# Epidemic situation and forecasting of COVID-19 in and outside China

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## Introduction

Due to the comparable transmissibility as severe acute respiratory syndrome coronavirus (SARS-CoV) in 2003,[1] since the first case of corona virus disease 2019 (COVID-19) was reported in Wuhan city of China in late December 2019, [2-4] it quickly spread to 24 countries in 4 continents around the world in less than two months (as of February 10).[5-7] To avoid the similar outbreaks of COVID-19 in other regions outside Wuhan city, Wuhan city announced that the city's urban bus, subway, ferry, and long-distance passenger transport were temporarily suspended, and the airports and trains departed from Wuhan were also temporarily closed since January 23, namely the "City Closure" strategies. During the next three days, almost all provinces (except Tibet in January 29) in China successively launched the highest-level of emergency response measures and issued a public notice calling to strengthen personal protection, reduce outings and gathering in the public places. On January 30, the World Health Organization (WHO) declared this fast-growing outbreak of COVID-19 as a Public Health Emergency of International Concern (PHEIC).[8] However, due to the rapid spread of the epidemic worldwide, WHO has increased the assessment of the risk of spread and risk of impact of COVID-19 to very high at the global level.[9]

Although several options are envisaged to treat or prevent COVID-19, including vaccines, monoclonal antibodies, oligonucleotide-based therapies, and other drugs, however, vaccines and antiviral drugs usually required months to years to develop.[6, 10-14] Given the urgency of the 2019-nCoV outbreak, timely update the epidemic situation, evaluation the effectiveness of current public health interventions, and forest the epidemic, are of great significance to China and other countries for the epidemic control in the future. Therefore, in this study, we will update and forecast the latest epidemic situation of the COVID-19 in and outside China up to March 7, 2020.

## Data sources

Since COVID-19 was classified as Class B infectious disease and managed as Class A infectious disease in China, confirmed patients are required to be reported within 24 hours to the Chinese National Infectious Disease Surveillance System according to the standard protocol issued by National Health Commission of the People’s Republic of China (NHCC). Publicly accessible data, including newly increased cases, cumulative numbers of confirmed cases, cured cases, died cases, quarantined cases, and suspected cases, are updated daily by the NHCC and the health commission of 34 provinces in

China.

Daily updated data of COVID-19 in countries outside China were collected from the coronavirus disease (COVID-2019) situation reports released by WHO.[15]

**Case Definitions**

In China, a suspected COVID-19 case was defined as a pneumonia based on symptoms (fever, with or without recorded temperature; radiographic evidence of pneumonia; low or normal white-cell count or low lymphocyte count; and no reduction in symptoms after antimicrobial treatment for 3 days, following standard clinical guidelines) and epidemiologic history (a travel history to Wuhan city or nearby cities, a travel history to communities with patients, or direct contact with confirmed patients). A clinically diagnosed case was defined as suspected case with imaging features of pneumonia (only applicable in Hubei Province). Confirmed cases were defined as those suspected case or clinically diagnosed cases (only applicable in Hubei Province) who also had positive results of viral nucleic acid testing by at least one of the following two methods for respiratory or blood specimens: positive results by real-time reverse-transcription–polymerasechain-reaction (RT-PCR) assay, or a genetic sequence that matches COVID-19 virus.

**Susceptible - Infectious - Recovered (SIR) model**

Due to the continuous public health interventions adopted in China and other countries outside China, the transmission model of COVID-19 would change all the time until it arrived at a relatively stable status. Therefore, the time-varying SIR models were developed based on the daily increased case number and were used to calculate the infection parameters of the COVID-19, including the time-varying reproduction number (Rt). The time-varying Rt was defined as the average number of secondary infections patients who generate in a fully susceptible population during the infectious period of the first patient at time t.


As in the classical SIR model, S(t), I(t), R(t) represented the number of susceptible, infectious, and recovered persons respectively at time t in the population size of *N*. To model the dynamics of the outbreak we need three differential equations, one for the change in each group, where $\beta$ and $\gamma$ represented the probability of a susceptible-infected contact resulting in a new infection and the probability of an infected case recovering and moving into the resistant phase, respectively.

$$\frac{dS}{dt} = -\frac{\beta IS}{N}$$

$$\frac{dI}{dt} = \frac{\beta IS}{N} - \gamma I$$

$$\frac{dR}{dt} = \gamma I$$

Differ from the classical SIR model with deterministic parameters of $\beta$ and $\gamma$ within the three differential equations, we estimate these parameters with the function *ode* from the *deSolve* package in R software. Then we optimize the parameters with function *optim* from *stats* package by minimizing the sum of the squared differences between the actual infections I(t) at time t and the corresponding predicted infections $\hat{I}(t)$ at time t :[16]

$$RSS(\beta, \gamma) = \sum_{t} \left( I(t) - \hat{I}(t) \right)^2$$

At present, it is difficult to accurately estimate the actual number of the initial population size *N* of the SIR model. However, in order to develop the optimal SIR model with the RSS infinitely close to or be equal to zero, we assume that all confirmed cases in a relatively independent area (a country or a province in China after a strong traffic control) come from similar routes of transmission and have been promptly quarantined and treated, and that all close contacts of have also been promptly tested and effectively quarantined. Under this assumption, the predicted infections should infinitely close to actual infections. Therefore, in order to achieve the optimal SIR model, we set the number of confirmed case number as the initial population size *N* of SIR model. The optimal model is also the most optimistic estimate, since it also assumes that the epidemic is nearing its end, and there will not be too many new cases, which would bias the overall distribution based on the previously reported cases. These optimal time-varying SIR models could be used to forecast the end date of the epidemic.

As a sensitivity analyses, we reset the population number in each province of China or the population number in a country as the initial population size *N* to develop the optional SIR models (**Supplementary file 1**). Under the optional model, we assume that all persons are exposed at a high-risk of COVID-19. Namely, the optional model is the worst estimate, and could be used to forecast the largest infections of the epidemic.

In order to estimate the preliminary effectiveness of "City Closure" strategies adopted in Hubei province and Wuhan city in response to the COVID-19 epidemic, the differences in the predicted infections between the optional SIR models and the optimal SIR models were calculated to present the potentially preventable infections due to the "City Closure" strategies.

## Results

### Current epidemic situation of COVID-19 in China

As of March 7, a total of 80,859 patients with COVID-19 had been confirmed in 34 provinces in China. The daily growth rate (DGR) of confirmed cases showed an obvious downward trend, while the latest DGR was 0.1% **(Fig 1A)**. Up to now, 57,143 patients had been cured, with a cumulative cure rate (CCR) of 70.7%, while the CCR showed a clear upward trend since January 27**(Fig 1B)**. At the same time, a total of 3,100 patients died, with a cumulative mortality rate (CMR) of 3.8%, while the CMR remained at a relatively low level (ranging from 2.0% to 3.8%) **(Fig 1B)**.

Among the 34 provinces in China, the top six provinces with confirmed cases were Hubei, Guangdong, Henan, Zhejiang, Hunan and Anhui. There were more than 100 confirmed cases in 26 provinces in China. In other provinces outside Hubei, the number of daily increased cases had showed an obvious decline since February 3. In addition to 30 provinces with no newly increased cases in March 7, the daily increased case was less than 2 in the remaining 3 provinces outside Hubei. The number of daily increased cases in Hubei Province also began to decline from February 13 **(Fig 2)**.

The CCRs of COVID-19 patients varied across different provinces. Among provinces with more than 100 COVID-19 patients, the highest CCR was reported in Fujian (99.7%), followed by Anhui (99.1%), Jiangxi (98.2%), Henan (98.0%), Yunnan (97.7%), and Jilin (96.8%) (**Fig 3)**. Moreover, from February 14, more than 1,000 people have been cured daily for nine consecutive days. From February 18, the number of newly cured patients nationwide (1826) began to exceed the number of newly confirmed cases (1748).

Up to March 7, there were no deaths in 6 of the 34 provinces in China. Among provinces with more than 100 COVID-19 patients and dead case was reported, the highest CMR was reported in Hubei (4.4%), followed by Hainan (3.6%), Heilongjiang (2.7%), Tianjin (2.2%), Hebei (1.9%), and Beijing (1.9%) **(Fig 4)**.

**Forecasting the epidemic situation of COVID-19 in China**

Due to the potential delays in early case reporting in most provinces in China, estimates of Rt of COVID-19 fluctuate between large ranges (**Supplementary file 2**). The Rt in the early phase (before January 23) in Hubei province and Wuhan city ranged from 1.85 to 4.46 (**Supplementary file 2**). However, as time goes on, under the optimal SIR models, Rt estimates in each province tend to stabilize. In provinces with more than 100 cases, the optimal estimates of Rt in different provinces are similar, ranging from 0.96 to 1.57 (**Supplementary file 2**).

As shown in **Figure 5**, based on optimal SIR models, the predicted end of epidemic in Hubei province would be around March 20, with a total of 67,795 infections. However, based on the optional SIR model with the whole population as the initial population size (scenario 2), the predicted end of epidemic in Hubei province would be around May 14, with largest infections of more than 17.35 million. The predicted infections in Wuhan city under the optimal and the optional models were 50,036 and 2.82 million infections, respectively. "City Closure" strategies would have prevented nearly 17.27 million infections in Hubei province and 2.76 million infections in Wuhan city. **(Fig 5)**.

In provinces outside Hubei, as shown in **Figure 6**, the number of daily increased infections in most provinces showed a downtown trend since February 3, and several provinces have not reported newly diagnosed cases since February 21. The distribution of daily increased infections in most provinces presents approximately normal distribution. Based on the optimal SIR models, most provinces outside Hubei province are nearing the end of the epidemic, where the predicted infections showed a good agreement with actual infections **(Fig 6)**. However, if the initial population sizes were set as the population number of each province, the predicted infections were great larger than actual infections (data are not shown). The differences in the predicted infections under the optimal and the optional models would be also considered as the potentially preventable infections.

**Epidemic situation and forecasting the of COVID-19 in countries outside China**

As of March 8, eight new countries/territories/areas (Bulgaria, Costa Rica, Faroe Islands, French Guiana, Maldives, Malta, Martinique, and Republic of Moldova) have reported cases of COVID-19 in the past 24 hours. A total of 24,727 confirmed cases (with 3,610 new cases) and 484 deaths (with 71 new deaths) are reported in 101 countries/territories/areas. There are more than 100 cases of COVID-

19 in 16 countries/territories/areas, and four of them (South Korea, Japan, Italy, Iran) show relatively obvious outbreak. The country with the highest case fatality rate is Italy (234/5883, 3.98%).

As in the early phase in China, Rt estimates varied in large ranges (from 1.23 to 5.77) based on optimal SIR models in the four countries with relatively obvious outbreak of COVID-19 (**Supplementary file 3**). However, unlike Rt showing a relative downward trend in Japan and South Korea, Rt shows a stable trend in Italy and an upward trend in Iran (**Supplementary file 3**).

As shown in **Fig 7,** under the assumption that we mentioned in the method, including all confirmed cases in the above four countries coming from similar routes of transmission and being promptly diagnosed, quarantined, and treated, and close contacts being effectively quarantined as in China, the epidemic situation in South Korea, Italy, and Iran would likely to be controlled by the middle of April based on the most optimistic estimates. Due to the limited data, it's very difficult to estimate when the epidemic may be controlled Japan. On the contrary, based on the worst estimate, the outbreak of COVID-19 in these four countries would follow a similar outbreak pattern in Wuhan, China. Namely, all residents in these countries are exposed to high risk. If that happened, more than one million people may be infected in each of the four countries.

## Discussion

Our study once again confirmed that the transmissibility of COVID-19 in the early phase (Rt ranged from 1.83 to 5.99) was comparable to that of severe acute respiratory syndrome coronavirus (SARS-CoV) (ranged from 2.2-3.7[17, 18]) and much higher than that of Middle East Respiratory Syndrome coronavirus (MERS-CoV) (range from 0.47-0.91[19-21]). Our estimate for Rt was higher than recently published estimates (R0=2.0) based on 425 early reported patients, which would be underestimated due to the potential delay in case reporting during the early phase.[2] Moreover, our estimate is similar to another estimate (R0=2.68) based on surveillance data though different methodologies were used.[1]

The current case mortality rate of the COVID-19 is lower than those of SARS-CoV and MERS-CoV.[22] In 2002, SARS-CoV spread to 37 countries and caused more than 8,000 cases and almost 800 deaths (with mortality rate of 10%). In 2012, MERS-CoV spread to 27 countries, causing 2,494 cases and 858 deaths worldwide to date (with mortality rate of nearly 34.4%).[1] Although early reported mortality rates of 99 and 41 patients with COVID-19 were 11% or 15%,[17, 23] respectively, these case analyses were mainly from early severe patients in Wuhan. Another retrospective study of 138 Wuhan

COVID-19 patients diagnosed from January 1 to January 28 showed that the overall mortality was 4.3% up to February 3.[24] As of February 11, the latest report from Chinese Infectious Disease Information System showed that a total of 1,023 deaths occurred among 44,672 confirmed cases, with an overall case-fatality rate of 2.3%.[25] However, the overall case fatality rate in Hubei Province was 2.9%, but it was 0.4% outside Hubei Province, which was 7.3 times that of the latter.[25] According to the our latest data, this situation still exists. The reason for this gap is mainly due to the relatively long duration of the epidemic in Wuhan. Due to the lack of timely prevention and control measures, many community cases have not been timely treated. The average waiting time for severe cases from the onset to hospitalization was 9.84 days. The wait for nearly 10 days has made many severe cases miss the best time for treatment.[25]

As of March 7, the newly diagnosed infections in Hubei Province has rapidly dropped to 41, while daily increased infections have dropped to less than 2 in most provinces outside Hubei. More importantly, more than 90% of these new cases have come from close contacts confirmed in the early phase. According to the guidance published by NHCC, these close contacts of includes those who live, study, or work with infected people; medical staff, family members, or visitors who have close contact these patients; persons who are on the same vehicle and have close contact; and those who have been classified as close contacts by the on-site investigators after detailed epidemiological investigation.[26] All these close contacts would be quarantined for at least 14 days, and if symptoms such as fever were present, they would be requarantined for another 14 days to prevent secondary infection.

