
Special Report: The COVID-19 Epidemic Forecasts

Issue 2

Ping An Group

Ping An Smart City Research Institute

Ping An Macroeconomic Research Institute

Ping An Health Technology Research Institute

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The COVID-19 Epidemic Forecasts Issue 2

Overview

- 1. The pandemic shows a three-wave global spreading trend. The cumulative number of confirmed cases globally has exceeded 1 million and we estimate the cumulative number of confirmed cases will exceed 2 million around April 15.**

As of April 4, there have been more than 1 million confirmed cases globally. It is expected that this current wave of infection, mainly in Europe and the U.S., will reach a peak of new confirmed cases by April 15. The cumulative number of confirmed cases will exceed 2 million around April 15. The first wave of infections occurred in China, the second wave is dominated by developed countries in Europe and North America, and the third wave is expected to occur in densely populated developing countries in Asia, Africa and South America.

- 2. Second wave: The number of newly confirmed cases in major European countries began to decline at the end of March, in line with our [March 20 prediction](#).**

We predicted that major European countries and Iran would reach the peak of daily new confirmed cases around the end of March. Newly confirmed cases in Italy peaked on March 22, Spain on March 27, Germany on March 28, Iran on March 31 and France on April 1. The peaks of new confirmed cases in Italy, Spain, and Germany were in line with our [predictions on March 20](#) and the peaks in Iran and France were two days later than predicted.

- 3. Second wave: The arrival of the peak of new confirmed cases in the U.S. will be in mid-April, later than originally predicted. The main reason is the U.S. has had fewer tests than some European countries during the same period, but is showing a higher test-positive rate.**

The U.S. added 34,168 new cases for a record high on April 5, and the peak of new confirmed cases is still to come. There are two main reasons for this: 1) Although the cumulative number of tests per million of population in the U.S. has increased from 47 to 4,933 since the implementation of containment measures, the test volume is still about 50% lower than that of European countries and South Korea during the same period, i.e. Italy at 10,870 per million, Germany at 10,962 and South Korea at 8,875; and 2) The eight U.S. states with the most severe epidemics have a test-positive rate of more than 20%. New York and New Jersey were 40.7% and 45.6% respectively, higher than Italy's 18.6% and Germany's 10.8%. Also, the cumulative number of confirmed cases in these eight states exceeds 200,000. Based on our analysis, we now expect the peak of new confirmed cases in the U.S. to occur between April 9 and April 15. The peak of new confirmed cases may reach 39,000 to 60,000, and the final cumulative confirmed cases in mid-May may reach 870,000 to 1.65 million.

4. Second wave: We expect the number of new confirmed cases in the U.K., Turkey, and Canada will start to decline around mid-April.

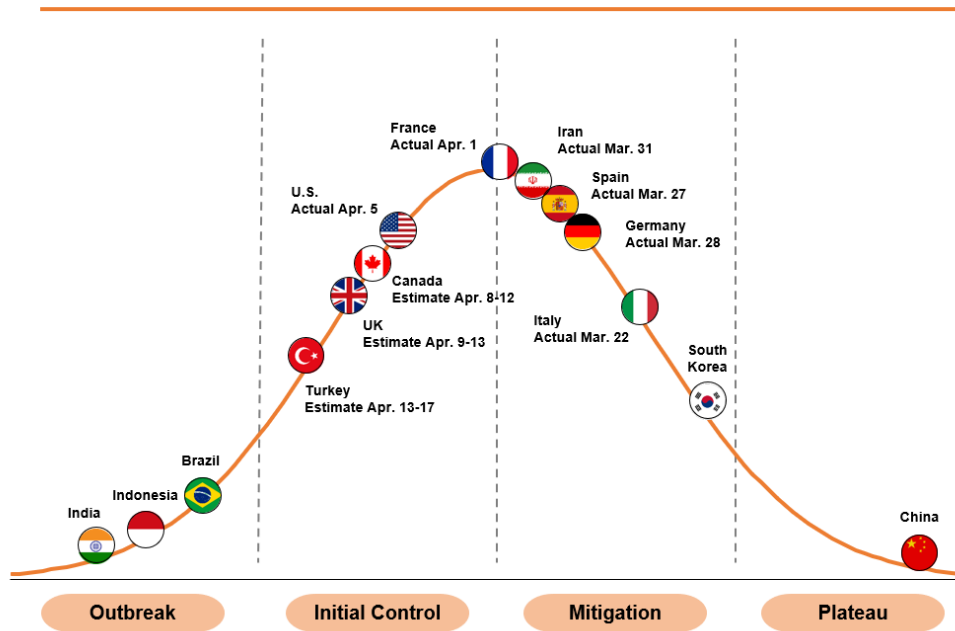
The numbers of new confirmed cases in these three countries have been growing rapidly recently. Based on the current trend, the three countries will reach the peak of new confirmed cases around April 15. Among them, we classify Turkey and Canada as Medium rate infection scenarios, with an estimated infection rate of 0.05% to 0.2% of the total population. We classify the U.K. as a Higher infection rate scenario, with an estimated infection rate of 0.2% of the total population). We estimate that the peak of new confirmed cases will arrive between April 8 to April 12 for Canada, April 9 to April 13 for the U.K. and April 13 to April 17 for Turkey. The cumulative confirmed cases in mid-May is expected to be: 130,000 to 180,000 in the U.K., 110,000 to 150,000 in Turkey and 35,000 to 50,000 in Canada.

5. Third wave: The epicenters of outbreak will be developing countries in Asia, South America and Africa, especially India, Indonesia and Brazil.

India, Indonesia, and Brazil have populations of about 1.38 billion, 270 million, and 210 million, respectively, making them the most populous countries other than China and the U.S.. At present, the testing volume per million of population in the three countries is only 50 in India, 23 in Indonesia and 215 in Brazil, far lower than the volumes in Europe and the U.S.. India's test-positive rate is less than 10% of the average of other countries. Assuming that the test-positive rate in India reaches the level of Europe and the U.S., the current number of infections in India may actually be 220,000.

In Africa, the number of confirmed cases is currently only 9,064. However, considering that Africa accounts for one-sixth of the world's population and has relatively limited medical resources, it is also a likely epicenter of outbreak for the third wave.

