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We Should Learn from Austria's Experiences Fighting COVID-19.



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As of April 4, Austria appears to be the first country other than China and South Korea where a fast exponential spreading of COVID-19 has been brought under control. Starting around March 27, the number of new cases in Austria has sustained a gradual decline. Austria achieved this without China's approach of physical isolation of entire cities, or S. Korea's extensive surveillance and contact tracing. Therefore, Austria offers another light of hope for other countries fighting COVID-19.

Austria.

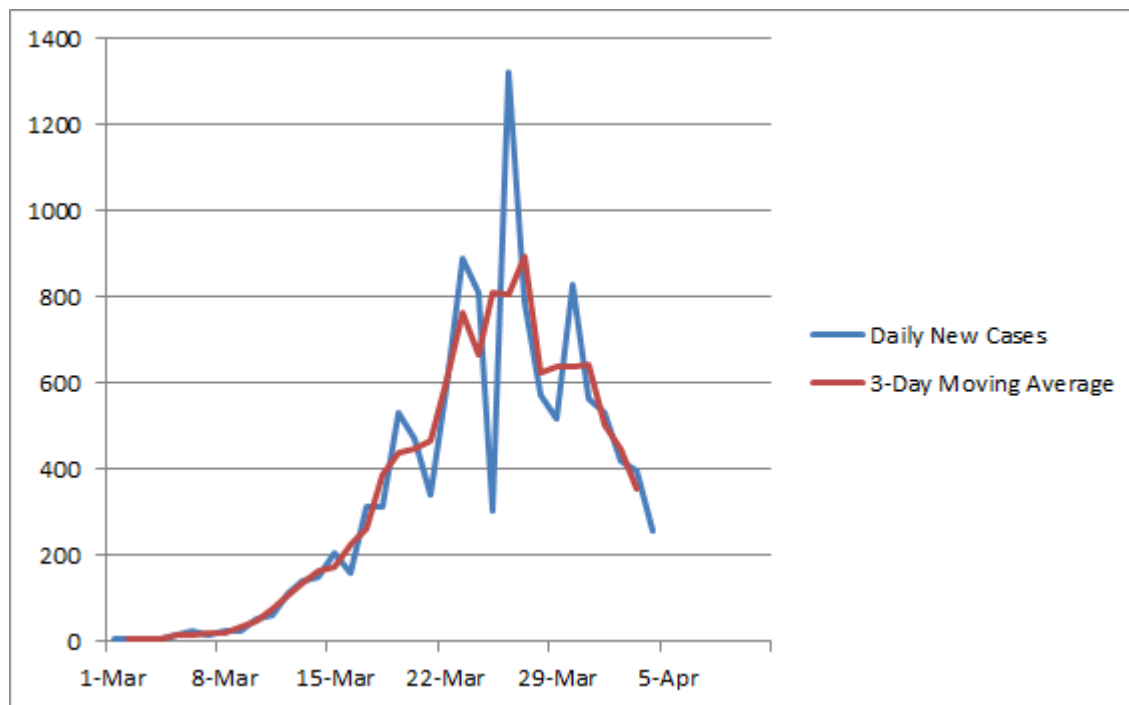
From <https://www.worldometers.info/coronavirus/country/austria/>, we can see that Austria had 14 cases on March 1. This increased 493 fold to 6909 cases on March 26, doubling about 9 times in 25 days. However, the tide had been turned starting around March 27. As of end of day April 4, Austria has 11,781 total cases, less than twice the case number on March 26.

I use two criteria to judge whether exponential spreading of COVID-19 has been brought under control in a country: trend of daily new case numbers, and daily test positive rate, which I elaborate below.

Trend of Daily New Case Numbers.

First and foremost, I want to see that the daily new case numbers have been on sustained decline for at least 5 days. Furthermore, the current level should be less than half of the

peak level. In some countries (including Austria), the daily numbers can change abruptly from one day to the next, perhaps because some cases are reported slightly late and counted in the next day's number. I thus use a 3-day moving average. See the figure below for the numbers of Austria.