As shown in figure 5 and figure 6, we find that there is a good fit between the prediction infections and the actual infections of COVID-19 in each province of China under the optimized SIR model. Therefore, it could be considered as relatively reasonable to use the optimal model to predict the current epidemic situation in Chinese provinces. Based on these optimal models, the epidemic is nearing the end in most provinces outside Hubei province. Moreover, it is estimated that “City Closure” strategies would have prevented nearly 17.28 million infections in Hubei province and 2.3 million infections in Wuhan city. These results strongly suggested that "City Closure" measures are very important and needed in response to this serious public health emergency, especially under the situation before the vaccines and antiviral drugs are developed.

Based on above preliminary results, for countries with or without the outbreak of COVID-19, there are some very important basic facts that are worthy of learning: first, although the transmissibility of COVID-19 is similar to SARS, the case fatality rate of COVID-19 is lower than SARS. Countries need to convey this information to their residents so that they can re-establish the confidence to overcome the epidemic and avoid excessive panic. Second, although the overall fatality rate of COVID-19 is not very high, the fatality rate of severe cases is still very high, which is nearly 10%. To prevent mild patients from becoming severe patients, countries need to adopt series of strategies to treat severe patients as soon as possible. Third, only timely and strong public emergency measures, including closing the city, traffic control, restricting the movement of people, strictly following close contacts and effective isolation, could stop the epidemic and avoid more infections before effective vaccines and antiviral drugs.

There are many limitations in this article. First, many assumptions for building an optimal model may not be met in real scenarios. We just build an optimal time-varying SIR models based on statistical theoretical assumptions. Even in the relatively well-fitted provinces of China, the epidemic may also be underestimated until the actual end the epidemic when all current cases are cured, and no new cases are reported. Second, the use of optimal SIR models for countries in the early phase of outbreak may also seriously underestimate the development of local epidemics. Third, the SIR models do not consider the effects of follow-up rate and effective isolation rate of close contacts, the mobility of the population, and other potential influential factors on the predictions. These impacts of potential influential factors may be adjusted during the model's self-fitting process, but we cannot clearly explain the exact impacts of these factors until now.

In conclusion, after a series of strategies in response to the epidemic in China, including the "City Closure" strategies and highest-level of emergency response measures, the epidemic situation in China is being controlled. However, outbreaks are emerging in many other countries, such as South Korea, Japan, Italy, Iran. There are still many problems that urgently need to be further studied, such as the causes of medical staff infection and protection failure, identification of animal hosts, determination of the source of the epidemic, identification of transmission routes, development of effective treatment and prevention methods (including quick test reagent development, drug and vaccine development).[3, 22, 27, 28] The current primary task of epidemic control for China is to maintain an appropriate level of emergency management protocols to prevent the rebound of the epidemic. Moreover, for countries with imported cases and/or outbreaks of COVID-19, immediately activate the highest level of national response management protocols are needed to contain COVID-19 with non-pharmaceutical public health measures.[29]

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**Figure 1. Current epidemic situation of COVID-19 in China**

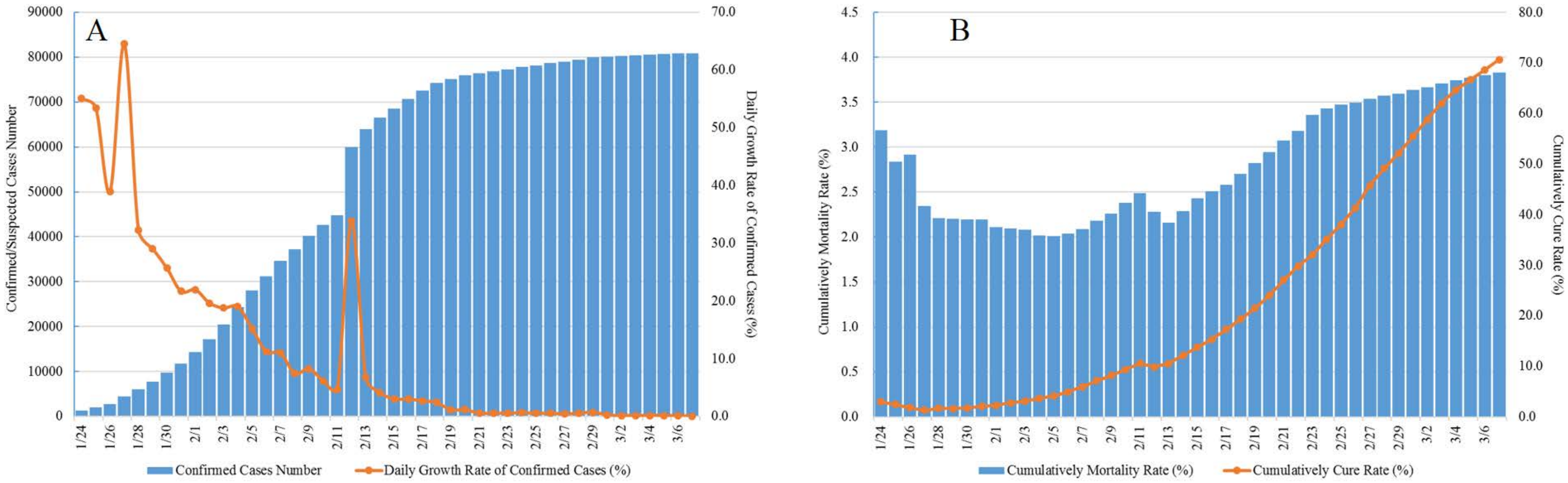


**Figure 2. Daily increased number of COVID-19 in 34 provinces in China**

| Date | Outside Hubei | Anhui | Macao | Beijing | Fujian | Gansu | Guangdong | Guangxi | Guizhou | Hainan | Hebei | Henan | Heilongjiang | Hubei | Hunan | Jilin | Jiangsu | Jiangxi | Liaoning | Inner Mongolia | Ningxia | Qinghai | Shandong | Shanxi | Shaanxi | Shanghai | Sichuan | Taiwan | Tianjin | Tibet | Hong Kong | Xinjiang | Yunnan | Zhejiang | Chongqing | Wuhan |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/24 | 277 | 24 | 0 | 14 | 6 | 2 | 25 | 10 | 1 | 9 | 6 | 23 | 5 | 180 | 19 | 1 | 9 | 11 | 8 | 1 | 1 | | 12 | 5 | 10 | 13 | 13 | 2 | 3 | | 3 | 1 | 3 | 19 | 30 | 77 |
| 1/25 | 365 | 21 | 0 | 5 | 8 | 3 | 20 | 10 | 1 | 5 | 5 | 51 | 6 | 323 | 26 | 0 | 13 | 18 | 4 | 5 | 1 | 1 | 18 | 3 | 7 | 7 | 16 | 0 | 2 | | 0 | 1 | 6 | 42 | 18 | 46 |
| 1/26 | 398 | 10 | 3 | 27 | 17 | 7 | 48 | 13 | 2 | 9 | 5 | 45 | 6 | 371 | 31 | 2 | 16 | 12 | 6 | 4 | 3 | 3 | 24 | 4 | 13 | 13 | 25 | 1 | 4 | | 3 | 1 | 8 | 24 | 35 | 80 |
| 1/27 | 480 | 36 | 2 | 12 | 38 | 5 | 42 | 5 | 2 | 9 | 15 | 40 | 9 | 1291 | 43 | 2 | 23 | 24 | 8 | 2 | 4 | 2 | 24 | 7 | 11 | 13 | 21 | 1 | 8 | | 0 | 5 | 7 | 45 | 22 | 892 |
| 1/28 | 619 | 46 | 0 | 11 | 9 | 5 | 53 | 7 | 0 | 3 | 15 | 38 | 7 | 840 | 78 | 1 | 29 | 37 | 6 | 3 | 1 | 0 | 34 | 7 | 10 | 14 | 18 | 3 | 2 | | 0 | 3 | 18 | 123 | 15 | 315 |
| 1/29 | 705 | 48 | 0 | 23 | 19 | 2 | 70 | 20 | 3 | 3 | 17 | 72 | 6 | 1032 | 56 | 5 | 30 | 53 | 3 | 2 | 5 | 0 | 24 | 8 | 7 | 16 | 34 | 0 | 3 | 1 | 2 | 1 | 26 | 132 | 18 | 356 |
| 1/30 | 761 | 37 | 0 | 18 | 19 | 3 | 82 | 9 | 3 | 3 | 17 | 74 | 16 | 1220 | 55 | 0 | 39 | 78 | 6 | 2 | 4 | 2 | 33 | 4 | 24 | 32 | 35 | 1 | 4 | 0 | 0 | 3 | 6 | 109 | 41 | 378 |
| 1/31 | 752 | 60 | 0 | 24 | 24 | 6 | 127 | 13 | 14 | 8 | 14 | 70 | 21 | 1347 | 57 | 3 | 34 | 46 | 15 | 3 | 5 | 1 | 24 | 8 | 14 | 25 | 30 | 1 | 1 | 0 | 2 | 1 | 15 | 62 | 32 | 576 |
| 2/1 | 668 | 43 | 0 | 27 | 15 | 5 | 84 | 11 | 9 | 6 | 8 | 71 | 15 | 1921 | 74 | 6 | 34 | 47 | 4 | 4 | 2 | 0 | 23 | 9 | 15 | 24 | 24 | 0 | 9 | 0 | 2 | 3 | 8 | 62 | 24 | 894 |
| 2/2 | 722 | 68 | 1 | 29 | 20 | 11 | 79 | 16 | 8 | 7 | 9 | 73 | 23 | 2103 | 58 | 7 | 35 | 58 | 6 | 7 | 3 | 4 | 21 | 10 | 12 | 16 | 23 | 0 | 7 | 0 | 1 | 3 | 10 | 63 | 38 | 1033 |
| 2/3 | 888 | 72 | 0 | 16 | 15 | 4 | 114 | 12 | 10 | 9 | 13 | 109 | 37 | 2345 | 72 | 12 | 37 | 85 | 4 | 1 | 3 | 2 | 24 | 8 | 14 | 15 | 28 | 0 | 12 | 0 | 0 | 5 | 8 | 105 | 37 | 1242 |
| 2/4 | 730 | 50 | 2 | 25 | 11 | 2 | 73 | 11 | 8 | 10 | 9 | 89 | 35 | 3156 | 68 | 12 | 33 | 72 | 7 | 7 | 0 | 2 | 28 | 7 | 23 | 25 | 19 | 1 | 7 | 0 | 0 | 3 | 5 | 66 | 29 | 1967 |
| 2/5 | 707 | 61 | 0 | 21 | 10 | 5 | 74 | 18 | 5 | 11 | 22 | 87 | 37 | 2987 | 50 | 5 | 32 | 52 | 8 | 4 | 6 | 1 | 45 | 9 | 8 | 21 | 20 | 0 | 2 | 0 | 3 | 4 | 6 | 59 | 23 | 1766 |
| 2/6 | 696 | 74 | 0 | 23 | 9 | 5 | 74 | 4 | 8 | 11 | 14 | 63 | 50 | 2447 | 61 | 6 | 35 | 61 | 5 | 4 | 3 | 0 | 36 | 6 | 11 | 15 | 23 | 5 | 10 | 0 | 6 | 3 | 7 | 52 | 22 | 1501 |
| 2/7 | 592 | 68 | 0 | 18 | 15 | 4 | 57 | 11 | 12 | 13 | 24 | 67 | 18 | 2841 | 31 | 4 | 31 | 37 | 5 | 2 | 2 | 0 | 28 | 8 | 11 | 12 | 19 | 0 | 2 | 0 | 2 | 3 | 3 | 42 | 15 | 1985 |
| 2/8 | 421 | 46 | 0 | 11 | 11 | 8 | 45 | 12 | 7 | 4 | 11 | 52 | 12 | 2147 | 35 | 9 | 29 | 42 | 6 | 2 | 0 | 0 | 28 | 11 | 13 | 11 | 23 | 2 | 7 | 0 | 0 | 3 | 2 | 27 | 20 | 1379 |
| 2/9 | 531 | 51 | 0 | 11 | 11 | 4 | 31 | 15 | 13 | 8 | 12 | 40 | 24 | 2531 | 41 | 2 | 24 | 31 | 2 | 4 | 4 | 0 | 24 | 4 | 5 | 3 | 19 | 0 | 2 | 0 | 10 | 4 | 1 | 17 | 22 | 1920 |
| 2/10 | 387 | 30 | 0 | 5 | 6 | 3 | 26 | 5 | 9 | 6 | 21 | 32 | 29 | 2097 | 33 | 1 | 23 | 33 | 4 | 0 | 4 | 0 | 27 | 3 | 6 | 7 | 12 | 0 | 5 | 0 | 6 | 6 | 8 | 25 | 18 | 1552 |
| 2/11 | 384 | 29 | 0 | 10 | 5 | 0 | 42 | 7 | 13 | 3 | 12 | 30 | 18 | 1638 | 34 | 2 | 28 | 40 | 5 | 2 | 5 | 0 | 11 | 2 | 6 | 4 | 19 | 0 | 11 | 0 | 7 | 4 | 5 | 14 | 19 | 1104 |
| 2/12 | 312 | 21 | 0 | 14 | 7 | 1 | 22 | 0 | 4 | 12 | 14 | 34 | 17 | 14840 | 22 | 1 | 27 | 28 | 0 | 1 | 6 | 0 | 9 | 2 | 4 | 7 | 15 | 0 | 6 | 0 | 1 | 4 | 1 | 14 | 13 | 13436 |
| 2/13 | 270 | 24 | 0 | 6 | 2 | 3 | 20 | 4 | 5 | 0 | 18 | 15 | 23 | 3780 | 20 | 2 | 23 | 28 | 1 | 4 | 3 | 0 | 13 | 0 | 1 | 5 | 12 | 0 | 7 | 0 | 3 | 2 | 7 | 10 | 11 | 2997 |
| 2/14 | 223 | 16 | 0 | 3 | 4 | 0 | 33 | 9 | 3 | 5 | 8 | 28 | 7 | 2420 | 13 | 2 | 11 | 13 | 2 | 3 | 3 | 0 | 11 | 1 | 2 | 8 | 7 | 0 | 1 | 0 | 3 | 5 | 6 | 7 | 8 | 1923 |
| 2/15 | 166 | 12 | 0 | 5 | 2 | 0 | 22 | 2 | 1 | 0 | 9 | 19 | 20 | 1843 | 3 | 1 | 13 | 12 | 1 | 2 | 0 | 0 | 7 | 1 | 0 | 2 | 11 | 0 | 2 | 0 | 0 | 1 | 1 | 5 | 7 | 1548 |
| 2/16 | 120 | 11 | 0 | 1 | 3 | 0 | 6 | 1 | 2 | 0 | 1 | 15 | 12 | 1933 | 2 | 0 | 9 | 5 | 1 | 2 | 0 | 0 | 4 | 1 | 4 | 3 | 14 | 2 | 2 | 0 | 1 | 4 | 2 | 4 | 7 | 1690 |
| 2/17 | 84 | 9 | 0 | 6 | 2 | 1 | 6 | 4 | 0 | 1 | 1 | 11 | 7 | 1807 | 1 | 0 | 3 | 3 | 0 | 1 | 0 | 0 | 2 | 1 | 4 | 2 | 13 | 2 | 1 | 0 | 3 | 1 | 1 | 1 | 2 | 1600 |
| 2/18 | 55 | 4 | 0 | 6 | 1 | 0 | 3 | 2 | 0 | 0 | 4 | 4 | 6 | 1693 | 1 | 1 | 2 | 0 | 0 | 2 | 1 | 0 | 1 | 1 | 0 | 0 | 6 | 0 | 3 | 0 | 2 | 0 | 0 | 1 | 2 | 1660 |
| 2/19 | 50 | 1 | 0 | 2 | 0 | 0 | 1 | 1 | 0 | 5 | 1 | 4 | 6 | 775 | 2 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 0 | 6 | 2 | 2 | 0 | 3 | 0 | 0 | 2 | 5 | 615 |
| 2/20 | 261 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 2 | 3 | 631 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 202 | 1 | 3 | 1 | 5 | 0 | 1 | 0 | 3 | 0 | 2 | 28 | 7 | 319 |
| 2/21 | 33 | 1 | 0 | 3 | 0 | 0 | 6 | 3 | 0 | 0 | 1 | 3 | 0 | 366 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 1 | 2 | 2 | 0 | 0 | 0 | 0 | 2 | 5 | 314 |
| 2/22 | 19 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 2 | 1 | 1 | 435 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 1 | 0 | 0 | 2 | 0 | 1 | 0 | 0 | 0 | 1 | 541 |
| 2/23 | 18 | 0 | 0 | 0 | 0 | 0 | 3 | 2 | 0 | 0 | 0 | 0 | 0 | 398 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 2 | 0 | 0 | 5 | 0 | 0 | 0 | 2 | 406 |
| 2/24 | 18 | 0 | 0 | 1 | 1 | 0 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 499 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 2 | 2 | 0 | 0 | 7 | 0 | 0 | 0 | 1 | 464 |
| 2/25 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 401 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 2 | 1 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 370 |
| 2/26 | 31 | 0 | 0 | 10 | 2 | 0 | 0 | 0 | 0 | 0 | 5 | 1 | 0 | 409 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 3 | 1 | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 383 |
| 2/27 | 11 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 318 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 313 |
| 2/28 | 7 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 423 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 420 |
| 2/29 | 9 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 570 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 565 |
| 3/1 | 10 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 196 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 193 |
| 3/2 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 114 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 2 | 0 | 0 | 8 | 0 | 111 |
| 3/3 | 5 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 115 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 114 |
| 3/4 | 9 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 134 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 4 | 0 | 0 | 2 | 0 | 131 |
| 3/5 | 19 | 0 | 0 | 4 | 0 | 11 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 126 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 126 |
| 3/6 | 29 | 0 | 0 | 4 | 0 | 17 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 74 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 1 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 74 |
| 3/7 | 5 | 0 | 0 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 41 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 41 |
| Total | 13152 | 990 | 10 | 428 | 296 | 120 | 1352 | 252 | 146 | 168 | 318 | 1272 | 481 | 67707 | 1018 | 93 | 631 | 935 | 125 | 75 | 75 | 18 | 758 | 133 | 245 | 342 | 539 | 45 | 136 | 1 | 109 | 76 | 174 | 1215 | 576 | 49912 |

