Impact of Public Health Interventions on Seasonal Influenza Activity During the SARS-CoV-2 Outbreak in Korea

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Summary: High level national response with multiple public health interventions to contain COVID-19 also resulted in substantial decrease in seasonal influenza activity. These interventions may serve as strategies for prevention and control of influenza in upcoming seasons.

Abstract

Background: COVID-19 was introduced in Korea early and experienced a large outbreak in mid-February. We aimed to review the public health interventions used during the COVID-19 outbreak and describe the impact on seasonal influenza activity in Korea.

Methods: National response strategies and public health interventions, along with daily COVID-19 confirmed cases in Korea were reviewed during the pandemic. National influenza surveillance data were compared between seven sequential seasons. Characteristics of each season, including the rate of influenza-like illness (ILI), duration of epidemic, date of termination of epidemic, distribution of influenza virus strain and hospitalization were analyzed.

Results: After various public health interventions including enforced public education on hand hygiene, cough etiquette and staying at home with respiratory symptoms, universal mask use in public places, refrain from non-essential social activities and school closure, the duration of the influenza epidemic in 2019/2020 decreased by 6-12 weeks and the influenza activity peak rated 49.8 ILI/1,000 visits compared to 71.9-86.2 ILI/1,000 visits of previous seasons. During the period of enforced social distancing from week 9 to 17 of 2020, influenza hospitalization cases were 11.9-26.9-fold lower compared with previous seasons. During the 2019/2020 season, influenza B accounted for only 4%, in contrast with previous seasons in which influenza B accounted for 26.6% to 54.9% of all cases.

Conclusions: Efforts to activate high level national response not only led to a decrease in COVID-19, but also substantial decrease in seasonal influenza activity. Interventions applied to control COVID-19 may serve as useful strategies for prevention and control of influenza in upcoming seasons.

Keywords: COVID-19; severe acute respiratory syndrome coronavirus 2; influenza

Introduction

The coronavirus disease 2019 (COVID-19) outbreak, which was first detected in December 2019 in Wuhan, Hubei Province, China, has quickly spread throughout countries worldwide. COVID-19 was introduced in Korea early with the first case diagnosed on January 20, 2020 [1], soon followed by an explosive outbreak of approximately 8,164 cases in the city of Daegu-si and Gyeongsangbuk-do in mid-February [1]. These epidemiologic factors led the Korean government to activate high level national response to contain COVID-19 in the country early in the pandemic. f

Korea has gone through great transformation on the policies for emerging infectious diseases after an outbreak of Middle Ease respiratory syndrome coronavirus (MERS-CoV) in 2015 [2]. A single imported MERS-CoV infection case led to a large outbreak including 186 confirmed cases across 16 hospitals with 38 deaths and 16,752 individuals were quarantined during the outbreak which lead to substantial impact not only on the medical health care system, but also in many areas including education, tourism, political and economic sectors [3]. After the outbreak, high-level isolations units designated by the national government were increased, regulations to support infection control in the hospital were implemented including increasing staffing and reinforcement for education and training. The importance of risk communication in public health crisis management based on transparency and prompt delivery of accurate information to the public has been greatly emphasized and the Korean population sensitization due to the 2015 MERS-CoV epidemic has facilitated the response of the public [4]. The early large scale COVID-19 outbreak may show that Korea was not sufficiently prepared for the next emerging infectious disease, however Korea was early in recognizing the threat and the national response was activated rapidly with implementation of multiple interventions.

These interventions were effective in not only containing the COVID-19 outbreak, but we also found substantial changes in the seasonal influenza activity. Herein we aim to review the public health interventions used early in the COVID-19 outbreak and describe the impact on seasonal influenza activity in the community in Korea.

Methods

COVID-19 in Korea and National Response Strategies

In this study, to assess the impact of the national response strategies to contain COVID-19, we reviewed the public health interventions implemented by date along with the number of cases of laboratory-confirmed COVID-19. Data is reported daily by the Korea Centers for Disease Control and Prevention (KCDC) and Ministry of Health and Welfare and is available on a dedicated website [5].

As of April 22, 2020 a total of 10,694 cases have been diagnosed among 577,959 tests performed in Korea. The early introduction of COVID-19 lead to rapid response in escalating the infectious disease alert level from blue to yellow on January 20, 2020 up to red by February 23, 2020. As an effort to contain COVID-19 during the large outbreak in Daegu and Gyeonsangbuk-do with the second highest largest cases globally at that time, the Korea Centers for Disease Control and Prevention (KCDC) and local health departments implemented multiple strategies to increase national capacities against outbreaks. Strategies included rapid activation of national response protocols led by national leadership, robust diagnostic screening with rapid turnaround time, prompt epidemiologic investigations, intensive contact tracing followed by quarantine measures and re-designing the triage and treatment systems in the country with mobilizing the necessary resources for clinical care [6]. Figure 1 shows the number of cases along with the public health interventions implemented during the COVID-19 outbreak.

