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Figure 1. As of April 11th, 3:00 AM PST, for the US, Johns Hopkins currently reports 501,615 confirmed positive cases of COVID-19 and 18,777 deaths. US COVID-19 estimated Case Fatality Rate (CFR) had peaked at around 7.4% (03/03/2020) following a series of deaths in a nursing home in King County, Washington then fell to a low point of 1.2% on 03/21/2020 as testing rates picked up nationally. Following the low point on 3/21, US CFR began to rise again and currently sits at 3.74%. This trend is consistent with the "testing lag" hypothesis, and that states and federal agencies are now ramping up testing capacity to meet the true spread of the disease in the US. The sharp decline of US CFR from 7.4% to 1.2% highlights the importance of rapid COVID-19 testing to identify early-stage illness. Of the 501,615 (worldometers.info) active US cases, 11,059 (2.2%) of them are reported as critical or severe, a stark contrast for the expected 20% critical rate published by the World Health Organization (WHO), meaning that the continuation of additional US fatalities is extremely high and that critical cases are currently under-reported. Experts have suggested that vast numbers of individuals are currently infected with the SARS-CoV-2 virus nationally and that increased testing has revealed the true scope of the disease.

Recently, the US Federal Coronavirus Taskforce has embraced an anticipated fatality count of 100,000 to 240,000 US citizens, a conservative estimate based on the current trend of social distancing and state-wide "stay-at-home" orders limiting the spread of the disease (Source: [https://www.vox.com/science-and-health/2020/3/31/21202188/us-deaths-coronavirus-trump-white-house-presser-modeling-100000|Vox]]). This is critical because it represents an official endorsement from the US Federal
Government that the novel coronavirus that causes COVID-19 is much more severe than the flu (Source: [[https://www.vox.com/science-and-health/2020/3/13/21176735/covid-19-coronavirus-worse-than-flu-comparison|Vox]]). As of April 9th, this report has been revised down to 61,000 expected total fatalities in the US (Source: [[https://www.npr.org/2020/04/09/830664814/fauci-says-u-s-coronavirus-deaths-may-be-more-like-60-000-antibody-tests-on-way|NPR]]) based on improved modeling data and continued social distancing practices.

Relative to other countries, the US had maintained a much higher CFR than South Korea (3.4% vs. South Korea's consistently less than 2% CFR), but as testing rates increased in the US and fatality rates caught up with confirmed case rates in South Korea, the two countries had converged to statistically similar CFRs (1.52% in the US vs. 1.42% in South Korea on 03/25/2020). However, the current trend in the US is an increase in CFR meaning that the scope of disease transmission in the US might still be underestimated, and US CFR is once again diverging from South Korea (3.74% in the US vs. 2.01% in South Korea). The general trend for both countries is an increasing CFR.

Meanwhile, Italy has continued its trend of vastly outranking the world in death per confirmed case (CFR) with an estimated 12.77% CFR, but has since been surpassed by the US in terms of total deaths (20,467 US deaths vs. 19,468 Italy deaths, 4/11/2020 – 3:00 PM PST, worldometers.info). China has only reported 29 new deaths in the month of April, a stark contrast to the US' 16,403 reported April deaths (worldometers.info). Recently, the United Kingdom has also posted a significantly disturbing CFR (12.03%), along with Spain and France (10.16% and 10.49%) respectively.

Globally, the average CFR has been on an increasing trend, with the global CFR of 3.4% being having been breached since March 10th. Today, the global average CFR is 6.07%, an increase most likely driven by high fatality countries still experiencing the exponential phase of their epidemics, including Italy, Spain, Iran, France, the UK, and the US.

In contrast to the high fatality rate countries, both Germany and Australian CFRs have remained low (2.24% and 0.89% respectively), suggesting these countries are similar indicators of "best case" scenarios, including South Korea as well. I would expect an optimal testing scenario to yield CFRs similar to the range exhibited by these countries (0.89% to 2.24%), although as previously mentioned, both Australia and Germany might be much earlier in their epidemic phase compared to South Korea, which is no longer experiencing exponential growth. All three of the countries continue to see increases in their CFRs, which is evidence suggesting these countries are still experiencing epidemic-level spread of COVID-19.

Figure 2. Current US COVID-19 doubling rate using the date of the first US death (2/29/2020) as the nucleation point for binning. Data through 4/11 is from Johns Hopkins CSSE. Data for 4/12-3/18 is the anticipated doubling point using a 4.2 day time frame based on the next anticipated point of 1,146,880 US reported cases. The rate had slowed recently to 3 days (3/13-3/16;3/20-3/23), but then increased again to a 2 day doubling time (3/16-3/18;3/18-3/20), suggesting that testing has started to catch up to existing infections, but that testing is lagged over the weekend (3/14-3/15). More recently, the doubling rate has continued to slow (4 days on 3/30, 5 days on 4/4, and 6 days on 4/11).

A 4.2 doubling time was determined by taking the average of the last 5 doubling points. Continued growth at a 4.2 day doubling time suggests that US testing is achieving a testing rate that matches the expected biological doubling rate of COVID-19 (~6 days). As long as the US maintains a doubling rate close to 6 days, this would suggest the US is still experiencing exponential growth during its epidemiological phase. This would fit the model of COVID-19 having a higher R0 (“contagion factor”) than seasonal flu (1.4 to 3.8 of COVID-19 compared to 1.28 for seasonal flu). More recent estimates have suggested COVID-19 can have an R0 as high as 5.7 on average (95% CI 3.9 to 8.9), meaning that a single infected individual with COVID-19 could transmit the virus to up to 9 people. As the United States enacts sweeping “social distancing” rules and “stay-at-home” orders at both the state and federal level, the spread of COVID-19 is expected to begin slowing, but the extent of undiscovered infections is still currently unknown.

R0 COVID-19:
https://promedmail.org/promed-post/?id=20200126.6918012 (1.4 to 3.8)
https://wwwnc.cdc.gov/eid/article/26/7/20-0282_article?deliveryName=USCDC_333-DM25287 (3.9 to 8.9)

R0 Seasonal Flu: https://www.ncbi.nlm.nih.gov/m/pubmed/25186370/
Figure 3. Peak hospital use in six countries (US, France, Germany, UK, Spain, Italy, Sweden, and Netherlands) representative of North America and European populations. Purple lines indicate the number of hospital beds needed at the projected peak hospital resource usage, green lines the number of ICU beds needed, and blue lines the number of required invasive ventilators at peak. France, Spain, Italy have already passed their projected peak dates, while the US, Germany, and UK are expected to reach their peak points this week. Sweden and the Netherlands both have extended peak points not expected to occur until early May. The US has the most anticipated deaths at the time of peak usage, followed by the UK, Italy, Spain, the Netherlands, Sweden, and Germany. Germany is not currently expected to experience a shortage of hospital or ICU beds.
Figure 4. Map depicting the spread and transmission of North America and Europe. Map source: Johns Hopkins CSSE: [https://coronavirus.jhu.edu/map.html](https://coronavirus.jhu.edu/map.html).