Second wave of infection: Peak of new cases by country

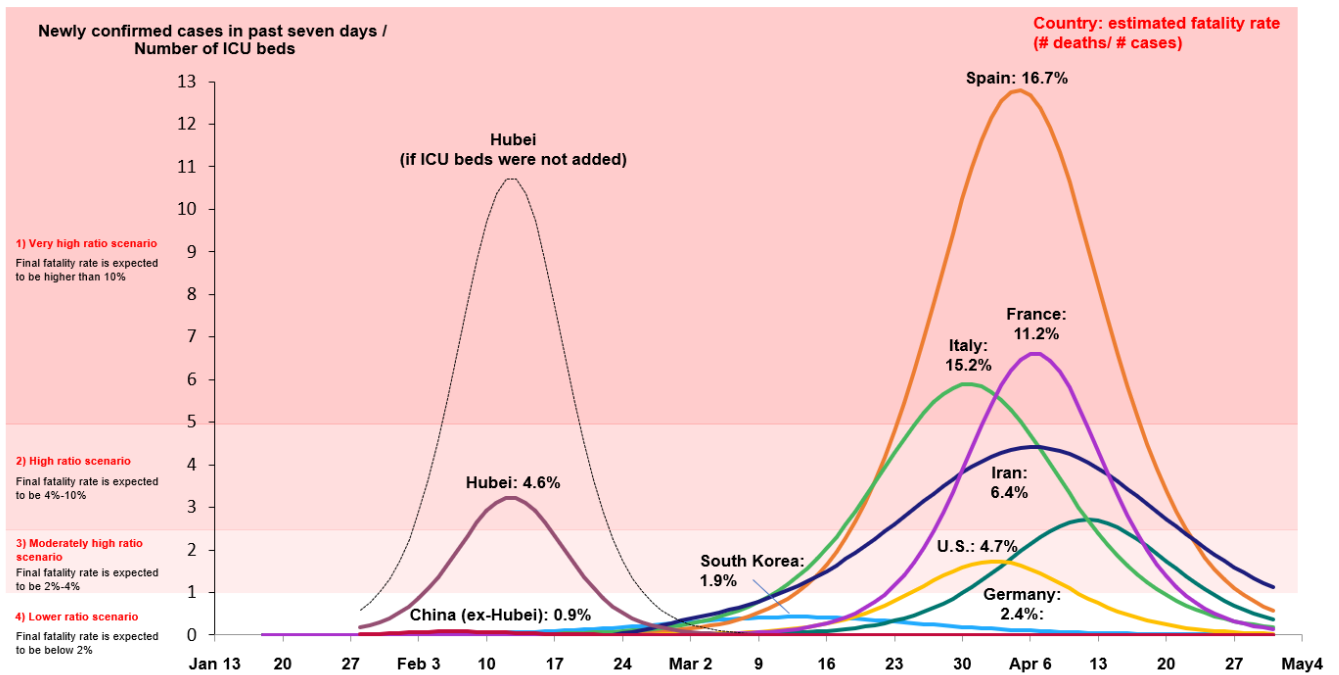


6. The ratio of peak confirmed cases in a seven-day period to the number of Intensive Care Unit (ICU) beds in a country significantly affects the fatality rate.

Since about 20% of patients diagnosed with COVID-19 will develop into severe cases, the level of confirmed cases compared to the number of ICU beds is an important ratio. A ratio of 1 or below indicates there may be sufficient ICU beds for the number of severe cases implied by the level of confirmed cases in the population. A higher ratio indicates there may not be enough ICU beds for the number of expected severe cases.

- 1) A low ratio of confirmed cases to the number of ICU beds would likely result in fatality rates of 0.9% to 2%.** For example, the ratio of the peak confirmed cases in a seven-day period to the number of Intensive Care Unit (ICU) beds is 0.08 in China (excluding Hubei) and 0.43 in South Korea.
- 2) A moderately high ratio would likely result in fatality rates of 2% to 4%.** In Germany, the ratio of the peak confirmed cases in a seven-day period to the number of ICU beds is 1.7.
- 3) A high ratio would likely result in fatality rates of 4% to 10%.** The ratio of the peak confirmed cases in a seven-day period to the number of ICU beds is 4.4 in Iran, and above 2.7 in the U.S..
- 4) A very high ratio would likely result in fatality rates of more than 10%.** The ratio of the peak confirmed cases in a seven-day period to the number of ICU beds is 5.9 in Italy, 12.8 in Spain and 6.6 in France.

Estimated fatality rates by country, based on demand for ICU beds



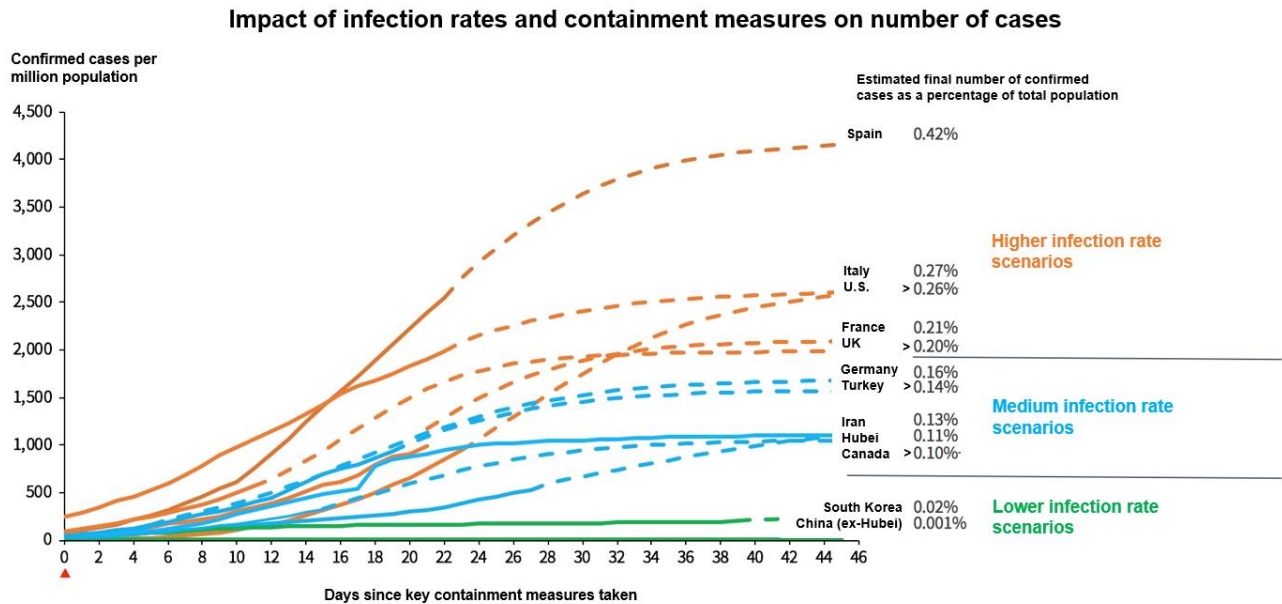
The following report is divided into five chapters. The first chapter introduces three control model scenarios to classify countries and expected final cumulative number of cases. The second chapter analyzes and predicts the epidemic mitigation in second-wave countries. The third chapter predicts the epidemic trends in the U.S. and Europe. The fourth chapter analyzes the third wave of infection from developing countries. The fifth chapter analyzes the relationship between the ratio of newly confirmed cases to ICU beds and fatality rates.