Quarantine measures

To prevent spread of COVID-19 in the community, individuals identified with contact to confirmed or suspected cases, along with individuals with recent travel to local areas affected in Korea with outbreaks were quarantined at home or in residential treatment centers for two weeks. All persons were required to use a self-health check mobile app which was monitored by the local public health departments for compliance in isolation measures and symptom development. For those not able to utilize the self-health check mobile app, individuals were called or visited by the local health department [7]. For quarantine of travelers from abroad, entry was banned for foreigners with travel history to Hubei, China since February 4, 2020. Strict quarantine was also required for travelers from Hong Kong and Macau, which later expanded to European countries, the United States and by April 1, 2020, travelers from any country. Inbound travelers were required of self-quarantine for 14 days. Quarantine measures were reinforced by the Quarantine and Infectious Disease Control and Prevention Act [8].

COVID-19 screening

Testing for COVID-19 was based on real-time reverse transcriptase-polymerase chain reaction (RT-PCR) of respiratory specimens [9]. Testing was done on all cases with epidemiologic risk factors for exposure to COVID-19 such as close contact to a confirmed case, contact to a local outbreak or for overseas entrants. Testing was also performed on cases with severe respiratory illness with clinical or radiologic evidence of pneumonia or acute respiratory distress syndrome (ARDS). With the increase of COVID-19 transmission in countries, travelers from Europe were required to receive a COVID-19 test regardless of symptoms during self-quarantine since March 23, 2020, symptomatic cases from the United

States since March 27, 2020 and from April 1, 2020 testing was required for travelers with fever or respiratory symptoms from all countries during the self-quarantine period.

Contact tracing

For contact tracing, all COVID-19 confirmed cases were subject to prompt epidemiological investigation and quarantine of contacts. In cases where contact tracing was difficult, medical records, mobile GPS, CCTV, credit card records were collected along with rigorous public announcements by the media to reach out to the public. Information of areas visited by COVID-19 cases were provided on websites to inform the community for possible exposure risks [10, 11].

Public health measures and social distancing

Multiple public health measures were adapted including rigorous education for self-protection against respiratory tract infections such as hand hygiene and cough etiquette [12, 13]. Persons with respiratory symptoms were recommended to stay at home until symptoms subsided. For wearing masks, the government provided masks for areas of outbreak, and later at minimal costs for the public. Masks were initially recommended for use for those with respiratory symptoms when visiting hospitals, but later was used widely throughout the country in all cases of close person-to-person contact. Social distancing was initiated early in the outbreak mostly based on voluntary participation of the public and was enforced by the government on February 29, 2020. During the first week of March, public transportation usage decreased by 34.5% compared with January, 2020 [14]. In Korea, the academic school year starts in March after a long winter break from the end of December or early January.

Academic calendars vary between schools and schools may end either with the beginning of winter vacation or return to school in early February for one or two weeks. Among schools which did return in February, the majority finished the school year, however some schools were closed in districts with COVID-19 confirmed cases. With the enforced social distancing, school closure or postponing the new school year started on March 1, 2020, and after three extensions, online classes started on April 6, 2020. Major messages for social distancing were to work from home, stay home except for essential matters and cancel or postpone non-essential travel, conferences and social gatherings [12]. High-risk facilities such as religious facilities, indoor fitness centers, nightlife venues were strongly recommended to suspend operation and venues that remained in operation were required to strictly comply with infection prevention guidelines set by the authorities. Detailed guidelines for various public prevention protocols including for individuals at workplace and employers were established to limit exposure to people with respiratory symptoms and unnecessary physical contact.

Health system triage and changes in health care systems

In response to the outbreak, the health system was redesigned to manage COVID-19 and non-COVID-19 related needs [6]. Designated triage centers (named National Safe Hospitals) were established at district health centers or hospitals to provide segregated treatment for non-respiratory and respiratory patients in order to guarantee medical services to patients in general and prevent virus spreading. The government permitted temporarily for non-respiratory patients to receive counseling and prescriptions by phone to prevent infection within healthcare institutions. Suspected patients or patients under investigation who developed fever or respiratory symptoms were advised to go to a screening center after guidance from a designated call center operated by the local public health department.

