, and Chinese scientists shared the genetic sequence of the virus internationally.
Jan 20	First confirmed case of Coronavirus reported, a 35-year-old female, Chinese national, residing in Wuhan, Hubei province. Detected with fever upon arrival at the Incheon international airport. Korean government raised the national alert level to Yellow (level 2)
Jan 23	Chinese government locked down Wuhan, the centre of the outbreak.
Jan 28	Korean government raised its infectious disease alert level to Orange (level 3). Special immigration measures were extended to all individuals travelling from mainland China.
Jan 30	WHO declared the coronavirus, global public health emergency
Jan 31	COVID-19 test kits based on the virus' genetic code released by China had been distributed to local government labs across the South Korea.
Feb 4	Korea began banning entry of all foreign nationals who have been to China's Hubei province in the past two weeks
Feb 7	COVID-19 test kits became available in private hospitals.
Feb 12	WHO declared an official name for the new coronavirus - COVID 19
Feb 18	First case related to Shincheonji cluster was identified
Feb 20	Number of confirmed cases in Korea reached 100, and first death case occurred. Testing began of the 9,334 members of Shincheonji Daegu group. Korean government switched to testing anyone with symptoms regardless of travel history or link to an existing case
Feb 21	Korean government declared 'Special Management Region' in Daegu and Chengdo. Testing of all staff at Cheongdo Daenem hospital was carried out.
Feb 23	Korean government raised its infectious disease alert level to Red (level 4) and delayed the start of the new semester by one week until Mar 9 (schools closed since mid-Feb). School closure Citizens of Daegu asked to refrain from leaving their homes for 2 weeks.
Mar 1	Korean government divided confirmed patients into four groups and only the sickest and elderly were sent to hospitals. The young and asymptomatic went to dormitories, “Life treatment centres”.
Mar 2	Korean government delayed the start of new semester to Mar 23.

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Date	**Event or Intervention** (continued)
Mar 5	Korean government declared 'Special Management Region', Gyeongsan. Drive thru sample collection centre established.
Mar 9	Korean government applied special entry procedures for Japan.
Mar 10	A cluster of confirmed cases appeared in a Seoul call centre.
Mar 11	WHO declared COVID-19 a pandemic
Mar 17	Korean government delayed the start of new semester to Apr 6.
Mar 19	Special entry procedures applied for all travellers flying into Korea.
Mar 22	Korean government began implementing stricter rules on social distancing, and began testing all incoming travellers from Europe
Mar 27	Korean government began testing all incoming travellers from the US
Apr 4	Korean government extended the period of stricter social distancing until at least the 19th April
Apr 9	Korean government began the new school semester remotely for 3rd year high school and 3rd year middle school students
Apr 15	Legislative election held in South Korea
Apr 16	Korean government began the new school semester remotely for 1st and 2nd years in high school, 1st and 2nd years in middle school, and 4th-6th years in elementary school.
Apr 19	Korean government extended the social distancing campaign in a slightly relaxed form until the 5th May
Apr 20	Korean government began the new school semester remotely for 1st-3rd year elementary school students.
Apr 20	A support centre was launched providing information on the development of COVID-19 vaccines, treatments, and prevention/control supplies and equipment
Apr 22	56 national outdoor facilities re-opened [3]
Apr 24	First meeting of inter-governmental support task force for development of COVID-19 treatment and vaccine held [4]
Apr 30	14 days since the election and no cases associated with it were found. First day since before February 18th with no new local cases in South Korea [5].
May 6	South Korea starts relaxed social distancing measures
May 8	A cluster of cases confirmed, associated with nightclubs and restaurants visited on 2nd May in Itaewon district of Seoul [6]

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Detailed protocols for case-based interventions in South Korea

1. Testing strategy

Currently all suspected cases and patients under investigation are tested (see definitions in Table S2). Every individual is tested at least twice. Close contacts of confirmed cases are also tested even if they do not exhibit symptoms [7].

Between January 28th and 7th February 7th, South Korea increased the number of its screening clinics from 288 to 556 [8]. In addition to traditional screening clinics, selected areas in South Korea also have drive-through and walk-through screening clinics [9,10]. Both methods offer a quicker turnaround of individuals than traditional methods [9]. Tests require an upper respiratory tract specimen and, if easily provided, a lower respiratory tract specimen [11].