I. Three control model scenarios and their epidemic impact

The three control model scenarios are based on the infection ratio in the population according to two key indicators: 1) the number of cumulative infections per million of population when the key quarantine and containment measures are initiated; and 2) the final percentage of cases in the total population. The higher the ratio, the higher the final cumulative number of cases:

- 1) **Lower infection rate scenario:** when the key measures are launched, the cumulative infections per million of population is in the range of 0-20, such as China (excluding Hubei) and South Korea. We expect the final cumulative cases to account for less than 0.05% of the total population.
- 2) **Medium infection rate scenario:** when the key measures are launched, the cumulative infections per million of population is in the range of 20-50, such as Hubei province in China, Germany, and Iran. We expect the final cumulative cases to account for 0.05% to 0.2% of the total population.

3) Higher infection rate scenario: when the key measures are initiated, the cumulative infections per million of population is more than 50, such as Spain, Italy, the U.S. and France. We expect the final cumulative cases to account for more than 0.2% of the total



population.

II. The second wave: major European countries have entered a period of moderation

The following is an analysis of the second wave of infection according to the three control scenarios. In addition to the infection ratios, the factors considered in the prediction include the level of testing and the implementation of the containment measures.

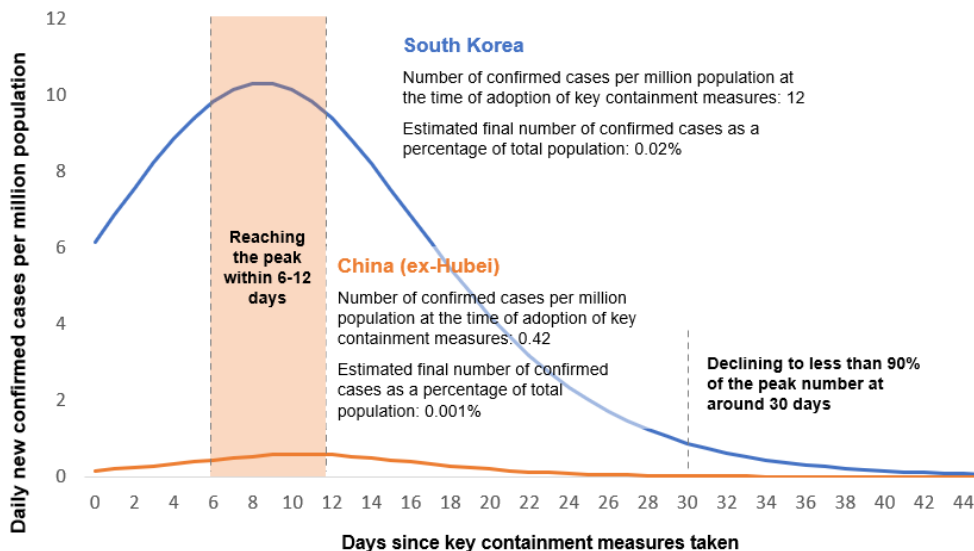
1) Lower infection rate scenarios: China (excluding Hubei) and South Korea

In countries with lower infection rate scenarios, the epidemic reaches the turning point within 12 days of control measures being implemented and the final infection rate is less than 0.05% of the total population. The key countries in this category are China (excluding Hubei) and South Korea.

China (excluding Hubei) launched key containment measures on January 24, and the cumulative number of confirmed cases per million of population at the time of launch was 0.42. The peak of new confirmed cases in China (excluding Hubei) occurred from Feb. 1 to Feb. 5, with the peak of daily new confirmed cases at about 800. It is predicted that the final cumulative case total will be about 15,000, and the final infection rate will be 0.001% of the total population.

South Korea launched key containment measures on Feb. 23 and the corresponding cumulative confirmed cases per million of population was 11.74 at that time. The peak of new confirmed cases in South Korea occurred from Feb. 29 to March 4, with the number of daily new confirmed cases at about 500. It is predicted that the final cumulative total will be around 12,000, and the final infection rate will be 0.02% of the total population.