To strengthen infection control for nursing home and long term care facilities, the MOHW temporarily implemented a nursing hospital inspection system which enabled daily symptom monitoring of caregivers. COVID-19 tests were required for newly recruited caregivers. Costs for testing and isolation rooms were covered by the local governments and the national insurance system. Institutions were also provided with additional financial support when hospitals designated or increased infection control personnel.

Risk communication

For centralized and unified communication, government briefings were made to the public twice a day by the leadership of the Central Disaster Management Headquarters, Central Disease Control Headquarters which were organized under MOHW and KCDC.

Influenza Surveillance System in Korea

Korea operates a national influenza surveillance system based on the clinical sentinel surveillance system, laboratory sentinel surveillance system (KINRESS, Korea Influenza and Respiratory Viruses Surveillance System) and hospitalization surveillance system. [15-17]. Influenza-like illness (ILI) surveillance includes approximately 200 sentinel sites of general outpatient clinics with the recommendation of a medical association. Among these sites, 100 centers are designated for adult patients and 100 centers for children. ILI is defined as an acute respiratory infection with measured fever of ≥ 38℃ with cough or sore throat. The seasonal (epidemic) threshold each year is calculated based on the nonepidemic mean ILI incidence of the past 3 years + 2 standard deviation. Nonepidemic is defined as the influenza detection rate (percentage of respiratory samples positive for influenza) less than 2% for 2 or more weeks. The end of the influenza season is when the influenza and ILI cases are lower than the seasonal threshold for 3 consecutive weeks.

Laboratory sentinel surveillance is operated at 52 sites among the clinics participating in the clinical sentinel surveillance. Specimens are collected from nasal and nasopharyngeal specimens for RT-PCR to differentiate the influenza virus type and subtype of human influenza A viruses, including A(H1N1)pdm09, A(H3N2), A(not subtyped) and B. Influenza hospitalization surveillance collects patients admitted to the hospital or cases visiting the emergency department with confirmed influenza and from 2017 (week 31) includes approximately 200 hospitals, hospitals included each with more than 200-bed capacity.

Data from the national influenza surveillance system was analyzed for seven consecutive seasons, from 2013/2014 to 2019/2020. Data was retrieved from data previously provided weekly and yearly by the KCDC on the sentinel surveillance system website [18]. Each season was analyzed from week 36 of the previous year to week 35, except 2020 which data was available up to week 17. Differences between the influenza seasons were compared based on rate of influenza-like illness (ILI), duration of epidemic season, date of termination of epidemic, distribution of influenza virus strain and subtype and data on hospitalization were included.

Statistical Analysis

We applied single series interrupted time series analysis based on segmented linear regression to evaluate the impact of public health interventions [19]. To model trend of ILI or influenza hospitalization, weekly seasonal trend and period effect were included in each model. The period effect herein quantified an average level change of outcome values over the intervention period. We considered two phases of the intervention period: week 4 to 8 (after the first COVID-19 confirmed case was reported) and week 9 to 17 (after enforced social distancing and school closure). In modelling the period effect of ILI trend, the epidemic curves within 2016/2017-2019/2020 seasons were chosen after observing overall seasonal patterns. In the analysis of influenza hospitalization, only 2017/2018 to 2019/2020 were included in the analysis due to difference in surveillance methods of previous seasons. Statistical analyses were conducted using R version 3.5.3 (R Core Team, 2019) and Stata version 15.0 (StataCorp).

Results

Influenza-like illness of seven consecutive seasons in Korea

Based on data from the national influenza surveillance system, epidemic curve patterns differed between the seven consecutive seasons. (Table 1, Figure 2). Among the seven seasons, four showed a bimodal pattern, and three seasons including 2019/2020, 2017/2018 and 2013/2014 showed one large peak. The beginning and peak of the seasonal epidemic shifted since 2016/2017, therefore ILI activity in 2019/2020 was compared with 2016/2017-2018/2019. Based on the ILI clinical sentinel surveillance system, the 2019/2020 influenza season started on the same surveillance week with 2018/2019, and two to three weeks prior to 2017/2018 and 2016/2017, however the epidemic season terminated 8 to 12 weeks earlier in 2019/2020 compared with seasons 2016/2017 to 2018/2019, leaving to a total decrease of 6 to 12 weeks of the seasonal epidemic. The peak activity was substantially lower in 2019/2020 with 49.8 ILI/1,000 visits compared with other seasons of 71.9 to 86.2 ILI/1,000 visits. In the segmented regression analysis, the ILI activity was decreased during week 9 to 17 (-12 on average, 95% confidence interval [CI]: -18 to -6). There was no meaningful difference during week 4 to 8 and this phase was excluded in the final model. The general trend of each season was seen in all age groups also (Supplementary Figure 1).