**Figure 3. Cumulative cure rate of COVID-19 in 34 provinces in China**

| Date | Outside Hubei | Anhui | Macao | Beijing | Fujian | Gansu | Guangdong | Guangxi | Guizhou | Hainan | Hebei | Henan | Heilongjiang | Hubei | Hunan | Jilin | Jiangsu | Jiangxi | Liaoning | Inner Mongolia | Ningxia | Qinghai | Shandong | Shanxi | Shaanxi | Shanghai | Sichuan | Taiwan | Tianjin | Tibet | Hong Kong | Xinjiang | Yunnan | Zhejiang | Chongqing |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/24 | 1.1 | 0.0 | 0.0 | 2.8 | 0.0 | 0.0 | 2.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4.4 | 0.0 | 0.0 | 5.6 | 0.0 | 0.0 | 0.0 | 0.0 |  | 0.0 | 0.0 | 0.0 | 3.0 | 0.0 | 0.0 | 0.0 |  | 0.0 | 0.0 | 0.0 | 1.6 | 0.0 |
| 1/25 | 0.7 | 0.0 | 0.0 | 2.4 | 0.0 | 0.0 | 2.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4.0 | 0.0 | 0.0 | 3.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.5 | 0.0 | 0.0 | 0.0 |  | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 |
| 1/26 | 0.5 | 0.0 | 0.0 | 1.5 | 0.0 | 0.0 | 1.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.1 | 0.0 | 0.0 | 2.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.9 | 0.0 | 0.0 | 0.0 |  | 0.0 | 0.0 | 0.0 | 0.8 | 0.0 |
| 1/27 | 0.7 | 0.0 | 0.0 | 2.5 | 0.0 | 0.0 | 2.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.7 | 0.0 | 0.0 | 1.4 | 2.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4.5 | 0.0 | 0.0 | 0.0 |  | 0.0 | 0.0 | 0.0 | 0.6 | 0.0 |
| 1/28 | 1.0 | 0.0 | 0.0 | 4.4 | 0.0 | 0.0 | 2.1 | 3.4 | 11.1 | 0.0 | 0.0 | 0.5 | 0.0 | 2.3 | 0.0 | 0.0 | 1.0 | 2.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 5.0 | 0.0 | 0.0 | 0.0 |  | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 |
| 1/29 | 1.2 | 1.0 | 0.0 | 3.5 | 0.0 | 0.0 | 1.9 | 2.6 | 8.3 | 2.2 | 0.0 | 0.7 | 0.0 | 2.0 | 0.0 | 0.0 | 0.8 | 1.9 | 2.6 | 0.0 | 0.0 | 0.0 | 0.7 | 2.9 | 0.0 | 5.2 | 0.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.9 | 0.6 |
| 1/30 | 1.4 | 1.3 | 0.0 | 3.8 | 0.0 | 0.0 | 2.3 | 2.3 | 6.7 | 2.0 | 0.0 | 0.9 | 0.0 | 2.0 | 0.6 | 7.1 | 1.2 | 2.9 | 2.2 | 0.0 | 0.0 | 0.0 | 1.1 | 2.6 | 0.0 | 3.9 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.7 | 0.5 |
| 1/31 | 1.7 | 1.0 | 0.0 | 3.2 | 0.0 | 0.0 | 1.9 | 2.0 | 6.9 | 1.8 | 0.0 | 0.7 | 0.0 | 2.3 | 0.8 | 5.9 | 2.5 | 3.1 | 1.7 | 4.3 | 0.0 | 0.0 | 1.0 | 2.1 | 0.0 | 5.9 | 1.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.1 | 2.5 | 0.4 |
| 2/1 | 2.1 | 1.5 | 0.0 | 4.9 | 0.0 | 0.0 | 2.0 | 1.8 | 5.3 | 1.6 | 2.9 | 0.8 | 2.1 | 2.4 | 1.7 | 4.3 | 2.5 | 3.0 | 1.6 | 3.7 | 0.0 | 0.0 | 2.2 | 1.8 | 0.0 | 5.6 | 1.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.0 | 3.5 | 1.1 |
| 2/2 | 3.1 | 1.7 | 0.0 | 5.7 | 0.0 | 5.9 | 2.0 | 1.6 | 4.3 | 5.7 | 2.7 | 2.5 | 1.7 | 2.6 | 3.1 | 3.3 | 2.6 | 4.6 | 1.4 | 2.9 | 0.0 | 0.0 | 2.4 | 3.0 | 0.0 | 5.2 | 4.7 | 0.0 | 2.1 | 0.0 | 0.0 | 0.0 | 2.8 | 5.0 | 2.3 |
| 2/3 | 3.6 | 2.9 | 0.0 | 10.1 | 0.5 | 5.5 | 2.5 | 5.0 | 3.6 | 5.1 | 2.4 | 3.0 | 1.3 | 2.9 | 3.7 | 2.4 | 2.6 | 4.0 | 1.4 | 2.9 | 2.9 | 0.0 | 2.6 | 2.7 | 0.7 | 4.8 | 5.0 | 0.0 | 1.7 | 0.0 | 0.0 | 0.0 | 4.3 | 5.8 | 2.7 |
| 2/4 | 4.9 | 3.8 | 0.0 | 9.5 | 3.4 | 7.0 | 3.7 | 6.7 | 7.8 | 4.5 | 3.0 | 5.4 | 2.1 | 3.1 | 5.3 | 1.9 | 3.8 | 4.9 | 2.5 | 2.4 | 2.9 | 0.0 | 4.4 | 4.9 | 1.2 | 5.2 | 7.6 | 0.0 | 3.0 | 0.0 | 0.0 | 0.0 | 4.1 | 7.0 | 3.8 |
| 2/5 | 6.2 | 3.9 | 0.0 | 11.3 | 5.1 | 9.7 | 5.2 | 8.3 | 8.7 | 5.0 | 4.5 | 6.3 | 3.1 | 3.3 | 7.9 | 3.4 | 7.0 | 6.2 | 4.5 | 8.7 | 2.5 | 16.7 | 5.2 | 6.7 | 4.0 | 5.9 | 8.4 | 0.0 | 2.9 | 0.0 | 0.0 | 0.0 | 3.9 | 8.5 | 3.9 |
| 2/6 | 8.0 | 5.1 | 10.0 | 11.1 | 6.7 | 13.4 | 6.8 | 9.9 | 7.8 | 7.2 | 9.4 | 7.4 | 2.9 | 3.7 | 11.8 | 6.2 | 9.3 | 6.8 | 5.3 | 8.0 | 2.3 | 16.7 | 8.2 | 12.5 | 6.0 | 9.3 | 10.8 | 6.3 | 2.5 | 0.0 | 0.0 | 0.0 | 5.2 | 9.7 | 5.8 |
| 2/7 | 9.7 | 6.4 | 10.0 | 10.8 | 8.4 | 12.7 | 9.0 | 9.3 | 6.7 | 8.9 | 12.8 | 9.9 | 4.1 | 4.5 | 14.8 | 5.8 | 9.8 | 7.9 | 7.1 | 9.6 | 11.1 | 16.7 | 9.3 | 14.4 | 4.6 | 10.7 | 13.8 | 6.3 | 2.5 | 0.0 | 0.0 | 0.0 | 8.7 | 12.1 | 7.3 |
| 2/8 | 12.1 | 7.6 | 10.0 | 11.3 | 9.6 | 15.2 | 11.2 | 9.2 | 7.3 | 11.7 | 14.6 | 12.7 | 4.2 | 5.3 | 19.0 | 6.4 | 10.9 | 9.7 | 11.4 | 9.3 | 28.9 | 16.7 | 11.5 | 18.3 | 8.2 | 14.0 | 15.5 | 5.6 | 4.5 | 0.0 | 0.0 | 0.0 | 12.1 | 16.1 | 8.7 |
| 2/9 | 14.0 | 8.8 | 10.0 | 13.1 | 13.4 | 19.3 | 12.4 | 8.6 | 6.4 | 14.0 | 16.1 | 15.8 | 4.5 | 6.1 | 21.2 | 15.0 | 14.6 | 13.2 | 11.2 | 8.6 | 26.5 | 16.7 | 13.7 | 21.0 | 9.4 | 14.9 | 18.8 | 5.6 | 4.4 | 0.0 | 0.0 | 0.0 | 12.8 | 18.3 | 10.9 |
| 2/10 | 16.2 | 10.2 | 10.0 | 14.0 | 14.6 | 24.4 | 15.4 | 14.0 | 8.5 | 13.4 | 17.2 | 17.9 | 7.5 | 7.0 | 23.4 | 16.0 | 16.3 | 15.8 | 15.3 | 8.6 | 26.4 | 16.7 | 14.6 | 21.3 | 11.9 | 15.9 | 19.7 | 5.6 | 8.4 | 0.0 | 0.0 | 0.0 | 12.8 | 22.4 | 13.6 |
| 2/11 | 18.5 | 12.1 | 10.0 | 15.9 | 16.9 | 27.9 | 19.8 | 14.0 | 13.0 | 13.8 | 19.1 | 20.4 | 7.4 | 7.9 | 27.8 | 21.7 | 17.3 | 18.0 | 16.4 | 8.3 | 37.9 | 27.8 | 16.1 | 24.2 | 13.8 | 17.3 | 19.5 | 5.6 | 9.4 | 0.0 | 0.0 | 5.1 | 13.0 | 24.7 | 15.6 |
| 2/12 | 21.2 | 14.1 | 20.0 | 18.6 | 19.4 | 35.6 | 22.9 | 14.9 | 14.8 | 17.2 | 20.4 | 22.1 | 7.8 | 6.6 | 32.2 | 26.2 | 23.0 | 19.5 | 19.0 | 9.8 | 37.5 | 50.0 | 19.4 | 26.2 | 15.7 | 18.2 | 20.6 | 5.6 | 9.8 | 100.0 | 2.0 | 4.8 | 14.8 | 28.6 | 19.7 |
| 2/13 | 24.0 | 17.8 | 30.0 | 21.2 | 21.0 | 43.3 | 26.3 | 15.5 | 20.0 | 19.1 | 24.4 | 26.4 | 8.9 | 7.4 | 35.6 | 29.1 | 23.1 | 20.8 | 18.8 | 9.2 | 35.8 | 61.1 | 21.4 | 28.6 | 19.1 | 19.5 | 22.7 | 5.6 | 17.6 | 100.0 | 1.9 | 9.2 | 16.7 | 31.8 | 24.2 |
| 2/14 | 27.3 | 20.8 | 30.0 | 25.9 | 23.2 | 48.9 | 29.8 | 17.0 | 23.1 | 23.5 | 29.6 | 29.4 | 11.3 | 8.8 | 38.9 | 28.4 | 26.5 | 23.0 | 24.4 | 8.8 | 38.6 | 61.1 | 26.2 | 29.9 | 21.1 | 27.6 | 24.5 | 5.6 | 26.7 | 100.0 | 1.8 | 8.6 | 20.8 | 35.2 | 28.3 |