Austria Daily New COVID-19 Case Numbers from Mar 1 to Apr 4

From Austria's numbers, we can see that the three-day moving average of new cases peaked on March 27 at 895. Six days later, this is reduced to 448 (about half of the peak) on April 2, and further reduced to 357 on April 3.

Daily Test Positive Rate.

I also want to see that the ratio of positive cases to the number of tests in recent days is sufficiently low, preferably below 10%. In my opinion, this indicates that most cases are discovered, so the daily new case numbers are reliable. According to this article, as of March 24 Austria tested 28,400 people with 4,900 cases. As of April 4, Austria made 104,134 tests with 11,781 cases. This means that the positive rate for the last 10 days is $(11,781 - 4,900) / (104,134 - 28,400) = 9.1\%$. Since the number of new cases has come down significantly over the last 10 days, the test positive rates in the most recent few days should be even lower.

Other Trends.

When the above two criteria are met, one should be able to see other trends as side effects. The number of active cases (cases without an outcome yet) should have started decreasing, or at least been increasing very slowly. For Austria, the number of active cases was 8874 in March 30; it gradually increased to 9334 on April 3, and decreased to 9088 on April 4.

Another effect of successful controlling COVID-19 is that the fatality rate of closed cases should be reduced to a reasonable level, e.g., below 10%. The total number of cases equals the sum of three numbers: death, recovered cases, and active cases. Closed cases include death and recovered. When examining fatality rates, I prefer to use the number of deaths divided by the number of closed cases. I exclude the active cases because they still do not have an outcome yet. Some of the active cases will result in death, and others will result in recovered. As more active cases are resolved, this rate goes towards the eventual case fatality rate.

As of April 4, Austria had 186 deaths, 2507 recovered cases, and 8732 active cases. Among the closed cases, the fatality rate is $186/(186+2507)=6.9\%$. This number has been steadily decreasing in recent days. My prediction for Austria's eventual case fatality rate is between 4% and 5%, based on observing the trend from South Korea and Germany.

Austria's Social Distancing Actions.

Austrian government took a series of decisive social distancing actions.

- March 10: the government announced that all universities would close their classes at the latest by March 16. All outdoor events with more than 500 people and all indoor events with more than 100 people were cancelled. All children older than 14 years old were ordered to stay at home, starting March 15, with the younger children starting March 17.
- March 15: a ban was also announced for public gatherings of more than five people, and restaurants were ordered to close beginning on March 17.
- March 16: nationwide, people may leave homes only for one of the following reasons: necessary professional activities, necessary purchases (groceries or medication), assisting other people, activities outside, alone or in the company of

people living in the same household. Officials stated that those restrictions are being actively enforced by the police.

Most social distancing actions in Austria started taking effect between Mar 15 and 17, and about 10 to 12 days later (around March 27) came the point in turning the tide on COVID-19.

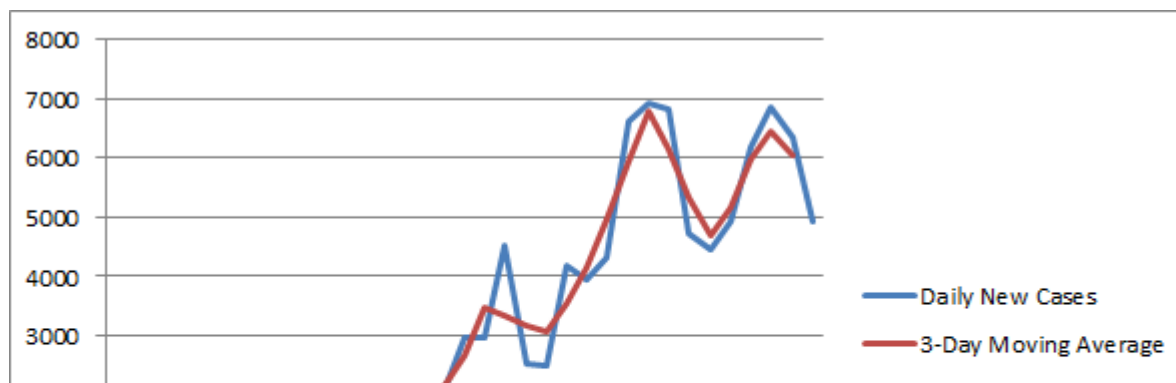
Austria's success lies in quick, decisive actions and avoiding dogmatic mistakes. Austria has a population of 9 million. On March 10, Austria has 182 cases. On March 16, Austria has 1018 cases. Austria started taking social distancing action at 20 cases per million. Within a week, at 113 cases per million, Austria deployed the strongest social distancing measures deployed in a Western democracy.