Distribution of influenza strains of seven consecutive seasons

The distribution of influenza strains was analyzed for the past seven consecutive seasons (Table 1, Figure 3). Among the seasons which showed one large peak in the ILI surveillance, 2013/2014 and 2017/2018 showed co-circulation of influenza A and B from the beginning of the seasonal epidemic with influenza B activity at 52.9% and 54.9% throughout the season, respectively. In contrast, among the four seasons which showed a bimodal pattern in the ILI surveillance, influenza A was the predominant strain of the first peak, followed by a second peak predominantly influenza B which contributed to 26.6% to 51.1% of all detected strains during the season. Interestingly, the 2019/2020 season was predominantly due to influenza A by 96.0%, of which A(H1N1)pdm09 was 70.6% and A(H3N2) was 25.4%, and the season terminated early with low level influenza B activity by 4%.

Influenza hospitalization in 2019/2020 compared with previous seasons

In the analysis of hospitalization of influenza confirmed cases, cases were compared up to week 17 of each season due to the period of data collected in 2019/2020 (Table 1). Total cases of hospitalization from week 36 to week 17 was highest in 2017/2018 by 21,616 cases followed by 15,683 cases in 2018/2019 and 12,564 cases in 2019/2020. When analyzing cases during the period social distancing along with school closure was enforced by the government (from week 9 to week 17), 161 cases were found to be admitted in 2019/2020. In contrast, 4,327 cases were admitted during the same period in 2018/2019, which was 26.9-fold the cases of 2019/2020. Hospitalization due to influenza in 2017/2018 were also higher than 2019/2020 with a total of 1,914 cases admitted in 2017/2018 which was approximately 11.9-fold higher than admissions in the 2019/2020 season. In the segmented regression, the average hospitalization numbers were significantly decreased during week 9 to 17 (-328, 95% CI: -611 to -47).

Discussion

With the early introduction and surge of COVID-19 in Korea, the entire country has been striving and focusing on rapid activation of national response. With much effort to contain COVID-19, the daily confirmed cases have been less than 40 cases per day since April 9, 2020 while more than 50% are travelers from abroad. Although there is yet a risk of a second wave, this does show the impact of public prevention measures in limiting transmission of COVID-19 in the community.

Alongside with the decrease in daily diagnosed cases of COVID-19, we found a substantial decrease in influenza activity. The overall influenza activity based on clinical ILI, laboratory and hospitalized cases was substantially lower compared with recent influenza seasons (2016/2017-2019/2020). The epidemic season terminated 8 to 12 weeks earlier leading to a decrease in the influenza epidemic duration by 6-12 weeks. The influenza activity peak was lower by 49.8 ILI/1,000 visits compared to 71.9-86.2 ILI/1,000 visits of previous seasons. Although we cannot directly evaluate the effect of each measure, alertness and compliance to personal hygiene guidelines and social distancing would by far be among the most influential methods for the reduction in influenza transmission. According to a recent series of surveys performed on 1,000 adults in each survey during February 25-28, March 25-27 and April 10-13, 2020, self-reported compliance for using masks while going to public places increased from 88.4% to 95.1%, hand washing ranged from 93.3%-95.0% and compliance for cough etiquette increased from 82.3% to 89.7% [20]. Mask use was higher compared to the 2015 MERS-CoV epidemic where among 1,004 respondents, 15.5% reported wearing face masks at least once due to the epidemic [21]. During the period of enforced social distancing by the government which started on February 29, 2020 influenza hospitalization cases were strikingly lower by 11.9- to 26.9-fold compared with previous influenza seasons, showing the impact of social distancing on influenza activity in the community. A decrease was also seen among the seven respiratory viruses of the sentinel surveillance system in 2020 compared with the weekly average in 2017-2019 (Supplementary Figure 2).

School closure (or postponing school opening) is considered as a potential non-pharmaceutical intervention to mitigate severe influenza epidemics and pandemics [22]. School closure presumably played an important role in the early termination of the 2019/2020 influenza epidemic, as school age children are known as a driving force of epidemics in the household and community during influenza seasons [23, 24]. This has been suggested to be related to the lack of pre-existing immunity [25] and the high intensity of social contacts in these age groups [26], reasons which support the necessity of influenza vaccination in school aged children. The relationship between school holidays and transmission of influenza has also been described [27, 28], and in a previous study influenza transmission was reduced by 27-39% in Korea during spring breaks [28].