Table S2: Case definitions for suspected cases and patients under investigation for COVID-19 infection (Source: COVID-19 Response Guidelines [7]).

Case type	**Definition**
Suspected case	Fever[1] or respiratory symptoms[2] within 14 days of contact with a confirmed COVID-19 patient during the confirmed patient's symptom-exhibiting period.
Patient under investigation	1. A suspected case of COVID-19 according to a physician's opinion for reasons such as fever[1] or respiratory symptoms[2] 2. A person exhibiting fever[1] or respiratory symptoms[2] within 14 days of visiting a country with local COVID-19 transmission, e.g. China (including Hong Kong, Macau) 3. A person exhibiting fever[1] or respiratory symptoms[2] with an epidemiological link to a domestic COVID-19 cluster.

1: 37.5 degrees Celsius or above; 2: cough, shortness of breath, etc.

2. Contact tracing of individuals

Contact-tracing in South Korea is a mix of traditional patient interview methods supplemented by access to health data. Contacts of cases are placed in quarantine (their quarantine location depends on their triaged risk group) and an application is used to monitor their movement. Movement restrictions are made under a public health order and release of detailed patient information is allowed under the public health acts introduced in 2015.

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According to the Korean CDC [11], the protocol for epidemiological investigations and contact-tracing is divided into four stages:

1. Investigation (collecting information on case's location history for a specified time period)
2. Exposure risk assessment
3. Contact classification
4. Contact management -- quarantine and symptom monitoring

During the case investigation phase, information collected from traditional patient interviews are then supplemented using mobile phone location data, card transaction logs, and CCTV footage to determine the geographic scope of contact tracing required and to overcome any recall bias. Medical record data, clinical records, and information on the use of medical facilities and pharmacy visits are used to estimate the time-window of infection and time of initial onset of symptoms. If a medical facility is included in the patient's route, quarantine of the medical facility is conducted [5]. The Epidemiology & Case Management Team (COVID-19 National Emergency Response Center, South Korean Centers for Disease Control) report that these methods are now being used for every confirmed COVID-19 case [12].

The KCDC Coronavirus Disease Response Guidelines specify that family members and close contacts must be identified and quarantined within 24 hours of identifying the confirmed case [7]. For identified contacts, dependent on presence or absence of symptoms and whether they are considered "high risk" they may be immediately isolated in hospitals, asked to quarantine at home, or be transferred to designated quarantine facilities. Regardless of symptoms contacts will then be under "movement restriction" as a public health order [5]. The Ministry of the Interior and Safety have developed a mobile-app [13] that is then used to monitor the movement of those under movement restrictions. Upon case confirmation, mild cases are places in home quarantine, moderate cases in hospital if hospital has capacity, and severe/extremely severe cases in tertiary hospitals [11]. Further information on the epidemiological investigation procedure is available through the Korean Ministry of Health dedicated coronavirus portal [14].

As part of the contact tracing protocol, within 24 hours of identifying a confirmed case, the Municipal COVID-19 Immediate Response Task Force should identify any healthcare or community settings that the case visited during the infectious period (including the day before symptom onset) and conduct an epidemiological investigation. Clusters of cases may be identified this way [7]. On top of contact tracing, South Korea have used targeted mass testing to investigate and manage clusters. In the case of Shincheonji and Guro-gu call centre, the standard case definition of a PUI (Table 2) was adapted to cluster investigation. Rather than explicitly tracing the close contacts of individual cases, local government tested all members of the Shincheonji religious group (42.5% were confirmed as cases) and subsequently monitored them [15]. Similarly, upon being notified of a case that was potentially part of a cluster in a mixed purpose building in central Seoul, every person who had worked resided or visited the building over the three weeks prior to reporting was designated a PUI and tested [12]. 97% of confirmed cases were linked to a call centre of the 11th floor in which the attack rate was calculated as 43%. Close contacts of the confirmed cases discovered by this targeted mass testing were then traced [12]. It is unclear what

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triggers the use of targeted mass testing over relying exclusively on individual contact tracing in the case of other clusters.