| 2/15 | 30.7 | 24.1 | 30.0 | 27.6 | 26.8 | 54.4 | 33.1 | 19.4 | 25.7 | 24.1 | 33.3 | 32.3 | 15.7 | 10.0 | 42.8 | 31.5 | 30.8 | 25.8 | 26.7 | 10.0 | 47.1 | 72.2 | 30.5 | 35.9 | 22.8 | 37.8 | 26.4 | 11.1 | 30.3 | 100.0 | 1.8 | 15.5 | 24.9 | 37.4 | 33.8 |
| 2/16 | 33.8 | 27.3 | 50.0 | 29.9 | 29.0 | 60.0 | 35.8 | 21.4 | 32.2 | 32.1 | 36.2 | 35.2 | 17.5 | 11.4 | 46.4 | 33.7 | 36.1 | 29.6 | 33.9 | 11.1 | 47.1 | 72.2 | 32.3 | 38.8 | 27.1 | 42.3 | 27.5 | 10.0 | 36.3 | 100.0 | 3.5 | 16.0 | 24.6 | 40.1 | 37.6 |
| 2/17 | 37.5 | 29.8 | 50.0 | 31.5 | 31.2 | 63.7 | 39.9 | 24.0 | 45.2 | 36.2 | 40.7 | 40.2 | 18.3 | 13.1 | 49.8 | 38.2 | 41.8 | 33.2 | 35.5 | 11.0 | 50.0 | 72.2 | 35.5 | 40.8 | 32.9 | 48.3 | 32.1 | 9.1 | 36.8 | 100.0 | 3.3 | 15.8 | 27.3 | 43.9 | 40.7 |
| 2/18 | 41.8 | 36.6 | 50.0 | 36.9 | 32.8 | 68.1 | 42.9 | 31.1 | 47.3 | 48.5 | 44.4 | 43.8 | 23.0 | 14.8 | 53.8 | 40.0 | 46.9 | 38.8 | 45.5 | 12.0 | 59.2 | 83.3 | 39.5 | 46.6 | 37.1 | 53.2 | 34.4 | 9.1 | 37.5 | 100.0 | 6.5 | 18.4 | 33.1 | 46.4 | 45.8 |
| 2/19 | 46.0 | 43.0 | 60.0 | 38.7 | 38.2 | 71.4 | 46.5 | 35.5 | 48.6 | 50.0 | 49.5 | 48.5 | 25.8 | 16.6 | 57.2 | 44.0 | 51.5 | 46.3 | 47.9 | 14.7 | 59.2 | 88.9 | 43.6 | 51.9 | 36.8 | 55.9 | 38.1 | 8.3 | 41.5 | 100.0 | 7.7 | 26.3 | 34.9 | 51.8 | 48.9 |
| 2/20 | 50.2 | 50.6 | 60.0 | 42.7 | 45.7 | 78.0 | 49.8 | 38.6 | 52.1 | 53.0 | 55.2 | 56.6 | 29.4 | 18.7 | 63.1 | 48.4 | 55.8 | 52.4 | 50.4 | 21.3 | 62.0 | 88.9 | 36.1 | 57.6 | 44.9 | 59.6 | 42.3 | 8.3 | 45.0 | 100.0 | 7.4 | 28.9 | 45.4 | 53.8 | 52.7 |
| 2/21 | 54.8 | 57.2 | 60.0 | 44.6 | 51.2 | 83.5 | 53.8 | 39.8 | 61.6 | 57.1 | 59.5 | 63.1 | 38.2 | 21.4 | 66.1 | 50.5 | 61.3 | 58.2 | 54.5 | 29.3 | 67.6 | 100.0 | 39.1 | 59.1 | 47.8 | 63.2 | 46.0 | 7.7 | 46.6 | 100.0 | 8.8 | 31.6 | 55.2 | 57.6 | 55.2 |
| 2/22 | 58.6 | 62.7 | 60.0 | 47.4 | 56.3 | 83.5 | 55.1 | 41.8 | 62.3 | 61.9 | 65.6 | 67.7 | 44.8 | 23.9 | 69.3 | 57.1 | 65.1 | 65.4 | 56.2 | 34.7 | 67.6 | 100.0 | 41.2 | 61.4 | 57.1 | 67.8 | 48.7 | 7.7 | 48.1 | 100.0 | 15.9 | 32.9 | 61.5 | 60.5 | 57.2 |
| 2/23 | 61.7 | 65.5 | 60.0 | 49.6 | 59.4 | 85.7 | 57.4 | 42.6 | 69.9 | 63.1 | 71.1 | 73.2 | 46.7 | 26.0 | 71.0 | 58.1 | 67.7 | 69.1 | 60.3 | 40.0 | 80.3 | 100.0 | 43.0 | 66.7 | 62.4 | 74.3 | 49.9 | 17.9 | 60.0 | 100.0 | 16.2 | 36.8 | 66.1 | 63.5 | 58.3 |
| 2/24 | 65.4 | 70.0 | 60.0 | 53.8 | 63.9 | 87.9 | 59.8 | 51.2 | 70.5 | 69.0 | 77.5 | 77.8 | 48.3 | 29.1 | 73.9 | 64.5 | 72.6 | 73.0 | 68.6 | 45.3 | 81.7 | 100.0 | 45.4 | 70.7 | 71.4 | 77.9 | 52.6 | 16.7 | 64.4 | 100.0 | 22.2 | 39.5 | 71.3 | 65.9 | 60.6 |
| 2/25 | 68.2 | 73.5 | 70.0 | 58.8 | 69.7 | 87.9 | 62.4 | 54.8 | 71.2 | 73.8 | 79.5 | 80.5 | 51.0 | 32.1 | 76.7 | 67.7 | 73.4 | 77.0 | 72.7 | 46.7 | 85.9 | 100.0 | 47.2 | 73.7 | 75.9 | 79.8 | 55.0 | 16.1 | 67.4 | 100.0 | 21.2 | 39.5 | 74.1 | 67.6 | 64.6 |
| 2/26 | 71.6 | 77.2 | 70.0 | 60.5 | 76.0 | 89.0 | 64.8 | 63.1 | 76.7 | 76.8 | 82.3 | 83.5 | 54.6 | 35.4 | 78.0 | 69.9 | 78.3 | 80.7 | 76.0 | 50.7 | 90.3 | 100.0 | 50.4 | 78.2 | 79.2 | 80.7 | 58.1 | 15.6 | 71.1 | 100.0 | 26.4 | 44.7 | 82.8 | 73.1 | 66.7 |
| 2/27 | 74.8 | 82.2 | 80.0 | 62.7 | 78.4 | 90.1 | 68.2 | 65.9 | 76.7 | 78.6 | 86.2 | 86.7 | 58.3 | 40.1 | 80.6 | 73.1 | 80.2 | 84.5 | 76.9 | 57.3 | 94.4 | 100.0 | 51.6 | 80.5 | 80.4 | 81.9 | 60.6 | 18.8 | 75.0 | 100.0 | 28.0 | 56.6 | 86.2 | 78.3 | 69.6 |
| 2/28 | 77.8 | 85.1 | 80.0 | 65.9 | 81.4 | 90.1 | 72.1 | 68.3 | 76.7 | 81.0 | 87.1 | 91.3 | 61.5 | 43.6 | 82.6 | 78.5 | 82.3 | 86.7 | 78.5 | 61.3 | 93.2 | 100.0 | 54.4 | 84.2 | 81.6 | 82.8 | 65.1 | 26.5 | 77.2 | 100.0 | 31.9 | 68.4 | 89.7 | 81.9 | 73.3 |
| 2/29 | 80.3 | 87.7 | 80.0 | 66.8 | 82.1 | 90.1 | 74.8 | 71.0 | 76.7 | 88.1 | 89.0 | 93.2 | 68.8 | 46.6 | 83.8 | 80.6 | 83.8 | 88.9 | 82.8 | 68.0 | 94.5 | 100.0 | 57.0 | 85.7 | 84.5 | 85.2 | 67.5 | 23.1 | 80.1 | 100.0 | 34.7 | 81.6 | 90.2 | 85.2 | 76.0 |
| 3/1 | 82.3 | 89.7 | 80.0 | 68.1 | 83.4 | 92.3 | 76.6 | 74.6 | 78.1 | 89.9 | 92.5 | 94.7 | 72.9 | 50.3 | 86.1 | 83.9 | 84.9 | 90.9 | 84.4 | 68.0 | 93.2 | 100.0 | 60.0 | 87.2 | 85.3 | 86.1 | 70.3 | 30.0 | 81.6 | 100.0 | 36.7 | 84.2 | 93.7 | 87.1 | 78.1 |
| 3/2 | 84.8 | 92.6 | 80.0 | 69.6 | 86.1 | 93.4 | 80.1 | 80.2 | 78.1 | 89.9 | 93.4 | 96.1 | 74.6 | 53.8 | 87.6 | 89.2 | 88.0 | 93.0 | 82.4 | 72.0 | 93.2 | 100.0 | 65.6 | 89.5 | 88.2 | 86.4 | 72.3 | 29.3 | 86.8 | 100.0 | 36.0 | 88.2 | 96.6 | 89.5 | 81.4 |
| 3/3 | 86.8 | 95.1 | 90.0 | 70.5 | 88.2 | 94.5 | 83.6 | 83.3 | 78.1 | 92.3 | 94.3 | 97.0 | 77.5 | 57.3 | 89.7 | 90.3 | 89.5 | 94.5 | 84.8 | 78.7 | 92.0 | 100.0 | 67.4 | 93.2 | 89.0 | 87.0 | 74.3 | 28.6 | 91.2 | 100.0 | 37.0 | 89.5 | 97.1 | 91.3 | 85.1 |
| 3/4 | 88.8 | 96.6 | 90.0 | 71.1 | 91.2 | 95.6 | 85.9 | 84.5 | 78.1 | 94.0 | 94.7 | 97.4 | 78.8 | 60.0 | 91.7 | 92.5 | 91.9 | 96.4 | 84.8 | 84.0 | 92.0 | 100.0 | 76.0 | 93.2 | 90.6 | 88.2 | 77.6 | 28.6 | 94.1 | 100.0 | 41.3 | 90.8 | 97.1 | 93.0 | 87.2 |
| 3/5 | 90.2 | 98.0 | 90.0 | 70.6 | 93.9 | 85.3 | 89.5 | 86.1 | 78.1 | 94.0 | 95.6 | 97.6 | 79.0 | 62.1 | 92.9 | 94.6 | 93.2 | 97.1 | 84.8 | 86.7 | 92.0 | 100.0 | 79.4 | 94.7 | 91.4 | 89.4 | 79.4 | 27.3 | 94.1 | 100.0 | 44.2 | 92.1 | 97.1 | 94.9 | 88.9 |
| 3/6 | 91.3 | 98.9 | 100.0 | 71.1 | 95.9 | 73.1 | 91.2 | 86.9 | 78.8 | 94.0 | 95.9 | 97.7 | 83.6 | 64.2 | 94.2 | 96.8 | 95.2 | 98.0 | 84.8 | 86.7 | 94.7 | 100.0 | 82.5 | 94.7 | 92.2 | 89.5 | 83.1 | 26.7 | 94.1 | 100.0 | 47.7 | 93.4 | 97.7 | 95.6 | 90.3 |
| 3/7 | 92.2 | 99.1 | 100.0 | 72.0 | 99.7 | 72.5 | 92.5 | 88.5 | 80.1 | 94.0 | 96.5 | 98.0 | 85.0 | 66.5 | 94.8 | 96.8 | 96.7 | 98.2 | 86.4 | 90.7 | 94.7 | 100.0 | 84.0 | 94.7 | 92.2 | 91.5 | 84.8 | 28.9 | 94.1 | 100.0 | 50.5 | 94.7 | 97.7 | 96.2 | 91.3 |