Interestingly we found influenza B accounted for only 4%, while A(H1N1)pdm09 was 70.6% and A(H3N2) was 25.4% of all cases during the 2019/2020 season. This distribution differs from reports in other countries. In the United States, the influenza season began early with predominant influenza B/Victoria virus circulation, followed by increasing A(H1N1)pdm09 virus activity with ongoing detection of both viruses [29]. Among 177 influenza B/Victoria viruses, 172 (97%) were of a genetic subclade V1A.3 that differed from the V1A.1 subclade that includes the 2019/2020 B/Victoria vaccine reference strain [29, 30]. Hospitalization rates among children and young adults in the United States were higher compared to recent seasons, and influenza associated deaths in children <18 years were highest in the season other than the 2009 pandemic [30]. In the United Kingdom, A(H3N2) predominated early during the 2019/2020 season with minimal A(H1N1)pdm09 activity and a slight increase in influenza B in the recent weeks [31]. When taking in together the ILI pattern and influenza strain distribution during the past seven influenza seasons in Korea, seasons with one large peak showed co-circulation of influenza A and B early in the season, whereas during seasons with bimodal pattern of ILI activity, the initial peak predominantly consisted of influenza A followed by influenza B. This differed with 2019/2020 which showed a single large peak with minimal influenza B activity throughout the season. Although, whether or not the public health measures suppressed the activity of influenza B before circulation in the community is not assessable, it could be that the multiple measures to prevent spread of COVID-19 started early in January and reinforced in February and March might have led to a bypass in circulation of influenza B in the 2019/2020 season in Korea.

There are limitations in this study. The decrease in ILI and influenza hospitalization may be related to a decrease in hospital visits and decrease in influenza testing. Many resources were focused on COVID-19 and concerns managing respiratory samples might have attributed to decrease in testing. However, ILI definition is based on clinical symptoms rather than laboratory confirmation, therefore the decrease in testing would not affect the ILI rate. Also, as ILI rate is defined as cases per 1,000 hospital visits, the decrease in visits is applied to the ILI rate.

In conclusion, the national response of alert and sequential implementation of multiple public health interventions to prevent further spread of COVID-19 in the country, led not only to containment of COVID-19 but also resulted in substantial decrease in seasonal influenza activity along with early termination of the influenza epidemic by 8-12 weeks compared with previous seasons. Although it may not be feasible to implement all the extensive interventions every year, public health measures such as hand washing, cough etiquette, mask use, staying home during acute symptoms and school closure when necessary may serve as useful strategies for prevention and control of influenza in upcoming seasons.

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Table 1. Comparison of Seven Recent Consecutive Influenza Seasons in Korea

		2019/2020	2018/2019	2017/2018	2016/2017	2015/2016	2014/2015	2013/2014
ILI clinical sentinel surveillance	Influenza season	Nov. 15, 2019-Mar. 27, 2020	Nov. 16, 2018-Jun. 21, 2019	Dec. 1, 2017-May 25, 2018	Dec. 8, 2016-June 2, 2017	Jan. 14, 2016-May 27, 2016	Jan. 22, 2015-May 1, 2015	Jan. 2, 2014-May 1, 2014
	Influenza season duration	20 weeks	32 weeks	26 weeks	26 weeks	18 weeks	16 weeks	15 weeks
	Seasonal threshold [a]	5.9	6.3	6.6	8.9	11.3	12.2	12.1
	Influenza activity peak [a]	49.8	71.9	72.1	86.2	53.8	45.5	64.3
	Influenza activity peak date and week	Dec. 22, 2019-Dec.28, 2019 (week 52)	Dec. 23, 2019-Dec. 29, 2018 (week 52)	Dec. 31, 2017-Jan. 6, 2018 (week 1)	Dec. 18, 2016-Dec. 24, 2016 (week 52)	Feb. 7, 2016-Feb. 13, 2016 (week 7)	Feb. 15, 2015-Feb. 21, 2015 (week 8)	Feb. 9, 2014-Feb. 15, 2014 (week 7)
Influenza laboratory sentinel surveillance	Number of virus detected	1,169	1,814	2,013	1,210[b]	1,320	1,593	2,094
	A(H1N1)pdm09 (N, %)	825 (70.6%)	760 (42.1%)	141 (7.0%)	6 (0.5%)	582 (44.1%)	175 (11.0%)	346 (16.5%)
	A(H3N2) (N, %)	297 (25.4%)	379 (21.0%)	771 (38.4%)	882 (72.9%)	62 (4.7%)	827 (51.9%)	640 (30.6%)
	B (N, %)	47 (4.0%)	675 (37.4%)	1,101 (54.9%)	322 (26.6%)	675 (51.1%)	591 (37.1%)	1,108 (52.9%)
Influenza hospitalization sentinel surveillance	No. during week 36-week 35	12,564 [c]	16,784	21,616	NA	NA	NA	NA
	No. during week 36-week 17	12,564	15,683	20,960	NA	NA	NA	NA
	No. during influenza epidemic	11,944	15,175	20,682	NA	NA	NA	NA
	After 1st COVID-19 case in Korea	3,232	5,493 (1.7-fold[e])	6,842 (2.1-fold[e])	NA	NA	NA	NA
	After enforced social distancing[d]	161	4,327 (26.9-fold[e])	1,914 (11.9-fold[e])	NA	NA	NA	NA