Lower infection rate scenarios: China (ex-Hubei) and South Korea

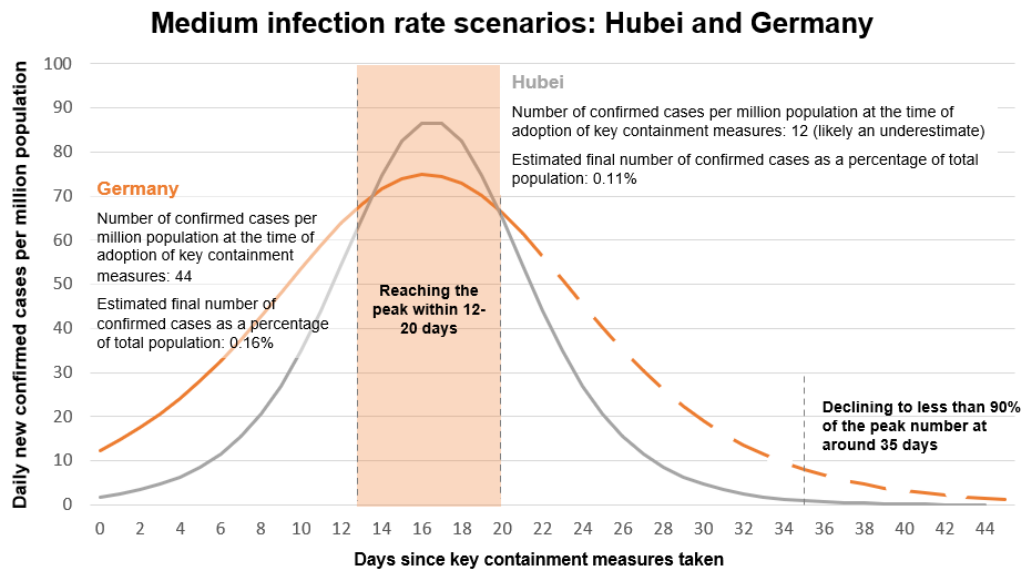


2) Medium infection rate scenarios: Hubei in China, Germany, Iran

In countries with medium infection rates when containment measures are taken, the epidemic reaches the turning point within 12 to 20 days, and the final infection rate accounts for 0.05% to 0.2% of the total population. The key regions and countries with this scenario include Hubei province in China, Germany and Iran.

Hubei launched key containment measures on January 24. Although the cumulative confirmed cases per million of population in Hubei was only 11.81 on January 24, as the earliest outbreak area, the number of infections in the initial stage was underestimated. Combined with the subsequent development of the epidemic, we classified Hubei as a medium infection rate scenario. The peak of new confirmed cases in Hubei occurred from Feb. 8 to Feb. 12, at about 5,000 cases. It is predicted that the final cumulative total will be about 68,000, and the final infection rate will be 0.11% of the total population.

Germany launched key containment measures on March 14, and the cumulative confirmed cases per million of population was 43.87. The peak of new confirmed cases in Germany occurred from March 26 to March 30, at about 7,000 cases. It is predicted that the final cumulative total will be about 130,000, and the final infection rate will be 0.16% of the total population.



Iran launched key containment measures on March 5, and the cumulative confirmed cases per million of population was 41.82. Despite the containment measures taken in the middle of the epidemic, Iran's testing rates have been low, and the cumulative infections per million of population as of April 5 was only 2,214. Limited by the ability to confirm the infections, Iran's curve for new confirmed cases was significantly flattened. The peak of new confirmed cases was not reached until March 31 to April 4, with about 3,100 new confirmed cases. It is predicted that the final cumulative total will be about 110,000, and the final infection rate will be 0.13% of the total population.

3) Higher infection rate scenarios: Italy, Spain, U.S. and France

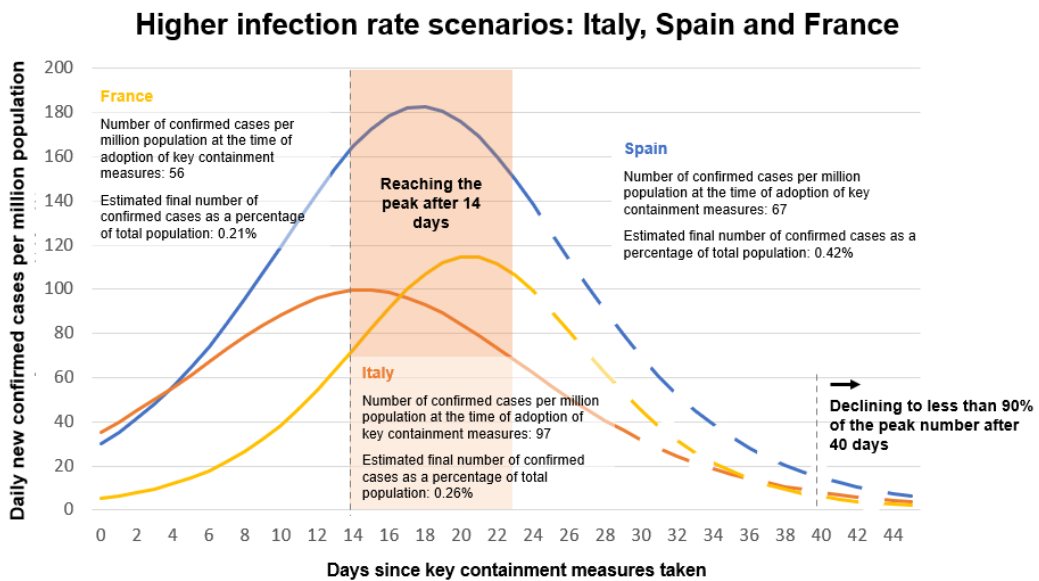
In higher infection rate scenario countries, the epidemic situation reaches the turning point more than 14 days after control measures are launched, and the final infection rate accounts for more than 0.2% of the total population. The countries include Italy, Spain, France and the U.S..

Italy launched key containment measures on March 8, and the cumulative confirmed cases per million of population was 97.29 at the

time. The peak of new confirmed cases in Italy occurred between March 22 and 26, and the peak of new confirmed cases was about 6,500. It is predicted that the final cumulative total will be around 160,000, and the final infection rate will be 0.26% of the total population.

Spain launched key containment measures on March 13, and the cumulative confirmed cases per million of population was 67.29 at the time. The peak of new confirmed cases in Spain occurred from March 28 to April 1, at about 8,200 cases. It is predicted that the final cumulative total will be around 200,000, and the final infection rate will be 0.42% of the total population.

France launched key containment measures on March 14, and the cumulative confirmed cases per million of population was 56.12 at that time. The peak of new confirmed cases in France occurred between April 1 and April 5 and the peak new confirmed cases was about 14,000. It is estimated that the final cumulative total will be around 140,000, and the final infection rate will be 0.21% of the total population.