Regional breakdown of case origins and/or epidemiological links

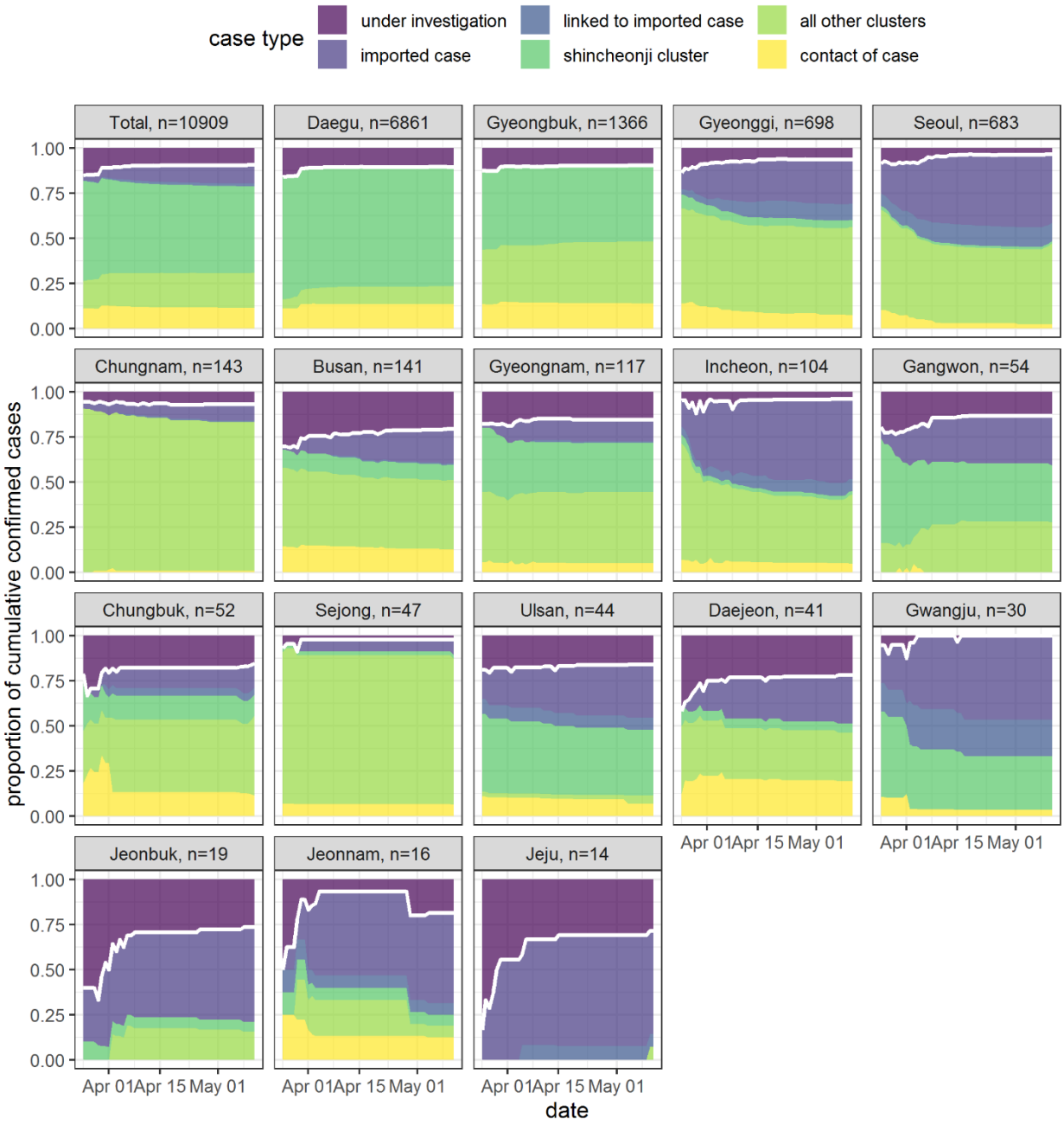

Figure S1: Cumulative proportion of confirmed cases by epidemiological link and/or origin from March 25th to May 11th, broken down by region. Regions are in descending order of total number of cases (n). The proportion of cumulative confirmed cases that are linked to existing cases or imported (white line) as opposed to "under investigation" (which includes apparent sporadic cases). Linked cases are broken down into whether they are connected to an imported case, part of the Shincheonji cluster, a smaller cluster or a non-cluster contact of a confirmed case. Source: KCDC press releases.

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Methods

Table S3: The prior means and standard deviations that were explored to check the sensitivity of our R estimates.

Mean of the prior distribution for R	Standard deviation of the prior distribution for R
5	5
2.6	2
2.6	1
1	1
1	0.5
2.6	10
1	10

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