**Figure 4. Cumulative mortality rate of COVID-19 in 34 provinces in China**

| Date | Outside Hubei | Anhui | Macao | Beijing | Fujian | Gansu | Guangdong | Guangxi | Guizhou | Hainan | Hebei | Henan | Heilongjiang | Hubei | Hunan | Jilin | Jiangsu |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/24 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 12.5 | 0.0 | 11.1 | 5.3 | 0.0 | 0.0 | 0.0 |
| 1/25 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 7.7 | 1.2 | 6.7 | 4.9 | 0.0 | 0.0 | 0.0 |
| 1/26 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.2 | 5.6 | 0.8 | 4.8 | 5.3 | 0.0 | 0.0 | 0.0 |
| 1/27 | 0.3 | 0.0 | 0.0 | 1.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.5 | 3.0 | 0.6 | 3.3 | 3.7 | 0.0 | 0.0 | 0.0 |
| 1/28 | 0.3 | 0.0 | 0.0 | 1.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.3 | 2.1 | 1.0 | 2.7 | 3.5 | 0.0 | 0.0 | 0.0 |
| 1/29 | 0.3 | 0.0 | 0.0 | 0.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.2 | 1.5 | 0.7 | 2.3 | 3.5 | 0.0 | 0.0 | 0.0 |
| 1/30 | 0.2 | 0.0 | 0.0 | 0.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.0 | 1.2 | 0.6 | 3.4 | 3.5 | 0.0 | 0.0 | 0.0 |
| 1/31 | 0.2 | 0.0 | 0.0 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.8 | 1.0 | 0.5 | 2.5 | 3.5 | 0.0 | 0.0 | 0.0 |
| 2/1 | 0.2 | 0.0 | 0.0 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.6 | 1.0 | 0.4 | 2.1 | 3.2 | 0.0 | 0.0 | 0.0 |
| 2/2 | 0.2 | 0.0 | 0.0 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.4 | 0.9 | 0.4 | 1.7 | 3.1 | 0.0 | 0.0 | 0.0 |
| 2/3 | 0.2 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.3 | 0.8 | 0.3 | 1.3 | 3.1 | 0.0 | 0.0 | 0.0 |
| 2/4 | 0.2 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.1 | 0.7 | 0.3 | 1.1 | 2.9 | 0.0 | 0.0 | 0.0 |
| 2/5 | 0.2 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 1.4 | 1.0 | 0.6 | 0.2 | 1.3 | 2.8 | 0.0 | 0.0 | 0.0 |
| 2/6 | 0.2 | 0.0 | 0.0 | 0.3 | 0.0 | 0.0 | 0.1 | 0.0 | 1.3 | 1.8 | 0.6 | 0.3 | 1.1 | 2.8 | 0.0 | 1.5 | 0.0 |
| 2/7 | 0.2 | 0.0 | 0.0 | 0.6 | 0.0 | 1.4 | 0.1 | 0.0 | 1.1 | 1.6 | 0.5 | 0.4 | 1.7 | 2.8 | 0.0 | 1.4 | 0.0 |
| 2/8 | 0.3 | 0.1 | 0.0 | 0.6 | 0.0 | 1.3 | 0.1 | 0.5 | 1.0 | 1.6 | 1.0 | 0.6 | 2.0 | 2.9 | 0.1 | 1.3 | 0.0 |
| 2/9 | 0.4 | 0.4 | 0.0 | 0.6 | 0.0 | 2.4 | 0.1 | 0.5 | 0.9 | 2.2 | 0.9 | 0.6 | 2.1 | 2.9 | 0.1 | 1.3 | 0.0 |
| 2/10 | 0.4 | 0.5 | 0.0 | 0.9 | 0.0 | 2.3 | 0.1 | 0.5 | 0.8 | 2.1 | 0.8 | 0.6 | 2.2 | 3.1 | 0.1 | 1.2 | 0.0 |
| 2/11 | 0.4 | 0.4 | 0.0 | 0.9 | 0.0 | 2.3 | 0.1 | 0.5 | 0.8 | 2.1 | 0.8 | 0.7 | 2.1 | 3.2 | 0.2 | 1.2 | 0.0 |
| 2/12 | 0.5 | 0.5 | 0.0 | 0.8 | 0.0 | 2.3 | 0.2 | 0.9 | 0.7 | 2.5 | 1.1 | 0.9 | 2.3 | 2.5 | 0.2 | 1.2 | 0.0 |
| 2/13 | 0.5 | 0.6 | 0.0 | 0.8 | 0.0 | 2.2 | 0.2 | 0.9 | 0.7 | 2.5 | 1.1 | 0.9 | 2.6 | 2.5 | 0.2 | 1.2 | 0.0 |
| 2/14 | 0.6 | 0.6 | 0.0 | 1.1 | 0.0 | 2.2 | 0.2 | 0.9 | 0.7 | 2.5 | 1.0 | 1.1 | 2.6 | 2.7 | 0.2 | 1.1 | 0.0 |
| 2/15 | 0.6 | 0.6 | 0.0 | 1.1 | 0.0 | 2.2 | 0.2 | 0.8 | 0.7 | 2.5 | 1.0 | 1.1 | 2.5 | 2.8 | 0.3 | 1.1 | 0.0 |
| 2/16 | 0.6 | 0.6 | 0.0 | 1.0 | 0.0 | 2.2 | 0.3 | 0.8 | 0.7 | 2.5 | 1.0 | 1.3 | 2.4 | 2.9 | 0.3 | 1.1 | 0.0 |
| 2/17 | 0.6 | 0.6 | 0.0 | 1.0 | 0.0 | 2.2 | 0.3 | 0.8 | 0.7 | 2.5 | 1.3 | 1.5 | 2.4 | 3.0 | 0.4 | 1.1 | 0.0 |
| 2/18 | 0.7 | 0.6 | 0.0 | 1.0 | 0.0 | 2.2 | 0.4 | 0.8 | 1.4 | 2.5 | 1.3 | 1.5 | 2.6 | 3.1 | 0.4 | 1.1 | 0.0 |
| 2/19 | 0.7 | 0.6 | 0.0 | 1.0 | 0.3 | 2.2 | 0.4 | 0.8 | 1.4 | 2.4 | 1.6 | 1.5 | 2.5 | 3.2 | 0.4 | 1.1 | 0.0 |
| 2/20 | 0.7 | 0.6 | 0.0 | 1.0 | 0.3 | 2.2 | 0.4 | 0.8 | 1.4 | 2.4 | 1.6 | 1.5 | 2.5 | 3.4 | 0.4 | 1.1 | 0.0 |
| 2/21 | 0.8 | 0.6 | 0.0 | 1.0 | 0.3 | 2.2 | 0.4 | 0.8 | 1.4 | 2.4 | 1.9 | 1.5 | 2.5 | 3.5 | 0.4 | 1.1 | 0.0 |
| 2/22 | 0.8 | 0.6 | 0.0 | 1.0 | 0.3 | 2.2 | 0.4 | 0.8 | 1.4 | 2.4 | 1.9 | 1.5 | 2.5 | 3.7 | 0.4 | 1.1 | 0.0 |
| 2/23 | 0.8 | 0.6 | 0.0 | 1.0 | 0.3 | 2.2 | 0.4 | 0.8 | 1.4 | 3.0 | 1.9 | 1.5 | 2.5 | 3.9 | 0.4 | 1.1 | 0.0 |
| 2/24 | 0.8 | 0.6 | 0.0 | 1.0 | 0.3 | 2.2 | 0.5 | 0.8 | 1.4 | 3.0 | 1.9 | 1.5 | 2.5 | 4.0 | 0.4 | 1.1 | 0.0 |
| 2/25 | 0.8 | 0.6 | 0.0 | 1.0 | 0.3 | 2.2 | 0.5 | 0.8 | 1.4 | 3.0 | 1.9 | 1.5 | 2.5 | 4.0 | 0.4 | 1.1 | 0.0 |
| 2/26 | 0.8 | 0.6 | 0.0 | 1.2 | 0.3 | 2.2 | 0.5 | 0.8 | 1.4 | 3.0 | 1.9 | 1.6 | 2.7 | 4.0 | 0.4 | 1.1 | 0.0 |
| 2/27 | 0.8 | 0.6 | 0.0 | 1.7 | 0.3 | 2.2 | 0.5 | 0.8 | 1.4 | 3.0 | 1.9 | 1.6 | 2.7 | 4.1 | 0.4 | 1.1 | 0.0 |
| 2/28 | 0.9 | 0.6 | 0.0 | 1.9 | 0.3 | 2.2 | 0.5 | 0.8 | 1.4 | 3.0 | 1.9 | 1.7 | 2.7 | 4.1 | 0.4 | 1.1 | 0.0 |
| 2/29 | 0.9 | 0.6 | 0.0 | 1.9 | 0.3 | 2.2 | 0.5 | 0.8 | 1.4 | 3.0 | 1.9 | 1.7 | 2.7 | 4.1 | 0.4 | 1.1 | 0.0 |
| 3/1 | 0.9 | 0.6 | 0.0 | 1.9 | 0.3 | 2.2 | 0.5 | 0.8 | 1.4 | 3.0 | 1.9 | 1.7 | 2.7 | 4.2 | 0.4 | 1.1 | 0.0 |
| 3/2 | 0.9 | 0.6 | 0.0 | 1.9 | 0.3 | 2.2 | 0.5 | 0.8 | 1.4 | 3.0 | 1.9 | 1.7 | 2.7 | 4.2 | 0.4 | 1.1 | 0.0 |
| 3/3 | 0.9 | 0.6 | 0.0 | 1.9 | 0.3 | 2.2 | 0.5 | 0.8 | 1.4 | 3.0 | 1.9 | 1.7 | 2.7 | 4.3 | 0.4 | 1.1 | 0.0 |
| 3/4 | 0.9 | 0.6 | 0.0 | 1.9 | 0.3 | 2.2 | 0.5 | 0.8 | 1.4 | 3.0 | 1.9 | 1.7 | 2.7 | 4.3 | 0.4 | 1.1 | 0.0 |
| 3/5 | 0.9 | 0.6 | 0.0 | 1.9 | 0.3 | 2.0 | 0.5 | 0.8 | 1.4 | 3.6 | 1.9 | 1.7 | 2.7 | 4.3 | 0.4 | 1.1 | 0.0 |
| 3/6 | 0.9 | 0.6 | 0.0 | 1.9 | 0.3 | 1.7 | 0.5 | 0.8 | 1.4 | 3.6 | 1.9 | 1.7 | 2.7 | 4.4 | 0.4 | 1.1 | 0.0 |
| 3/7 | 0.9 | 0.6 | 0.0 | 1.9 | 0.3 | 1.7 | 0.5 | 0.8 | 1.4 | 3.6 | 1.9 | 1.7 | 2.7 | 4.4 | 0.4 | 1.1 | 0.0 |

| Date | Jiangxi | Liaoning | Inner Mongolia | Ningxia | Qinghai | Shandong | Shanxi | Shaanxi | Shanghai | Sichuan | Taiwan | Tianjin | Tibet | Hong Kong | Xinjiang | Yunnan | Zhejiang | Chongqing |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/24 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1/25 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.5 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1/26 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.9 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1/27 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.5 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1/28 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.3 | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1/29 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1/30 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.8 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| 1/31 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.7 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 |
| 2/1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.6 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 |
| 2/2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.7 |
| 2/3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.6 |
| 2/4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 | 0.3 | 0.0 | 0.0 | 0.0 | 6.7 | 0.0 | 0.0 | 0.0 | 0.5 |
| 2/5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 | 0.3 | 0.0 | 1.4 | 0.0 | 5.6 | 0.0 | 0.0 | 0.0 | 0.5 |
| 2/6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 | 0.3 | 0.0 | 1.3 | 0.0 | 4.2 | 0.0 | 0.0 | 0.0 | 0.5 |
| 2/7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 | 0.3 | 0.0 | 1.2 | 0.0 | 3.8 | 0.0 | 0.0 | 0.0 | 0.5 |
| 2/8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.3 | 0.3 | 0.0 | 1.1 | 0.0 | 3.8 | 0.0 | 0.0 | 0.0 | 0.4 |
| 2/9 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.3 | 0.2 | 0.0 | 1.1 | 0.0 | 2.8 | 0.0 | 0.0 | 0.0 | 0.4 |
| 2/10 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.3 | 0.2 | 0.0 | 2.1 | 0.0 | 2.4 | 0.0 | 0.0 | 0.0 | 0.4 |
| 2/11 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.3 | 0.2 | 0.0 | 1.9 | 0.0 | 2.0 | 0.0 | 0.0 | 0.0 | 0.6 |
| 2/12 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.3 | 0.2 | 0.0 | 1.8 | 0.0 | 2.0 | 1.6 | 0.0 | 0.0 | 0.6 |
| 2/13 | 0.1 | 0.9 | 0.0 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.3 | 0.2 | 0.0 | 2.5 | 0.0 | 1.9 | 1.5 | 0.0 | 0.0 | 0.8 |
| 2/14 | 0.1 | 0.8 | 0.0 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.3 | 0.2 | 0.0 | 2.5 | 0.0 | 1.8 | 1.4 | 0.0 | 0.0 | 0.9 |
| 2/15 | 0.1 | 0.8 | 0.0 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.3 | 0.6 | 0.0 | 2.5 | 0.0 | 1.8 | 1.4 | 0.0 | 0.0 | 0.9 |
| 2/16 | 0.1 | 0.8 | 0.0 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.3 | 0.6 | 5.0 | 2.4 | 0.0 | 1.8 | 1.3 | 0.0 | 0.0 | 0.9 |
| 2/17 | 0.1 | 0.8 | 0.0 | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 | 0.3 | 0.6 | 4.5 | 2.4 | 0.0 | 1.7 | 1.3 | 0.0 | 0.0 | 0.9 |
| 2/18 | 0.1 | 0.8 | 0.0 | 0.0 | 0.0 | 0.6 | 0.0 | 0.0 | 0.3 | 0.6 | 4.5 | 2.3 | 0.0 | 1.6 | 1.3 | 0.0 | 0.0 | 0.9 |
| 2/19 | 0.1 | 0.8 | 0.0 | 0.0 | 0.0 | 0.7 | 0.0 | 0.0 | 0.6 | 0.6 | 4.2 | 2.3 | 0.0 | 3.1 | 1.3 | 0.6 | 0.0 | 0.9 |
| 2/20 | 0.1 | 0.8 | 0.0 | 0.0 | 0.0 | 0.5 | 0.0 | 0.4 | 0.6 | 0.6 | 4.2 | 2.3 | 0.0 | 2.9 | 1.3 | 1.1 | 0.1 | 1.1 |
| 2/21 | 0.1 | 0.8 | 0.0 | 0.0 | 0.0 | 0.5 | 0.0 | 0.4 | 0.9 | 0.6 | 3.8 | 2.3 | 0.0 | 2.9 | 2.6 | 1.1 | 0.1 | 1.0 |
| 2/22 | 0.1 | 0.8 | 0.0 | 0.0 | 0.0 | 0.5 | 0.0 | 0.4 | 0.9 | 0.6 | 3.8 | 2.2 | 0.0 | 2.9 | 2.6 | 1.1 | 0.1 | 1.0 |
| 2/23 | 0.1 | 0.8 | 0.0 | 0.0 | 0.0 | 0.5 | 0.0 | 0.4 | 0.9 | 0.6 | 3.6 | 2.2 | 0.0 | 2.7 | 2.6 | 1.1 | 0.1 | 1.0 |
| 2/24 | 0.1 | 0.8 | 0.0 | 0.0 | 0.0 | 0.8 | 0.0 | 0.4 | 0.9 | 0.6 | 3.3 | 2.2 | 0.0 | 2.5 | 2.6 | 1.1 | 0.1 | 1.0 |
| 2/25 | 0.1 | 0.8 | 0.0 | 0.0 | 0.0 | 0.8 | 0.0 | 0.4 | 0.9 | 0.6 | 3.2 | 2.2 | 0.0 | 2.4 | 2.6 | 1.1 | 0.1 | 1.0 |
| 2/26 | 0.1 | 0.8 | 0.0 | 0.0 | 0.0 | 0.8 | 0.0 | 0.4 | 0.9 | 0.6 | 3.1 | 2.2 | 0.0 | 2.2 | 2.6 | 1.1 | 0.1 | 1.0 |
| 2/27 | 0.1 | 0.8 | 0.0 | 0.0 | 0.0 | 0.8 | 0.0 | 0.4 | 0.9 | 0.6 | 3.1 | 2.2 | 0.0 | 2.2 | 3.9 | 1.1 | 0.1 | 1.0 |
| 2/28 | 0.1 | 0.8 | 0.0 | 0.0 | 0.0 | 0.8 | 0.0 | 0.4 | 0.9 | 0.6 | 2.9 | 2.2 | 0.0 | 2.1 | 3.9 | 1.1 | 0.1 | 1.0 |
| 2/29 | 0.1 | 0.8 | 0.0 | 0.0 | 0.0 | 0.8 | 0.0 | 0.4 | 0.9 | 0.6 | 2.6 | 2.2 | 0.0 | 2.1 | 3.9 | 1.1 | 0.1 | 1.0 |
| 3/1 | 0.1 | 0.8 | 0.0 | 0.0 | 0.0 | 0.8 | 0.0 | 0.4 | 0.9 | 0.6 | 2.5 | 2.2 | 0.0 | 2.0 | 3.9 | 1.1 | 0.1 | 1.0 |
| 3/2 | 0.1 | 0.8 | 0.0 | 0.0 | 0.0 | 0.8 | 0.0 | 0.4 | 0.9 | 0.6 | 2.4 | 2.2 | 0.0 | 2.0 | 3.9 | 1.1 | 0.1 | 1.0 |
| 3/3 | 0.1 | 0.8 | 1.3 | 0.0 | 0.0 | 0.8 | 0.0 | 0.4 | 0.9 | 0.6 | 2.4 | 2.2 | 0.0 | 2.0 | 3.9 | 1.1 | 0.1 | 1.0 |
| 3/4 | 0.1 | 0.8 | 1.3 | 0.0 | 0.0 | 0.8 | 0.0 | 0.4 | 0.9 | 0.6 | 2.4 | 2.2 | 0.0 | 1.9 | 3.9 | 1.1 | 0.1 | 1.0 |
| 3/5 | 0.1 | 0.8 | 1.3 | 0.0 | 0.0 | 0.8 | 0.0 | 0.4 | 0.9 | 0.6 | 2.3 | 2.2 | 0.0 | 1.9 | 3.9 | 1.1 | 0.1 | 1.0 |
| 3/6 | 0.1 | 0.8 | 1.3 | 0.0 | 0.0 | 0.8 | 0.0 | 0.4 | 0.9 | 0.6 | 2.2 | 2.2 | 0.0 | 1.9 | 3.9 | 1.1 | 0.1 | 1.0 |
| 3/7 | 0.1 | 0.8 | 1.3 | 0.0 | 0.0 | 0.8 | 0.0 | 0.4 | 0.9 | 0.6 | 2.2 | 2.2 | 0.0 | 1.8 | 3.9 | 1.1 | 0.1 | 1.0 |