ILI; influenza-like illness, No; number, NA; not available, [a] cases/1,000 visits, [b] non-typable, [c] up to week 17 in 2019/2020, [d] compared with 2019/2020, [e] up to week 17, (N=1)

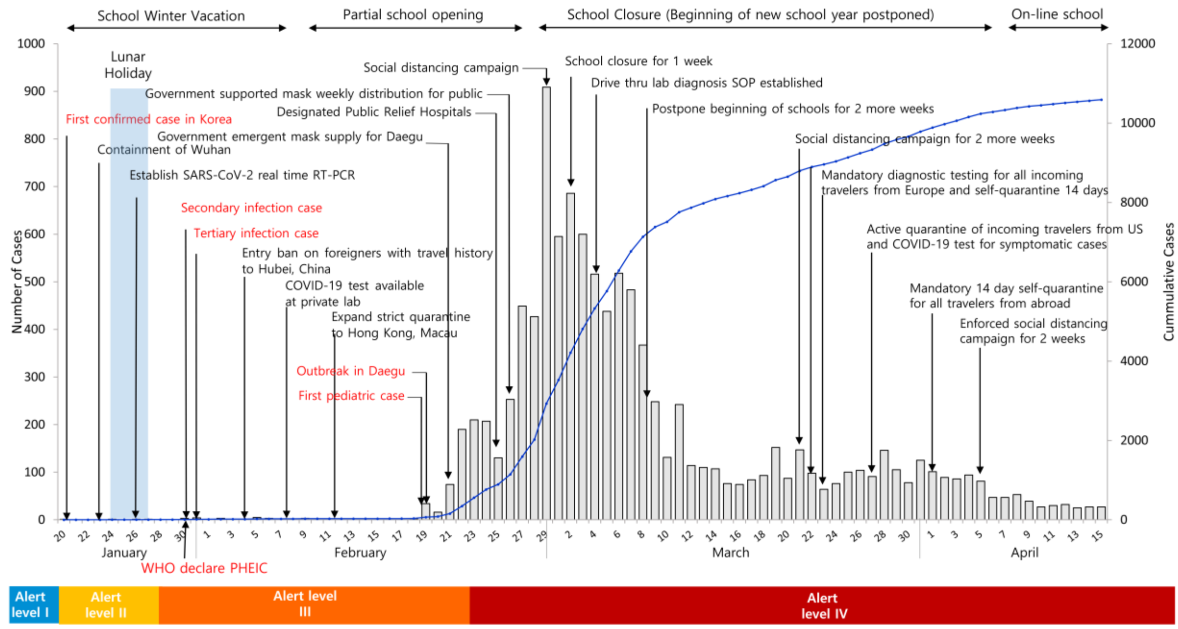
Figure Legends

Figure 1. COVID-19 cases and public health interventions by date in Korea. The lunar holiday was on January 25-27, 2020. The majority of schools started winter vacation in late December or early January. Schools opened on February 3 for one or two weeks, or were in vacation during February according to the academic calendar. The beginning of the new school year was postponed and school was closed from March 1, 2020. Social distancing was enforced by the government on February 29, 2020. The national infectious disease risk alert system for emerging infectious diseases is classified into 4 levels (Blue, Yellow, Orange and Red) based on risk of importation or local transmission.

Figure 2. ILI surveillance in Korea 2016/2017-2019/2020. The ILI rate is shown per week for seven consecutive seasons during (A) 2019/2020, (B) 2018/2019, (C) 2017/2018, (D) 2016/2017, (E) 2015/2016, (F) 2014/2015, and (G) 2013/2014. Influenza epidemic is shown in the shadowed area and epidemiologic threshold is shown in dotted lines for each season. *Some schools were opened for one or two weeks in early February according to the academic calendar.