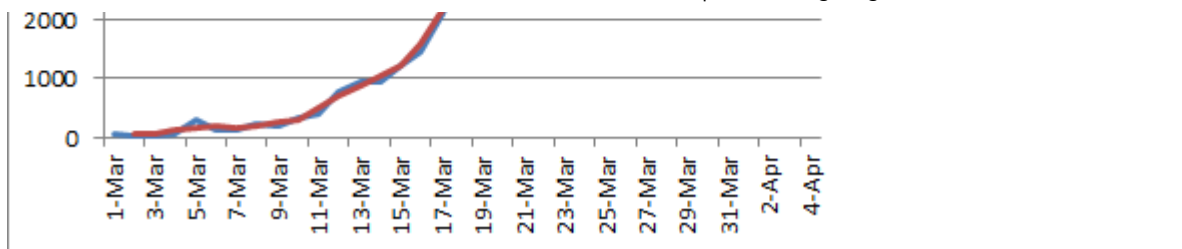
Other countries and states took much longer to go from cancelling large gathering to the policy that combines (1) a stay-at-home order, (2) a ban of gathering of more than a few people, (3) some enforcement mechanism. Some still have not adopted these policies.

As another example of Austria's quick correction of dogmatic mistakes, on March 30 the Austrian government announced that everyone entering a store has to wear a face mask effective April 6, becoming the first Western country to mandate face masks for the public, albeit in the limited context of shopping.

Comparing with Some Other European Countries.

Germany appears to be on the verge of controlling the spread of COVID-19. Germany's 3-day moving average of daily new case numbers also peaked on March 27 (at 6791). However, after coming down until reaching 4706 on March 30, the number went back up to a level close to the peak on April 2 (at 6460). It has started to come down again. If this downward trend continues, April 2 will be Germany's turning point.





Germany Daily new Cases from Mar 1 to April 4

Germany's adoption of strong social distancing mechanisms were about one week later than Austria. On 20 March, Bavaria and Saarland were the first two states to declare a curfew similar to Austria. On March 22, the German government and the states agreed for at least two weeks to forbid gatherings of more than two people in public except for families, partners or people living in the same household. Individual states and districts were allowed to impose stricter measures than these. Saxony joined Bavaria and the Saarland in prohibiting residents from leaving their dwellings except for good reasons; outdoor exercise is permitted under the new rules only alone or in groups of maximal five members of the same household.

Since Germany's nation-wide social distancing action is 6 days later than Austria, it appears that April 2 (6 days after March 27) should be the turning point for Germany; however, since not all states in Germany adopted as strong a policy as Austria, the speed of cases going down should be slower, and it is possible that Germany's numbers will go back up again.