**Figure 5. Forecasting the epidemic situation of COVID-19 in Hubei province (A) and Wuhan city (B) in China**

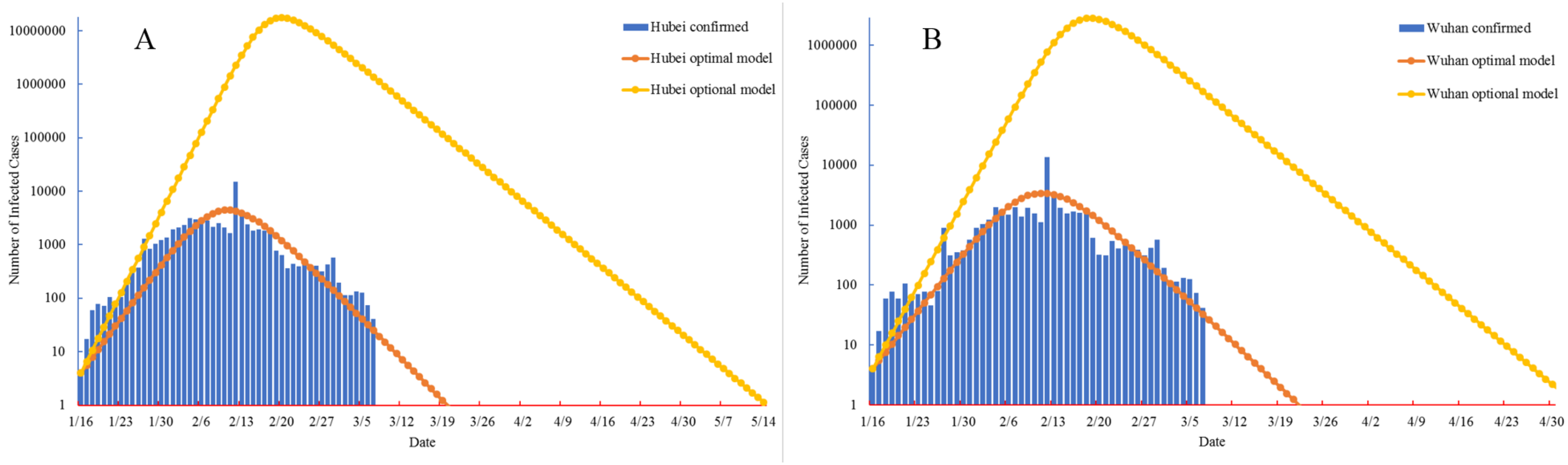


**Figure 6. Forecasting the epidemic situation of COVID-19 in provinces outside Hubei (A), and top the 2nd to 6th provinces with confirmed case COVID-19 (B, Guangdong; C, Henan; D, Zhejiang; E, Hunan; F, Anhui) in China***

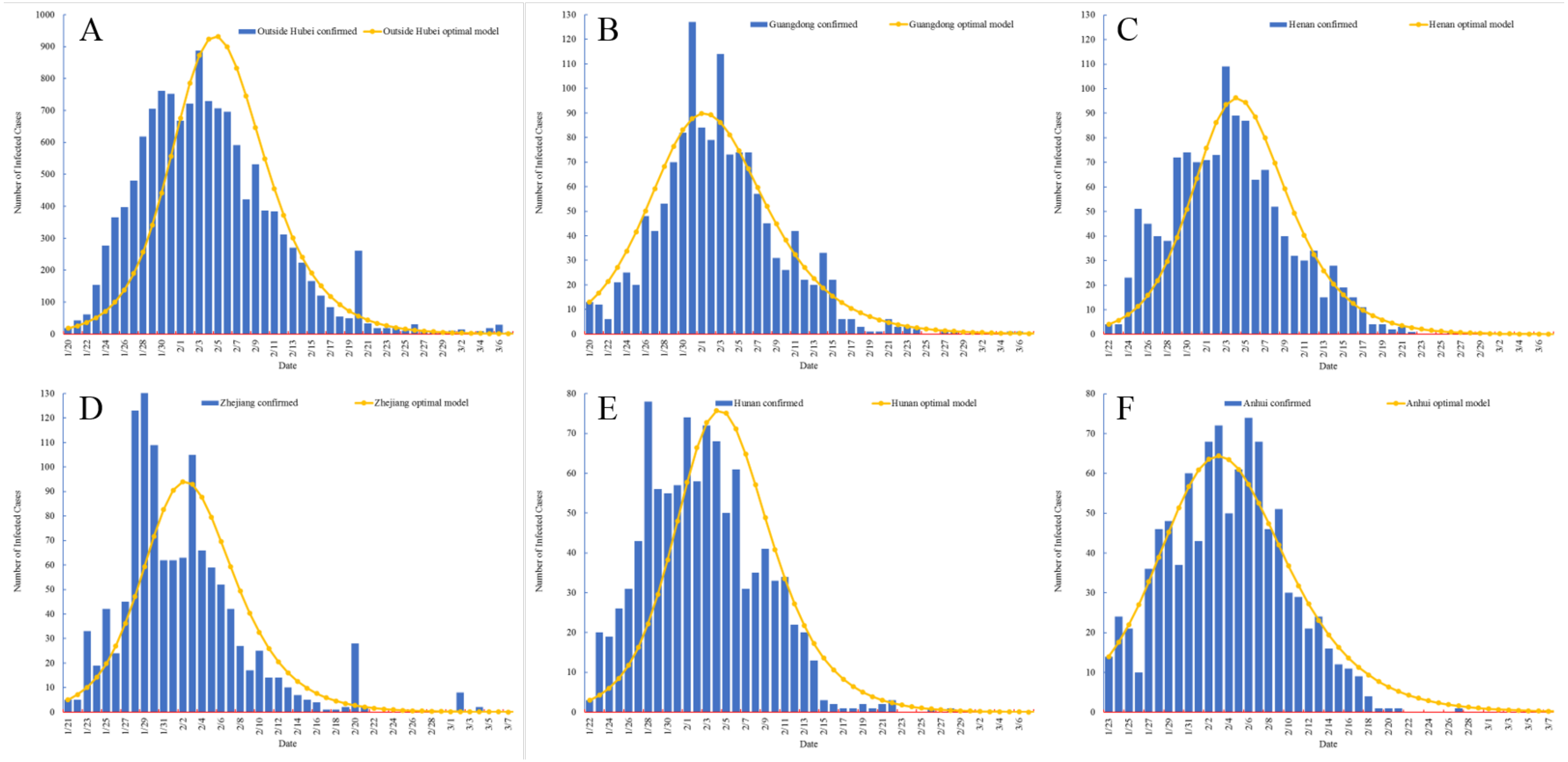
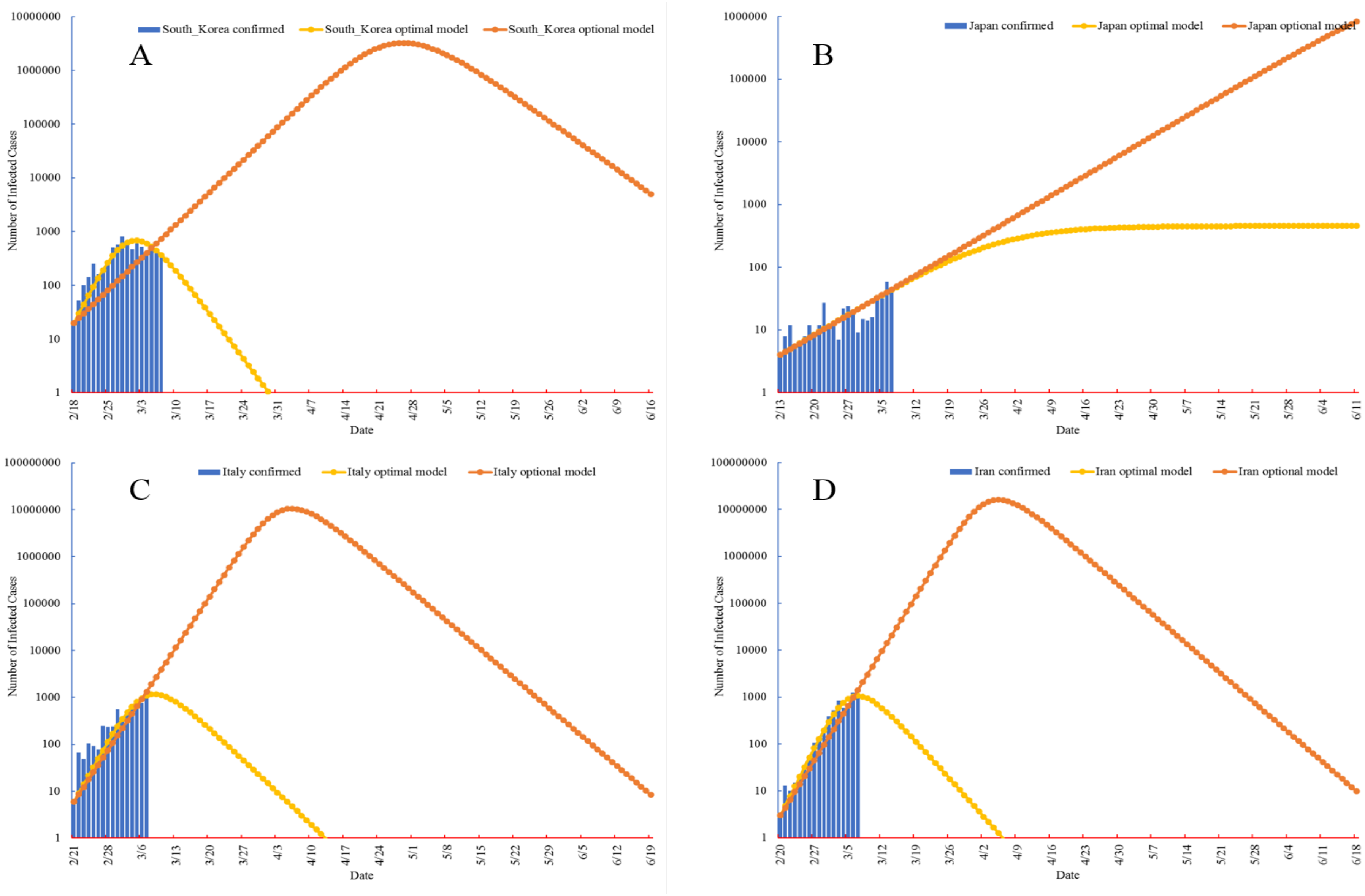


**Figure 7. Forecasting the epidemic situation of COVID-19 in South Korea, (A), Japan (B), Italy (C), Iran (D)***



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**Supplementary file 1. Number of confirmed case and close contacts with infected cases in 34 provinces in China up to March 7**

| Province/City | Confirmed case number | Population size (10,000) |
|---|---|---|
| Provinces outside Hubei | 13152 | 139008 |
| Anhui | 990 | 6254.8 |
| Macao | 10 | 63.2 |
| Beijing | 428 | 2170.7 |
| Fujian | 296 | 3911 |
| Gansu | 120 | 2625.71 |
| Guangdong | 1352 | 11169 |
| Guangxi | 252 | 4885 |
| Guizhou | 146 | 3580 |
| Hainan | 168 | 925.76 |
| Hebei | 318 | 7519.52 |
| Henan | 1272 | 9559.13 |
| Heilongjiang | 481 | 3788.7 |
| Hubei | 67707 | 5902 |
| Hunan | 1018 | 6860.2 |
| Jilin | 93 | 2717.43 |
| Jiangsu | 631 | 8029.3 |
| Jiangxi | 935 | 4622.1 |
| Liaoning | 125 | 4368.9 |
| Inner Mongolia | 75 | 2528.6 |
| Ningxia | 75 | 681.79 |
| Qinghai | 18 | 598.38 |
| Shandong | 758 | 10005.83 |
| Shanxi | 133 | 3702.35 |
| Shaanxi | 245 | 3835.44 |
| Shanghai | 342 | 2418.33 |
| Sichuan | 539 | 8302 |
| Taiwan | 45 | 2369 |
| Tianjin | 136 | 1556.87 |
| Tibet | 1 | 337.15 |
| Hong Kong | 109 | 743 |
| Xinjiang | 76 | 2444.67 |
| Yunnan | 174 | 4800.5 |
| Zhejiang | 1215 | 5657 |
| Chongqing | 576 | 3048.43 |
| Wuhan city | 49912 | 1089.29 |
| South Korea | 7134 | 5126.9185 |
| Japan | 455 | 12718.5332 |
| Italy | 5883 | 6048.2200 |
| Iran | 5823 | 8201.1735 |