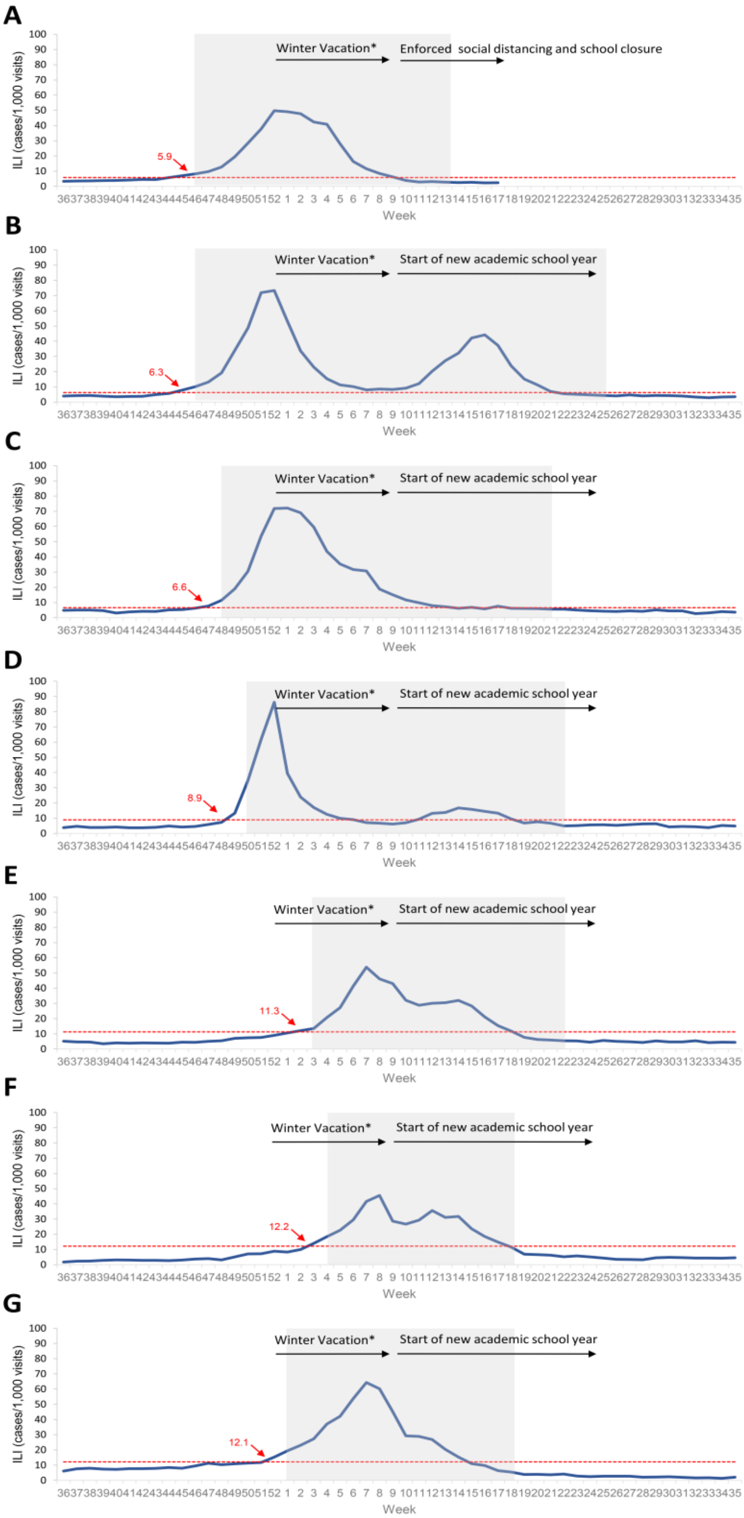
Figure 3. Laboratory surveillance of influenza in Korea 2013-2020. Distribution of viral strains and subtype are shown for (A) 2019/2020, (B) 2018/2019, (C) 2017/2018, (D) 2016/2017, (E) 2015/2016, (F) 2014/2015, and (G) 2013/2014. Influenza epidemic is shown in the shadowed area for each season. *Some schools were opened for one or two weeks in early February according to the academic calendar.