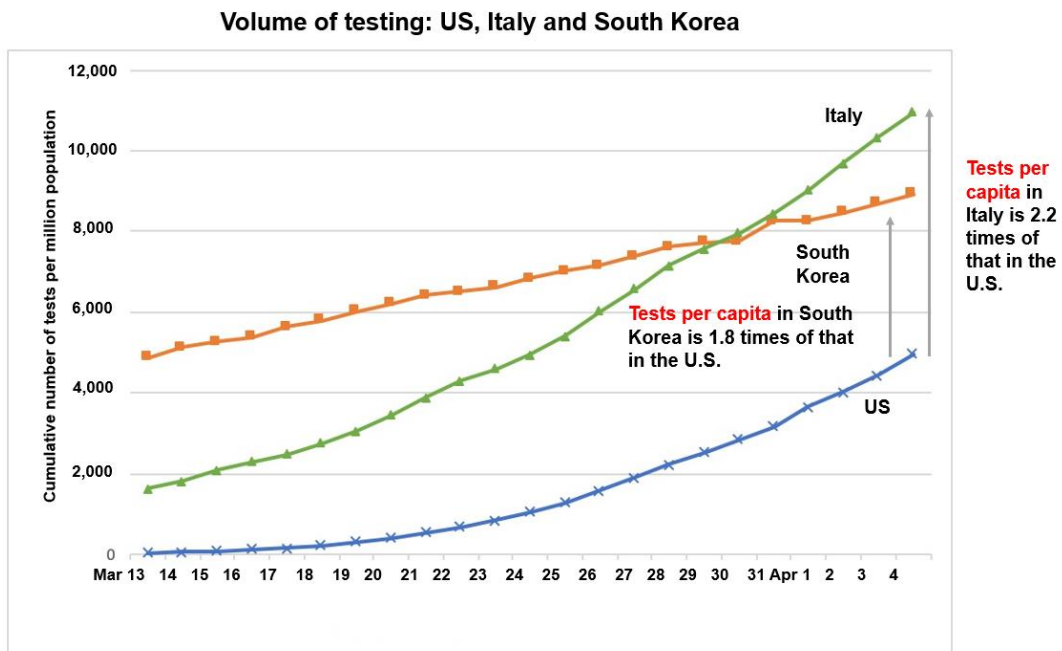


The U.S. launched key containment measures on March 13. Although the cumulative confirmed cases per million of population in the U.S. was only 5.37 at that time, the rate of testing in the U.S. at the beginning of the epidemic was less than those of European countries. The number of tests per million population on March 13 was only 47, so the number of infections may have been underestimated. Combined with the subsequent development of its epidemic, we classify the U.S. in the higher infection rate scenario. The next chapter will provide a more detailed analysis and prediction of the U.S. epidemic.

III. Second wave: The US, the UK, Turkey and Canada are expected to enter a period of moderation around April 15

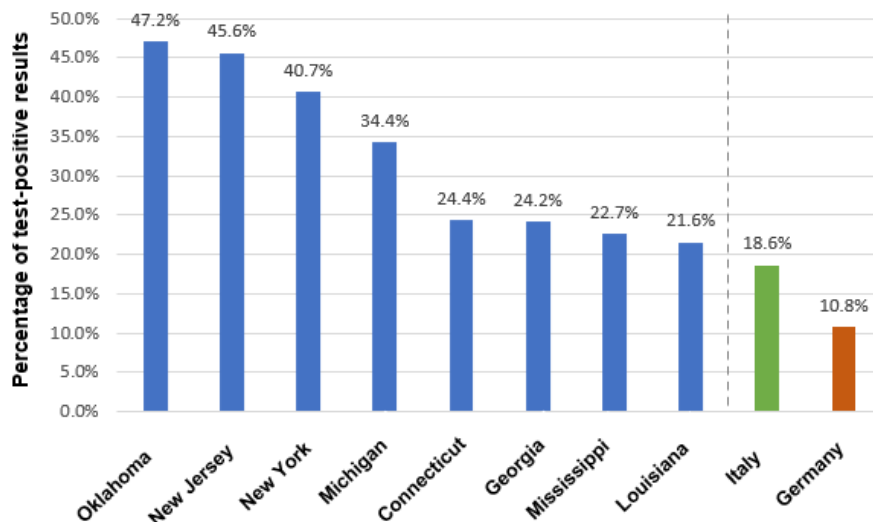
1) U.S.

The arrival of the peak of daily new confirmed cases in the U.S. will be later than we predicted on March 20. The first reason is that compared with European countries and South Korea, the U.S. has had fewer tests per capita. The second reason is that the eight U.S. states with severe epidemics have higher test-positive rates than European countries. As of April 5, more than 310,000 cases were confirmed in the U.S.. When the U.S. implemented containment measures on March 13, the cumulative number of tests per million of population was 47. By April 5, the cumulative number of tests in the U.S. rose to 4,933 per million of population, a 100-fold increase. However, it is still less than other countries: in Italy, the cumulative number of tests per million of population is 10,870, Germany is 10,962, and South Korea is 8,875. The following chart compares the recent changes in the cumulative number of tests per million of population in the U.S., Italy, and South Korea. It shows that the number of tests per capita in the U.S. has been significantly lower.