## Supplementary file 2. Time-varying reproduction number (Rt) in 34 provinces in China based on the optimal model.

| Date | Outside Hubei | Anhui | Macao | Beijing | Fujian | Gansu | Guangdong | Guangxi | Guizhou | Hainan | Hebei | Henan | Heilongjiang | Hubei | Hunan | Jilin | Jiangsu | Jiangxi | Liaoning | Inner Mongolia |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/20 | | | | | | | | | | | | | | 4.46 | | | | | | |
| 1/21 | Inf | | | 1.01 | | | 0.86 | | | | | | | 3.12 | | | | | | |
| 1/22 | 2.77 | | | 0.94 | | | 0.73 | | | | | | | 2.21 | | | | | | |
| 1/23 | Inf | | | Inf | | | Inf | Inf | 0.00 | 0.33 | | | | 1.98 | Inf | | | | | |
| 1/24 | 3.29 | 3.50 | 0.00 | Inf | Inf | 1.02 | Inf | Inf | 0.00 | Inf | | Inf | 3.15 | 1.93 | Inf | 0.18 | 1.29 | Inf | Inf | |
| 1/25 | 2.73 | 1.40 | 0.00 | 1.19 | 2.14 | Inf | Inf | 2.70 | 0.00 | 1.17 | 0.70 | Inf | 1.61 | 1.95 | 4.29 | 0.05 | Inf | Inf | 2.17 | |
| 1/26 | 2.29 | 1.09 | Inf | Inf | Inf | Inf | Inf | 2.18 | 0.00 | Inf | 0.00 | Inf | 1.40 | 1.88 | 2.76 | 0.00 | Inf | 1.91 | 1.81 | 0.68 |
| 1/27 | 2.07 | Inf | Inf | 1.36 | Inf | 1.52 | Inf | 1.63 | 0.00 | Inf | Inf | 2.99 | 1.42 | Inf | 2.38 | 0.00 | Inf | 1.89 | 1.74 | 0.70 |
| 1/28 | 1.96 | Inf | 1.48 | 1.29 | 1.93 | 1.43 | Inf | 1.48 | 0.00 | 1.20 | Inf | 2.17 | 1.32 | 1.92 | 2.39 | 0.00 | Inf | 1.90 | 1.56 | 0.00 |
| 1/29 | 1.87 | Inf | 1.40 | 1.39 | 1.76 | 1.29 | Inf | 1.77 | 0.00 | 1.17 | Inf | 2.10 | 1.25 | 1.83 | 2.05 | Inf | 1.44 | 1.90 | 1.39 | 0.00 |
| 1/30 | 1.79 | 1.35 | 1.35 | 1.34 | 1.66 | 1.25 | Inf | 1.50 | 0.00 | 1.15 | 1.40 | 1.95 | Inf | 1.77 | 1.86 | 0.00 | 1.58 | 2.35 | 1.38 | 0.00 |
| 1/31 | 1.72 | 1.48 | 1.33 | 1.41 | 1.64 | 1.28 | Inf | 1.47 | Inf | 1.18 | 1.37 | 1.81 | Inf | 1.71 | 1.75 | Inf | 1.44 | 1.75 | Inf | 0.00 |
| 2/1 | 1.66 | 1.37 | 1.31 | 1.51 | 1.57 | 1.29 | 1.80 | 1.44 | Inf | 1.17 | 1.32 | 1.71 | 1.40 | 1.69 | 1.71 | Inf | 1.43 | 1.65 | 1.44 | 0.00 |
| 2/2 | 1.61 | 1.45 | 1.34 | 1.56 | 1.55 | Inf | 1.51 | 1.45 | Inf | 1.16 | 1.30 | 1.65 | 1.56 | 1.66 | 1.64 | Inf | 1.42 | 1.61 | 1.43 | 0.00 |
| 2/3 | 1.60 | 1.52 | 1.34 | 1.40 | 1.53 | 1.37 | 1.56 | 1.44 | Inf | Inf | 1.30 | 1.65 | Inf | 1.63 | 1.62 | Inf | 1.43 | 1.62 | 1.41 | 0.00 |
| 2/4 | 1.58 | 1.43 | 0.00 | 1.41 | 1.51 | 1.33 | 1.50 | 1.43 | Inf | Inf | 1.29 | 1.62 | Inf | 1.62 | 1.60 | Inf | 1.43 | 1.61 | 1.42 | 0.00 |
| 2/5 | 1.56 | 1.44 | 0.00 | 1.41 | 1.49 | 1.33 | 1.49 | 1.45 | 2.26 | Inf | 1.31 | 1.61 | 1.78 | 1.59 | 1.58 | Inf | 1.43 | 1.59 | 1.43 | 0.00 |
| 2/6 | 1.55 | 1.46 | 1.12 | 1.41 | 1.49 | 1.33 | 1.49 | 1.44 | 1.56 | Inf | 1.31 | 1.58 | 2.17 | 1.56 | 1.57 | 1.75 | 1.44 | 1.58 | 1.43 | 0.00 |
| 2/7 | 1.54 | 1.47 | 1.33 | 1.41 | 1.49 | 1.33 | 1.49 | 1.44 | Inf | Inf | 1.45 | 1.57 | 1.53 | 1.54 | 1.56 | 1.49 | 1.44 | 1.57 | 1.43 | 0.00 |
| 2/8 | 1.54 | 1.46 | 1.34 | 1.41 | 1.49 | 1.34 | 1.48 | 1.44 | 1.48 | 3.72 | 1.34 | 1.57 | 1.49 | 1.51 | 1.55 | 1.53 | 1.44 | 1.57 | 1.43 | 0.00 |
| 2/9 | 1.54 | 1.46 | 1.34 | 1.41 | 1.49 | 1.34 | 1.48 | 1.44 | 3.58 | 1.38 | 1.33 | 1.56 | 1.49 | 1.50 | 1.55 | 1.46 | 1.44 | 1.56 | 1.43 | 0.00 |
| 2/10 | 1.54 | 1.45 | 1.35 | 1.41 | 1.49 | 1.34 | 1.48 | 1.44 | 1.55 | 1.28 | 1.35 | 1.56 | 1.50 | 1.48 | 1.55 | 1.45 | 1.44 | 1.56 | 1.43 | 0.00 |
| 2/11 | 1.54 | 1.45 | 1.35 | 1.41 | 1.49 | 1.34 | 1.48 | 1.44 | 1.80 | 1.26 | 1.35 | 1.56 | 1.49 | 1.46 | 1.55 | 1.44 | 1.44 | 1.56 | 1.42 | 0.00 |
| 2/12 | 1.54 | 1.45 | 1.35 | 1.41 | 1.49 | 1.34 | 1.48 | 1.44 | 1.42 | 1.28 | 1.35 | 1.56 | 1.49 | Inf | 1.55 | 1.44 | 1.44 | 1.56 | 1.43 | 0.00 |
| 2/13 | 1.54 | 1.45 | 1.35 | 1.41 | 1.49 | 1.34 | 1.48 | 1.44 | 1.40 | 1.26 | 1.35 | 1.56 | 1.50 | 1.79 | 1.55 | 1.44 | 1.44 | 1.56 | 1.43 | 0.00 |
| 2/14 | 1.54 | 1.45 | 1.35 | 1.41 | 1.49 | 1.34 | 1.48 | 1.44 | 1.39 | 1.26 | 1.35 | 1.56 | 1.50 | 1.57 | 1.55 | 1.44 | 1.44 | 1.56 | 1.43 | 0.00 |
| 2/15 | 1.54 | 1.45 | 1.35 | 1.41 | 1.49 | 1.34 | 1.48 | 1.44 | 1.39 | 1.27 | 1.35 | 1.56 | 1.50 | 1.53 | 1.55 | 1.44 | 1.44 | 1.56 | 1.43 | 0.00 |
| 2/16 | 1.54 | 1.45 | 1.35 | 1.41 | 1.49 | 1.34 | 1.48 | 1.44 | 1.39 | 1.27 | 1.35 | 1.56 | 1.50 | 1.52 | 1.55 | 1.44 | 1.44 | 1.56 | 1.43 | 0.00 |
| 2/17 | 1.54 | 1.45 | 1.35 | 1.41 | 1.49 | 1.34 | 1.48 | 1.44 | 1.39 | 1.27 | 1.35 | 1.56 | 1.50 | 1.52 | 1.55 | 1.44 | 1.44 | 1.56 | 1.43 | 0.03 |
| 2/18 | 1.54 | 1.46 | 1.35 | 1.41 | 1.49 | 1.34 | 1.48 | 1.44 | 1.39 | 1.27 | 1.35 | 1.56 | 1.50 | 1.52 | 1.55 | 1.44 | 1.44 | 1.56 | 1.43 | 0.00 |
| 2/19 | 1.54 | 1.46 | 1.35 | 1.41 | 1.49 | 1.34 | 1.48 | 1.44 | 1.39 | 1.27 | 1.35 | 1.56 | 1.50 | 1.51 | 1.55 | 1.44 | 1.44 | 1.56 | 1.43 | 0.09 |
| 2/20 | 1.54 | 1.46 | 1.35 | 1.41 | 1.49 | 1.34 | 1.48 | 1.44 | 1.39 | 1.27 | 1.35 | 1.56 | 1.50 | 1.51 | 1.55 | 1.44 | 1.44 | 1.56 | 1.43 | 0.71 |
| 2/21 | 1.54 | 1.46 | 1.35 | 1.41 | 1.49 | 1.34 | 1.48 | 1.44 | 1.39 | 1.28 | 1.35 | 1.56 | 1.50 | 1.51 | 1.55 | 1.44 | 1.44 | 1.56 | 1.43 | 0.83 |
| 2/22 | 1.54 | 1.46 | 1.35 | 1.41 | 1.49 | 1.34 | 1.48 | 1.44 | 1.39 | 1.28 | 1.35 | 1.56 | 1.50 | 1.51 | 1.55 | 1.44 | 1.44 | 1.56 | 1.43 | 0.88 |
| 2/23 | 1.54 | 1.46 | 1.35 | 1.41 | 1.49 | 1.34 | 1.48 | 1.44 | 1.39 | 1.28 | 1.35 | 1.56 | 1.50 | 1.51 | 1.55 | 1.44 | 1.44 | 1.56 | 1.43 | 0.91 |
| 2/24 | 1.54 | 1.46 | 1.35 | 1.41 | 1.49 | 1.34 | 1.48 | 1.44 | 1.39 | 1.28 | 1.35 | 1.56 | 1.50 | 1.51 | 1.55 | 1.44 | 1.44 | 1.56 | 1.43 | 0.93 |
| 2/25 | 1.54 | 1.46 | 1.35 | 1.41 | 1.49 | 1.34 | 1.48 | 1.44 | 1.39 | 1.28 | 1.35 | 1.56 | 1.50 | 1.51 | 1.55 | 1.44 | 1.44 | 1.56 | 1.43 | 0.94 |
| 2/26 | 1.54 | 1.46 | 1.35 | 1.41 | 1.49 | 1.34 | 1.48 | 1.44 | 1.39 | 1.28 | 1.35 | 1.56 | 1.50 | 1.51 | 1.55 | 1.44 | 1.44 | 1.56 | 1.43 | 0.95 |
| 2/27 | 1.54 | 1.46 | 1.35 | 1.41 | 1.49 | 1.34 | 1.48 | 1.44 | 1.39 | 1.28 | 1.35 | 1.56 | 1.50 | 1.51 | 1.55 | 1.44 | 1.44 | 1.56 | 1.43 | 0.96 |
| 2/28 | 1.54 | 1.46 | 1.35 | 1.41 | 1.49 | 1.34 | 1.48 | 1.44 | 1.39 | 1.28 | 1.35 | 1.56 | 1.50 | 1.51 | 1.55 | 1.44 | 1.44 | 1.56 | 1.43 | 0.96 |
| 2/29 | 1.54 | 1.46 | 1.35 | 1.41 | 1.49 | 1.34 | 1.48 | 1.44 | 1.39 | 1.28 | 1.35 | 1.56 | 1.50 | 1.51 | 1.55 | 1.44 | 1.44 | 1.56 | 1.43 | 0.97 |
| 3/1 | 1.54 | 1.46 | 1.35 | 1.41 | 1.49 | 1.34 | 1.48 | 1.44 | 1.39 | 1.28 | 1.35 | 1.56 | 1.50 | 1.51 | 1.55 | 1.44 | 1.44 | 1.56 | 1.43 | 0.97 |
| 3/2 | 1.54 | 1.46 | 1.35 | 1.41 | 1.49 | 1.34 | 1.48 | 1.44 | 1.39 | 1.28 | 1.35 | 1.56 | 1.50 | 1.51 | 1.55 | 1.44 | 1.44 | 1.56 | 1.43 | 0.98 |
| 3/3 | 1.54 | 1.46 | 1.35 | 1.41 | 1.49 | 1.34 | 1.48 | 1.44 | 1.39 | 1.28 | 1.35 | 1.56 | 1.50 | 1.51 | 1.55 | 1.44 | 1.44 | 1.56 | 1.43 | 0.98 |
| 3/4 | 1.54 | 1.46 | 1.35 | 1.41 | 1.49 | 1.34 | 1.48 | 1.44 | 1.39 | 1.28 | 1.35 | 1.56 | 1.50 | 1.51 | 1.55 | 1.44 | 1.44 | 1.56 | 1.43 | 0.98 |
| 3/5 | 1.54 | 1.46 | 1.35 | 1.41 | 1.49 | 1.34 | 1.48 | 1.44 | 1.39 | 1.28 | 1.35 | 1.56 | 1.50 | 1.51 | 1.55 | 1.44 | 1.44 | 1.56 | 1.43 | 0.98 |
| 3/6 | 1.54 | 1.46 | 1.35 | 1.41 | 1.49 | 1.34 | 1.48 | 1.44 | 1.39 | 1.28 | 1.35 | 1.56 | 1.50 | 1.51 | 1.55 | 1.44 | 1.44 | 1.56 | 1.43 | 0.98 |
| 3/7 | 1.54 | 1.46 | 1.35 | 1.41 | 1.49 | 1.34 | 1.48 | 1.44 | 1.39 | 1.28 | 1.35 | 1.56 | 1.50 | 1.51 | 1.55 | 1.44 | 1.44 | 1.56 | 1.43 | 0.98 |