Figure 1



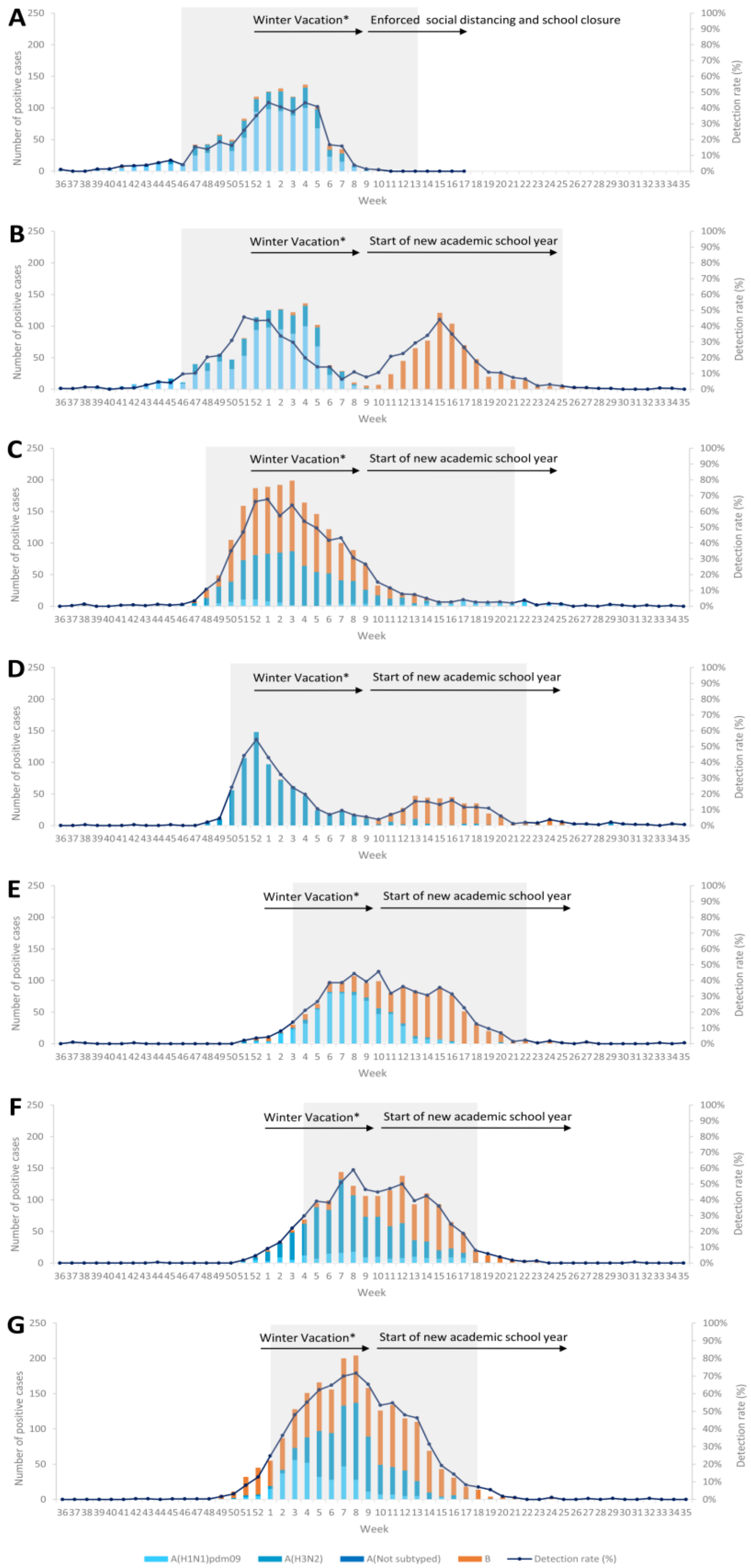
School Winter Vacation
Partial school opening
School Closure (Beginning of new school year postponed)
On-line school
Lunar Holiday
First confirmed case in Korea
Containment of Wuhan
Establish SARS-CoV-2 real time RT-PCR
Secondary infection case
Tertiary infection case
Entry ban on foreigners with travel history to Hubei, China
COVID-19 test available at private lab
Expand strict quarantine to Hong Kong, Macau
Outbreak in Daegu
First pediatric case
Government emergent mask supply for Daegu
Designated Public Relief Hospitals
Government supported mask weekly distribution for public
Social distancing campaign
School closure for 1 week
Drive thru lab diagnosis SOP established
Postpone beginning of schools for 2 more weeks
Social distancing campaign for 2 more weeks
Mandatory diagnostic testing for all incoming travelers from Europe and self-quarantine 14 days
Active quarantine of incoming travelers from US and COVID-19 test for symptomatic cases
Mandatory 14 day self-quarantine for all travelers from abroad
Enforced social distancing campaign for 2 weeks
Number of Cases
Cummulative Cases
January
February
March
April
WHO declare PHEIC
Alert level I
Alert level II
Alert level III
Alert level IV

Figure 2



A
B
C
D
E
F
G
ILI (cases/1,000 visits)
Week
Winter Vacation*
Enforced social distancing and school closure
Start of new academic school year
5.9
6.3
6.6
8.9
11.3
12.2
12.1

Figure 3



A
B
C
D
E
F
G
Winter Vacation*
Enforced social distancing and school closure
Start of new academic school year
Number of positive cases
Detection rate (%)
Week
A(H1N1)pdm09
A(H3N2)
A(Not subtyped)
B
Detection rate (%)