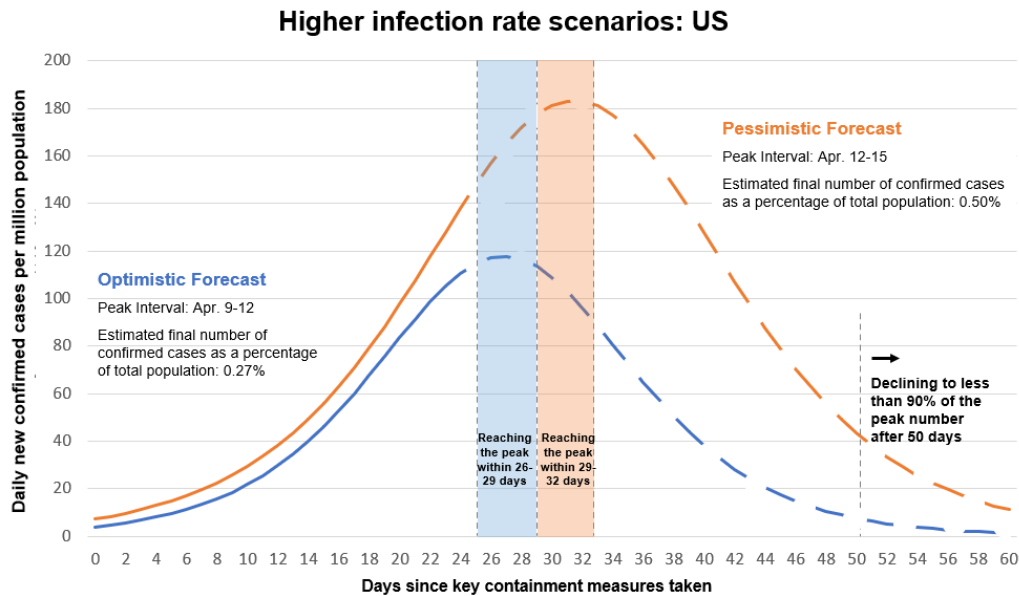


The eight states with severe epidemics in the U.S. have cumulatively more than 200,000 confirmed cases, and the test-positive rate is much higher than Italy and Germany. The real infection rate in the U.S. may be higher than those countries. There are currently eight states in the United States with a test-positive rate higher than 20%, including New York, New Jersey, Oklahoma, Michigan, Connecticut, Georgia, Mississippi, and Louisiana. The cumulative confirmed cases in these states is 204,558, accounting for nearly two-thirds of all cases confirmed in the U.S.. Among them, New York and New Jersey are the epicenters, where the cumulative confirmed cases reached 123,018 and 37,505 respectively. The test-positive rates were 40.7% in New York and 45.6% in New Jersey, far higher than Italy's 18.6% and Germany's 10.8%.

Test-positive rates: US states



It is now predicted that the peak of new confirmed cases in the U.S. will occur between April 9 and April 15 at about 39,000-60,000 cases. The final cumulative total in mid-May will be about 870,000 to 1.65 million, and the final infection rate will be 0.27% to 0.50% of the total population.



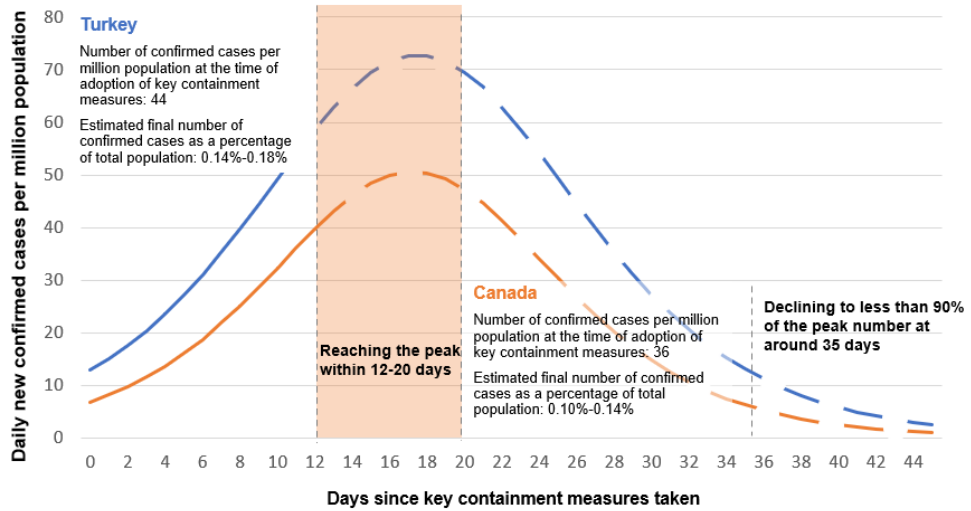
2) The second wave of epicenters: UK, Turkey and Canada

The second wave of outbreaks have been centered in developed countries in Europe and North America. In addition to the countries analyzed above, the recent outbreaks in the U.K., Turkey and Canada have also grown rapidly. Among them, Turkey and Canada are classified as medium infection rate scenarios, where the infection rate will account for 0.05% to 0.2% of the total population. The U.K. is classified as a higher infection rate model, where the proportion of confirmed cases will be more than 0.2% of the total population.

Canada launched critical containment measures around March 23, and the cumulative confirmed cases per million of population was 35.83 at that time. The new confirmed cases in Canada is expected to peak between April 8 and April 12 at about 1,800 to 2,500 cases. It is predicted that the final cumulative total will be around 35,000 to 50,000 cases, and the final infection rate will be 0.10% to 0.14% of the total population.

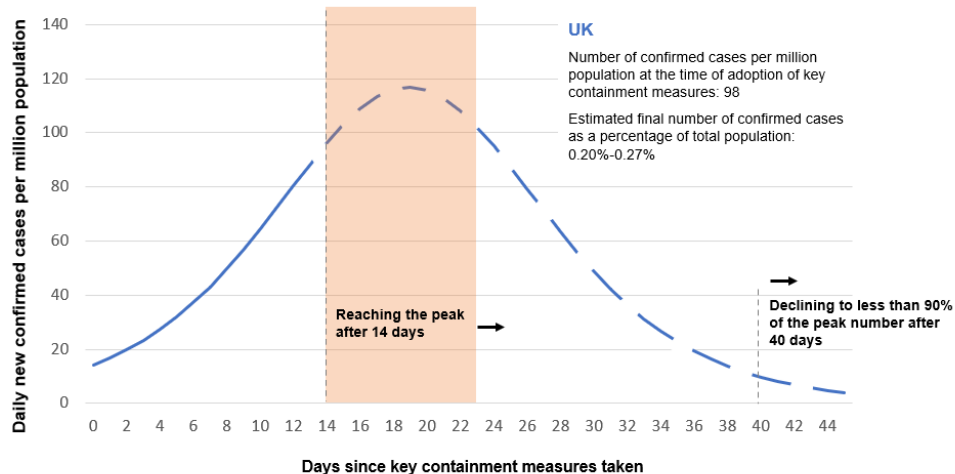
Turkey launched key containment measures on March 27, when the cumulative confirmed cases per million of population was 44.26. The new confirmed cases in Turkey is expected to peak between April 13 and April 17 at about 5,100 to 6,900 cases. It is predicted that the final cumulative total will be about 110,000 to 150,000 cases, and the final infection rate will be 0.14% to 0.18% of the total population.