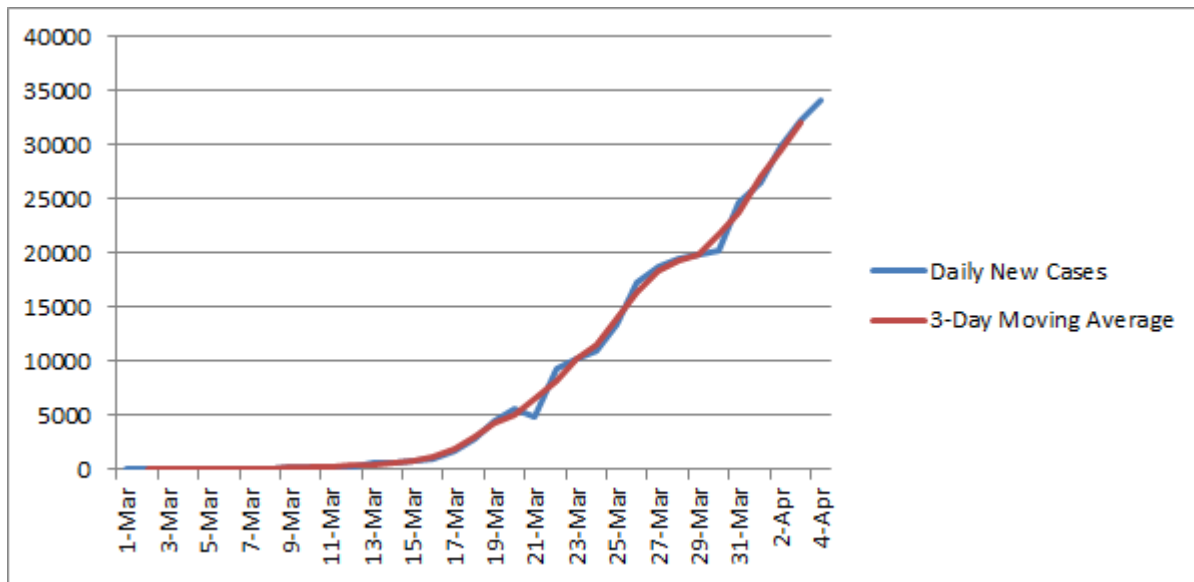
France adopted the policy that all people are required to complete and carry an attestation form to leave their homes and can be fined for non-essential journeys on March 23, and may also be on the verge of controlling COVID-19. However, it is difficult to draw conclusions regarding France based on current data. First, very few tests have been conducted (224,254 tests for 89,953 cases). Second, until April 1, French official counts only included deaths of hospitalized patients, and did not include deaths that have occurred in nursing homes. Starting April 2 these data were being added, resulting in very high daily new cases on April 3 (23,060 cases), where the previous high was 7578 on March 31.

Italy started national lockdown on March 10, but it is less stringent than Austria's policy. On March 21 Italy extended the lockdown by shutting down all non-necessary businesses and industries. While some social distancing measures have been taken as

early as Mar 11, Spain's responses were overall slow. On 28 March, Spain's prime minister ordered all non-essential workers to stay at home from 30 March to 9 April. In both Italy and Spain, daily new case numbers have been more or less constant or slightly decreasing over the last 10 days. However, in both countries, tests are insufficient, and it is difficult to draw conclusions.

United States.

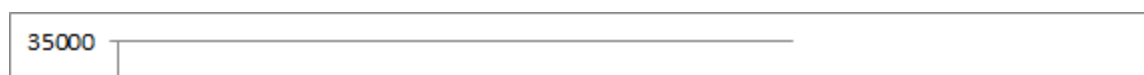
The situation in the United States as of April 4 is alarming. The number of new cases keeps going up at a quick pace, as can be seen from the figure below.