| Date | Ningxia | Qinghai | Shandong | Shanxi | Shaanxi | Shanghai | Sichuan | Taiwan | Tianjin | Tibet | Hong Kong | Xinjiang | Yunnan | Zhejiang | Chongqing | Wuhan |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/20 | | | | | | | | | | | | | | | | 3.94 |
| 1/21 | | | | | | | | | | | | | | | | 3.09 |
| 1/22 | | | | | | Inf | 2.38 | | 1.02 | | | | | | | 2.15 |
| 1/23 | | | 0.33 | | | 1.14 | Inf | 0.00 | 0.79 | | | | | Inf | Inf | 1.85 |
| 1/24 | 1.02 | | Inf | | | Inf | 2.95 | Inf | Inf | | | 0.18 | | Inf | Inf | 1.69 |
| 1/25 | 1.02 | | Inf | 0.33 | 0.49 | 1.27 | 2.31 | 0.88 | Inf | | 0.00 | 0.00 | Inf | 3.79 | 2.78 | 1.53 |
| 1/26 | Inf | Inf | 1.74 | 0.00 | Inf | 1.31 | 2.19 | 0.00 | Inf | | 0.00 | 0.00 | 2.22 | 2.06 | 2.47 | 1.48 |
| 1/27 | Inf | 2.37 | 1.61 | Inf | Inf | 1.31 | 1.89 | 0.00 | Inf | | 0.00 | Inf | 1.64 | 1.93 | 1.88 | Inf |
| 1/28 | 1.34 | 1.24 | 1.59 | Inf | 1.13 | 1.31 | 1.70 | Inf | 1.25 | | 0.00 | Inf | Inf | Inf | 1.60 | 1.71 |
| 1/29 | Inf | 1.08 | 1.49 | Inf | 1.12 | 1.35 | 1.69 | 1.12 | 1.21 | | 0.00 | 1.12 | Inf | 2.20 | 1.49 | 1.62 |
| 1/30 | 1.43 | 1.23 | 1.46 | 1.19 | Inf | Inf | 1.66 | 1.10 | 1.22 | 0.50 | 0.00 | Inf | 1.72 | 2.02 | 1.54 | 1.56 |
| 1/31 | 1.50 | 1.24 | 1.41 | Inf | Inf | Inf | 1.61 | 1.10 | 1.19 | 0.50 | 0.00 | 1.14 | 1.67 | 1.82 | 1.51 | 1.54 |
| 2/1 | 1.39 | 1.19 | 1.38 | Inf | Inf | 1.63 | 1.55 | 1.10 | Inf | 0.50 | 0.00 | 1.13 | 1.57 | 1.70 | 1.47 | 1.53 |
| 2/2 | 1.38 | Inf | 1.35 | 0.00 | 1.29 | 1.46 | 1.51 | 1.09 | Inf | 0.50 | 0.00 | Inf | 1.54 | 1.64 | 1.48 | 1.52 |
| 2/3 | 1.37 | Inf | 1.34 | Inf | 1.28 | 1.44 | 1.50 | 1.08 | Inf | 0.50 | 0.00 | Inf | 1.51 | 1.63 | 1.48 | 1.51 |
| 2/4 | 1.33 | Inf | 1.34 | 1.33 | Inf | 1.45 | 1.47 | 1.09 | Inf | 0.50 | 0.00 | Inf | 1.49 | 1.61 | 1.47 | 1.52 |
| 2/5 | 1.36 | 1.58 | 1.35 | 1.36 | 1.29 | 1.46 | 1.46 | 1.08 | 1.35 | 0.50 | 0.00 | Inf | 1.48 | 1.59 | 1.46 | 1.51 |
| 2/6 | 1.37 | 1.38 | 1.36 | 1.31 | 1.29 | 1.46 | 1.46 | Inf | 1.47 | 0.50 | 0.00 | Inf | 1.48 | 1.58 | 1.46 | 1.49 |
| 2/7 | 1.37 | 1.38 | 1.36 | 1.31 | 1.29 | 1.45 | 1.45 | | 1.34 | 0.50 | 0.00 | 1.42 | 1.47 | 1.57 | 1.46 | 1.48 |
| 2/8 | 1.36 | 1.38 | 1.36 | 1.36 | 1.29 | 1.45 | 1.45 | Inf | 1.34 | 0.50 | 0.00 | 1.27 | 1.47 | 1.57 | 1.46 | 1.46 |
| 2/9 | 1.37 | 1.39 | 1.36 | 1.32 | 1.29 | 1.45 | 1.45 | 0.00 | 1.33 | 0.50 | 0.00 | 1.36 | 1.47 | 1.56 | 1.46 | 1.45 |
| 2/10 | 1.36 | 1.39 | 1.37 | 1.32 | 1.30 | 1.45 | 1.45 | 0.89 | 1.33 | 0.50 | | Inf | 1.47 | 1.56 | 1.46 | 1.43 |
| 2/11 | 1.35 | 1.39 | 1.36 | 1.32 | 1.30 | 1.45 | 1.45 | 1.04 | 1.35 | 0.50 | Inf | Inf | 1.47 | 1.56 | 1.46 | 1.42 |
| 2/12 | 1.41 | 1.39 | 1.36 | 1.33 | 1.30 | 1.45 | 1.45 | 1.06 | 1.35 | 0.50 | Inf | Inf | 1.47 | 1.56 | 1.46 | Inf |
| 2/13 | 1.37 | 1.39 | 1.36 | 1.33 | 1.31 | 1.45 | 1.45 | 1.07 | 1.35 | 0.50 | Inf | 1.30 | 1.47 | 1.56 | 1.46 | 2.45 |
| 2/14 | 1.37 | 1.39 | 1.36 | 1.33 | 1.31 | 1.45 | 1.45 | 1.08 | 1.35 | 0.50 | Inf | 1.35 | 1.47 | 1.56 | 1.46 | 1.64 |
| 2/15 | 1.36 | 1.40 | 1.36 | 1.34 | 1.31 | 1.45 | 1.45 | 1.08 | 1.35 | 0.50 | 0.00 | 1.28 | 1.47 | 1.57 | 1.46 | 1.57 |
| 2/16 | 1.36 | 1.40 | 1.36 | 1.34 | 1.31 | 1.45 | 1.45 | 1.04 | 1.35 | 0.50 | 0.00 | 1.29 | 1.47 | 1.57 | 1.46 | 1.55 |
| 2/17 | 1.36 | 1.40 | 1.36 | 1.34 | 1.31 | 1.45 | 1.45 | 0.00 | 1.35 | 0.50 | 0.00 | 1.28 | 1.47 | 1.57 | 1.46 | 1.54 |
| 2/18 | 1.36 | 1.40 | 1.36 | 1.34 | 1.31 | 1.45 | 1.45 | 0.95 | 1.35 | 0.50 | 0.00 | 1.28 | 1.47 | 1.57 | 1.46 | 1.54 |
| 2/19 | 1.36 | 1.40 | 1.36 | 1.34 | 1.31 | 1.45 | 1.45 | 0.00 | 1.35 | 0.50 | 0.00 | 1.28 | 1.47 | 1.57 | 1.46 | 1.53 |
| 2/20 | 1.36 | 1.40 | Inf | 1.34 | 1.31 | 1.45 | 1.45 | 0.00 | 1.35 | 0.50 | 0.00 | 1.28 | 1.47 | 1.57 | 1.46 | 1.53 |
| 2/21 | 1.36 | 1.40 | Inf | 1.34 | 1.31 | 1.45 | 1.45 | 0.00 | 1.35 | 0.50 | 0.12 | 1.29 | 1.47 | 1.57 | 1.46 | 1.53 |
| 2/22 | 1.36 | 1.40 | 1.33 | 1.34 | 1.31 | 1.45 | 1.45 | 0.00 | 1.35 | 0.50 | 0.22 | 1.29 | 1.47 | 1.57 | 1.46 | 1.53 |
| 2/23 | 1.36 | 1.40 | 1.31 | 1.34 | 1.31 | 1.45 | 1.45 | 0.00 | 1.35 | 0.50 | 0.00 | 1.29 | 1.47 | 1.57 | 1.46 | 1.53 |
| 2/24 | 1.36 | 1.40 | 1.32 | 1.34 | 1.31 | 1.45 | 1.45 | 0.00 | 1.35 | 0.50 | 0.00 | 1.29 | 1.47 | 1.57 | 1.46 | 1.53 |
| 2/25 | 1.36 | 1.40 | 1.32 | 1.34 | 1.31 | 1.45 | 1.45 | 0.00 | 1.35 | 0.50 | 0.00 | 1.29 | 1.47 | 1.57 | 1.46 | 1.53 |
| 2/26 | 1.36 | 1.40 | 1.33 | 1.34 | 1.31 | 1.45 | 1.45 | 0.00 | 1.35 | 0.50 | Inf | 1.29 | 1.47 | 1.57 | 1.46 | 1.53 |
| 2/27 | 1.36 | 1.40 | 1.33 | 1.34 | 1.31 | 1.45 | 1.45 | 0.00 | 1.35 | 0.50 | Inf | 1.29 | 1.47 | 1.57 | 1.46 | 1.53 |
| 2/28 | 1.36 | 1.40 | 1.33 | 1.34 | 1.31 | 1.45 | 1.45 | 0.00 | 1.35 | 0.50 | 0.00 | 1.29 | 1.47 | 1.57 | 1.46 | 1.53 |
| 2/29 | 1.36 | 1.40 | 1.33 | 1.34 | 1.31 | 1.45 | 1.45 | Inf | 1.35 | 0.50 | 0.00 | 1.29 | 1.47 | 1.57 | 1.46 | 1.53 |
| 3/1 | 1.36 | 1.40 | 1.33 | 1.34 | 1.31 | 1.45 | 1.45 | Inf | 1.35 | 0.50 | 0.43 | 1.29 | 1.47 | 1.57 | 1.46 | 1.53 |
| 3/2 | 1.36 | 1.40 | 1.33 | 1.34 | 1.31 | 1.45 | 1.45 | Inf | 1.35 | 0.50 | 0.00 | 1.29 | 1.47 | 1.57 | 1.46 | 1.53 |
| 3/3 | 1.36 | 1.40 | 1.33 | 1.34 | 1.31 | 1.45 | 1.45 | Inf | 1.35 | 0.50 | 0.74 | 1.29 | 1.47 | 1.57 | 1.46 | 1.53 |
| 3/4 | 1.36 | 1.40 | 1.33 | 1.34 | 1.31 | 1.45 | 1.45 | Inf | 1.35 | 0.50 | 0.53 | 1.29 | 1.47 | 1.57 | 1.46 | 1.53 |
| 3/5 | 1.36 | 1.40 | 1.33 | 1.34 | 1.31 | 1.45 | 1.45 | Inf | 1.35 | 0.50 | 0.97 | 1.29 | 1.47 | 1.57 | 1.46 | 1.53 |
| 3/6 | 1.36 | 1.40 | 1.33 | 1.34 | 1.31 | 1.45 | 1.45 | Inf | 1.35 | 0.50 | 0.92 | 1.29 | 1.47 | 1.57 | 1.46 | 1.53 |
| 3/7 | 1.36 | 1.40 | 1.33 | 1.34 | 1.31 | 1.45 | 1.45 | Inf | 1.35 | 0.50 | 0.96 | 1.29 | 1.47 | 1.57 | 1.46 | 1.53 |

**Supplementary file 3. Time-varying reproduction number (Rt) in countries outside of China based on the optimal model.**

| Date | South Korea | | Japan | | Italy | | Iran | |
|---|---|---|---|---|---|---|---|---|
| | Optimal model | Optional model | Optimal model | Optional model | Optimal model | Optional model | Optimal model | Optional model |
| 2/14 | | | 5.77 | 5.52 | | | | |
| 2/15 | | | 2.39 | 3.56 | | | | |
| 2/16 | | | 1.43 | 1.76 | | | | |
| 2/17 | | | 1.26 | 1.43 | | | | |
| 2/18 | | | 1.24 | 1.37 | | | | |
| 2/19 | Inf | Inf | 1.27 | 1.41 | | | | |
| 2/20 | 5.60 | 9.72 | 1.23 | 1.33 | | | | |
| 2/21 | 3.18 | 5.13 | 1.24 | 1.32 | | | Inf | Inf |
| 2/22 | 2.95 | 4.61 | Inf | 1.43 | Inf | Inf | 3.18 | 5.33 |
| 2/23 | 2.06 | 2.93 | 1.37 | 1.36 | Inf | Inf | 2.29 | 3.55 |
| 2/24 | 1.84 | 2.50 | 1.29 | 1.32 | Inf | Inf | 1.92 | 2.81 |
| 2/25 | 1.76 | 2.32 | 1.27 | 1.26 | 3.95 | 6.64 | 1.95 | 2.87 |
| 2/26 | 1.80 | 2.34 | 1.29 | 1.28 | 2.44 | 3.76 | 1.88 | 2.72 |
| 2/27 | 1.79 | 2.25 | 1.38 | 1.28 | Inf | 4.17 | Inf | 2.97 |
| 2/28 | 2.05 | 2.20 | 1.36 | 1.27 | 2.34 | 3.46 | 2.02 | 2.90 |
| 2/29 | 1.76 | 2.04 | 1.31 | 1.23 | 2.08 | 2.95 | 1.96 | 2.81 |
| 3/1 | 1.71 | 1.89 | 1.31 | 1.22 | 2.45 | 3.01 | Inf | 2.86 |
| 3/2 | 1.70 | 1.81 | 1.31 | 1.20 | 1.97 | 2.62 | 2.69 | 2.80 |
| 3/3 | 1.68 | 1.72 | 1.31 | 1.19 | 1.90 | 2.43 | Inf | 2.78 |
| 3/4 | 1.67 | 1.65 | 1.35 | 1.20 | 1.87 | 2.32 | 2.01 | 2.54 |
| 3/5 | 1.67 | 1.60 | 1.48 | 1.21 | 1.87 | 2.25 | 1.95 | 2.36 |
| 3/6 | 1.67 | 1.27 | Inf | 1.23 | 1.87 | 2.15 | 2.12 | 2.35 |
| 3/7 | 1.67 | 1.50 | Inf | 1.23 | 2.27 | 2.12 | 2.17 | 2.25 |

*, inf, infinity.