Medium infection rate scenarios: Turkey and Canada



The U.K. launched key containment measures on March 24, when the cumulative confirmed cases per million of population was 98.00. The number of new confirmed cases in the U.K. is expected to peak between April 9 and April 13 at about 8,000 to 11,000 cases. It is estimated that the final cumulative total will be about 130,000 to 180,000 cases, and the final infection rate will be 0.20% to 0.27% of the total population.

Higher infection rate scenarios: UK



IV. The third wave of epicenters: Developing countries in Asia, South America and Africa, especially India, Brazil and Indonesia

After the second wave of outbreaks mainly in developed countries in Europe and North America, a third wave of outbreaks is expected to occur in densely populated developing countries in Asia, Africa and South America. India, Indonesia and Brazil are densely populated, and the level of testing volume was as low as 20% of the U.S. volume for the same period. India, Indonesia, and Brazil are the three of the most populous countries in the world, other than China and the U.S., with populations of about 1.38 billion, 270 million, and 210 million, respectively. The cumulative number of tests per million of population in the early stage of the epidemic on March 20 were 10.5 in India, 7.4 in Indonesia, and 13.7 in Brazil, initially on par with the U.S. rate of 10.6 on March 10. However, in the following 15 days, the cumulative number of tests per million of population in the U.S. reached 1,000, while these three countries only grew to 50 (India), 23 (Indonesia), and 215 (Brazil), far below the U.S..

Due to the low test volumes, the actual number of infections may be 7 times the total number of confirmed cases in India, 24 times in Indonesia, and 5 times in Brazil. According to the testing reports from March 10 to March 25 in the U.S. and Italy, with the continuous increase in test volume, the test-positive rate did not show a downward trend in 15 days. Based on the test-positive rates on March 20 of 1.4% in India, 17.4% in Indonesia and 22.5% in Brazil, if these countries had increased the test volume to a cumulative 1,000 people per million of population by April 4 (a level reached in the U.S. on March 25), then the cumulative number of infections would be 19,000 in India, 48,000 in Indonesia, and 48,000 in Brazil. That would be 7 times the cumulative confirmed cases reported on April 4 in India, 24 times in Indonesia, and 5 times in Brazil.

The test-positive rate in India is only 6% of the average global test positive rate, and it is estimated that the actual infections may be 80 times the cumulative confirmed cases. In addition, the test-positive rate of 123 countries that have published corresponding data worldwide is about 23%. The ratio of cumulative confirmed cases to cumulative number of tests conducted in India was only 1.4% on March 20, far below the average of other countries. India's previous test objects were mainly external arrivals, but there have been community-transmitted cases, so the test-positive rate in India may be underestimated. If the test-positive rate in India reached the level of the U.S. of 15.6% on March 25, it is estimated that the cumulative number of infections on April 4 would be about 220,000, more than 80 times the cumulative cases that have been reported.

V. Prediction of Fatality Rate Based on Four Healthcare Resources Scenarios

The ratio of peak confirmed cases in a seven-day period to the number of Intensive Care Unit (ICU) beds significantly affects the fatality rate. According to statistics in China, 20% of confirmed cases of COVID-19 are severe, and most deaths are from severe cases. The level of ICU beds is an important healthcare resource for treating these patients and controlling fatality rates. We use the number of peak new confirmed cases in a seven-day period to measure the demand of the current epidemic on the medical system, and categorize each country into one of four scenarios according to the ratio of the peak number of new confirmed cases in a seven-day period to the number of ICU beds:

1) A lower ratio of confirmed cases to the number of ICU beds: If the peak number of new confirmed cases in a seven-day period is less than the number of ICU beds, the medical system can operate normally and patients can be fully treated. In these countries, the final fatality rate is expected to be less than 2%.

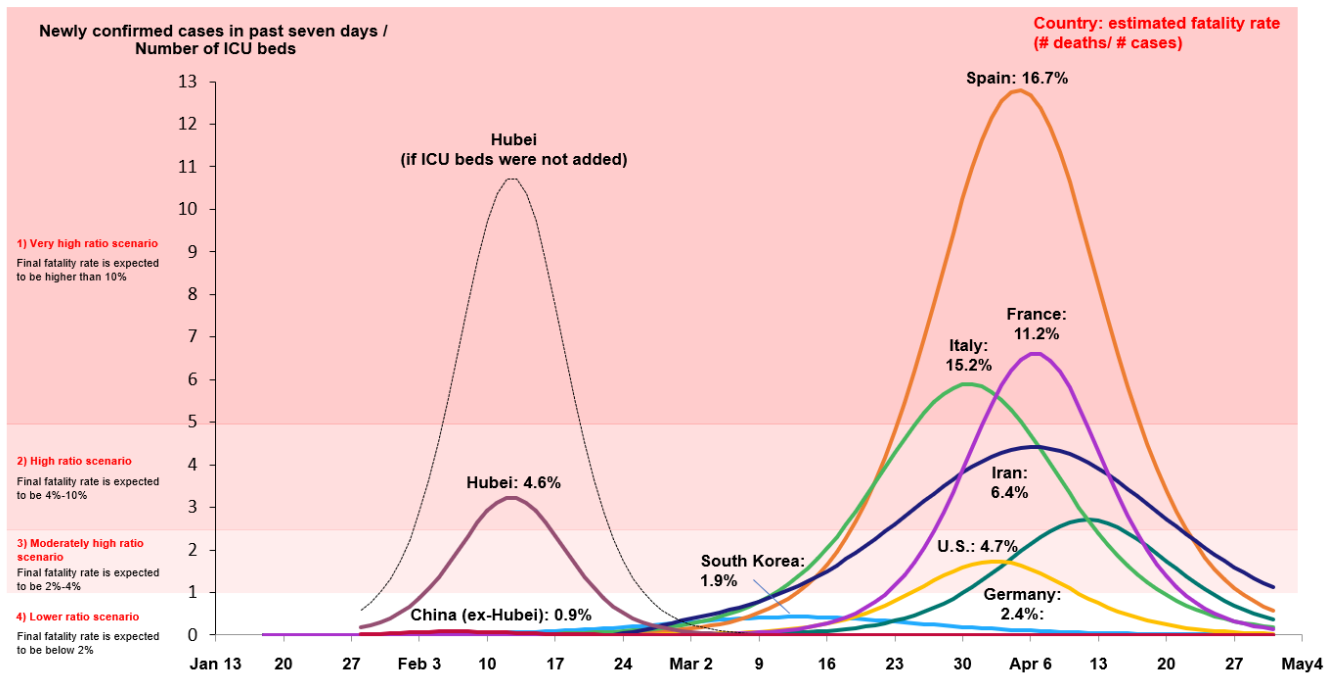
2) A moderately high ratio: If the peak number of new confirmed cases in a seven-day period is more than double the number of ICU beds, but less than 2.5 times, healthcare resources are strained, but the medical system is still operational, and the final fatality rate is expected to be 2% to 4%.