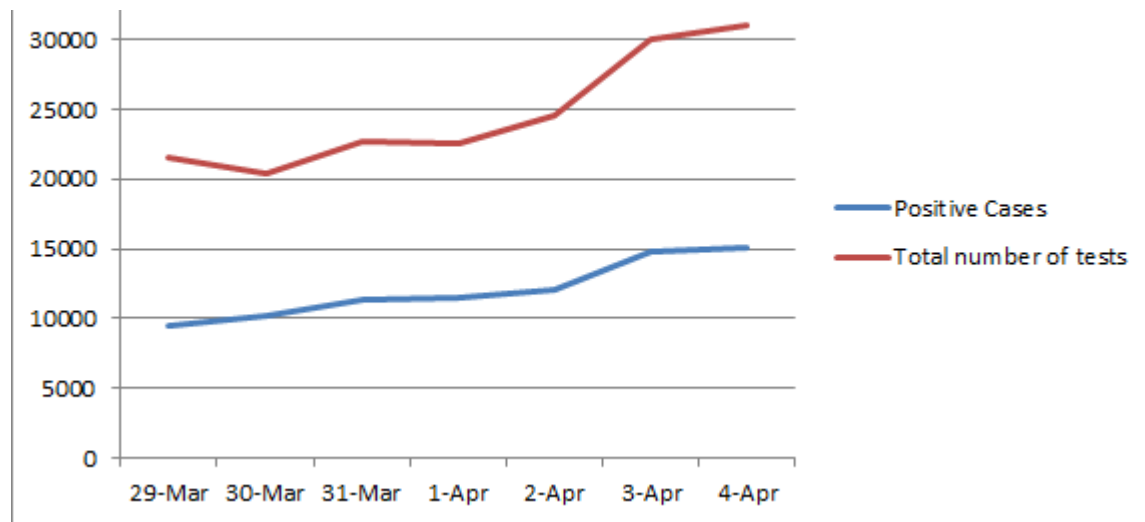


United States Daily New Cases

While the growth trend from the most recent days is closer to linear than exponential, an important factor is that the daily numbers of tests have not increased much over the last week or so. As a result, the positive rate have been going up. The degree to which the number of reported cases underestimates the true number has been increasing.

Let us examine the data for New York and New Jersey, the two states that currently have the most number of confirmed cases in the United States. As of April 4, the two states have a combined $114,775 + 34,124 = 148,899$ confirmed cases, which is 47.8% of the total number of US cases. The following figure shows the number of tests and the number of positive cases for the week from Mar 29 to April 4.





From Mar 29 to April 4 in New York and New Jersey, there were 172,533 tests and 84,386 of which were positive, for a positive rate of 48.9%. In total, there were 358,977 tests. In other words, before the most recent week, there were 186,444 tests, of which 64,513 were positive, for a positive rate of 34.6%. The positive rate has increased from slightly more than 1/3 a week ago to slightly less than 1/2 this past week.

At the same time, while most states have issued Stay at Home (aka. Shelter in place, Shelter at home) orders, they are less stringent than policies adopted by Austria and rarely enforced. Existing evidences suggest that they are not as effective as Austria, most likely due to not enough people following it. For example, New York's Stay-at-home order started on March 22; two weeks later, we still see number of new cases increasing.

Existing social distancing measures have certainly slowed the spreading of COVID-19, so that we are no longer seeing doubling case numbers in less than 3 days. The most recent doubling happened between 6 to 7 days. However, the society cannot afford to see an even slower exponential growth. If the number of cases doubles every 10 days, the country will see 8 times as many cases in one month.

Even if testing capacity can catch up with the growth of number of cases in the US, which increasingly appears unlikely, the effectiveness of testing alone is limited. Researchers found that patients can spread the virus even before developing symptoms, and there are a non-trivial percentage of people who are infected by COVID-19 without developing symptoms, yet can spread the virus. On the other hand, if everyone reduces physical contact with people outside the household as much as possible, spreading of COVID-19 can be turned from exponential growth to exponential decay without testing.

The number of cases in the US surpassed 0.1 percent of the population on April 5. At the same time, US has 9572 deaths and only 17,242 recovered cases. Among these closed cases, 35.7% result in death. This suggests that a large number of cases were not tested. As the case fatality rate should be close to 3.5% or less, the number of recovered cases should be around 10 times the current number. Therefore, the number of people carrying the virus in the US is likely close to 1 percent of the population, i.e., 3.3 millions. Due to the exponential growth nature, most of these people were infected during the last week, and many have yet to develop serious symptoms and require hospital care.

The United States cannot afford to let COVID-19 spread further! Providing medical treatment for the people who have already been infected when many of them develop symptoms over the coming days and weeks is likely to already overwhelm the hospitals in many regions.

Call to Action

I want to repeat my call to action in my second open letter written on March 14. It is the duty and responsibility for every one of us to conduct the most aggressive social distancing measures we can afford.

For more analysis on COVID-19, see my article published in the online ACM Risk forum, which is also available [here](#).

Personally, I have identified a small group of people that I will maintain close face-to-face contact. I have asked that everyone within the group try to avoid close contact with anyone outside the group if at all possible. (I do not count passing people in the store and on the road without talking or touching as close contact.) When having to have close contact with anyone outside the group, assess the risk (if possible, ask what measures the other person is practicing and history of potential contact) and use precautions recommended by CDC, e.g, using face masks (homemade if they cannot be found), washing hands thoroughly afterwards, etc.

If you want to help fight COVID-19, practice Aggressive Social Distancing, and convince more people to do the same.

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