3) A higher ratio: When the peak number of new confirmed cases in a seven-day period exceeds 2.5 times the number of ICU beds, many critically ill patients cannot be effectively treated. It is expected that the final fatality rate will be 4% to 10%.

4) A very high ratio: When the peak number of new confirmed cases in a seven-day period exceeds five times the number of ICU beds, the number of ICU beds nationwide is insufficient to meet the needs of newly added severe patients with COVID-19. The medical system will be overwhelmed and a large number of severe patients will not receive treatment. The final fatality rate is expected to be higher than 10%.

The graph below shows the four scenarios and the expected fatality rate of each country. China (excluding Hubei) and South Korea are lower ratio models, and Germany has a moderately high ratio of confirmed cases to ICU beds at its peak period. The fatality rate of these countries is relatively low. Iran and the U.S. are categorized as higher ratio models, suggesting it will be difficult to cope with the epidemic. This could lead to a significant increase in the fatality rate. Italy, Spain, and France have very high ratios of confirmed cases to ICU beds, and the resources required for severe patients far exceed the existing ICU resources, which could lead to higher fatality rates.

Estimated fatality rates by country, based on demand for ICU beds



Taking into consideration the four scenarios and the impact of aging populations, we have predicted the cumulative death toll in seven key countries, and based on this, we have derived the predicted final fatality rate in each country.

1) Lower ratio scenario: China (excluding Hubei) and South Korea.
Healthcare resources in China (excluding Hubei) and South Korea are more abundant than their epidemic situation. It is estimated that the total cumulative death toll in China except Hubei will be about 130, with a case fatality rate of 0.9%. The total cumulative death toll in South Korea is expected to be around 230, with a case fatality rate of 1.9%.

2) Moderately high ratio scenario: Germany
At the peak of the epidemic situation, the German healthcare resources are relatively tight. It is estimated that the final death toll in Germany will be about 3,200 cases, with a case fatality rate of 2.4%.

3) Higher ratio scenario: Iran, the U.S., Hubei
The healthcare resources in Iran and the U.S. are expected to be insufficient during the peak of the epidemic. Iran expects the final cumulative death toll to be 7,100, with a case fatality rate of 6.4%. Under an optimistic scenario in the U.S., the final cumulative death toll is 41,000, and the case fatality rate is 4.7%. If the effectiveness of US's testing level and containment measures in the next stage does not achieve the expected results, in a more pessimistic scenario, the death toll is expected to reach 100,000, with a case fatality rate of 6.0%.

At the beginning of the epidemic in Hubei, there were only about 3,000 ICU beds in the province. Based on this, Hubei faced a serious shortage of healthcare resources at that point. However, after speeding up construction in Hubei Province, the number of ICU beds was increased to about 10,000 in February; and there were 11,000 critical medical personnel from all over the country gathered in Wuhan to treat severe cases. As such, Hubei's healthcare resources gradually met the needs of severe cases, resulting in the flattening of fatality rate. The cumulative death toll in Hubei is estimated to be 3,200, with a case fatality rate of 4.8%.

4) Very high ratio scenario: Italy, Spain, France

The healthcare treatment capacity of Italy, Spain, and France has been unable to withstand the pressure of their epidemics. The resources required by severe cases far exceed the existing ICU resources, which could result in a sharp increase in the fatality rates. The cumulative death toll in Italy is expected to be 24,000, with a case fatality rate of 15.2%. The final cumulative death toll in Spain is expected to be 33,000, with a case fatality rate of 16.7%. The final cumulative death toll in France is expected to be 15,000, with a case fatality rate of 11.2%.

About Us

Ping An Insurance (Group) Company of China, Ltd. ("Ping An") is a world-leading technology-powered retail financial services group. With over 200 million retail customers and 516 million Internet users, Ping An is one of the largest financial services companies in the world.

In 2019, Ping An ranked 7th in the Forbes Global 2000 list and 29th on the Fortune Global 500 list. Ping An also ranked 40th in the 2019 WPP Millward Brown BrandZ™ Top 100 Most Valuable Global Brands list. For more information, please visit www.pingan.cn.

Ping An Health Technology Research Institute is a world-leading healthtech research institute, being top-ranked in nine global competitions in the field of healthtech. It has more than 1,000 top scientists and nearly 10,000 developers in China, Boston and San Francisco. **Ping An Macroeconomic Research Institute** utilizes more than 50 high frequency data points, more than 30 years of historical data and more than 1.5 billion data points, to drive research on "AI + Macro Forecast", to provide insights and methods towards precise macroeconomic trends. Driven by the leading healthtech, **Ping An Smart City Research Institute** has developed solutions including artificial intelligence (AI)-based disease prediction, medical image recognition, smart medical decision support and treatment and smart chronic disease

management, with operations in more than 150 cities in China and Southeast Asia. Its solutions have been adopted by over 10,000 medical institutions.

Over the past two months, Ping An Health Technology Research Institute, Ping An Macroeconomic Research Institute and Ping An Smart City Research Institute have closely followed the developments of the COVID-19 pandemic, and have conducted corresponding analyses and forecasts. The first issue of the overseas epidemic analysis report was published on 21 March 2020 and the second on 7 April 2020. For further information, please contact Dr. Li Xiang through lixiang453@pingan.com.cn.

Disclaimer

This research report is based on current public information that we consider reliable, but we do not represent it is accurate or complete, and it should not be relied on as such. The information, opinions, estimates and forecasts contained herein are as of the date hereof and are subject to change without prior notification. We seek to update our research as appropriate, but various regulations may prevent us from doing so. Other than certain reports published on a periodic basis, the large majority of reports are published at irregular intervals as appropriate in the analyst's judgment.