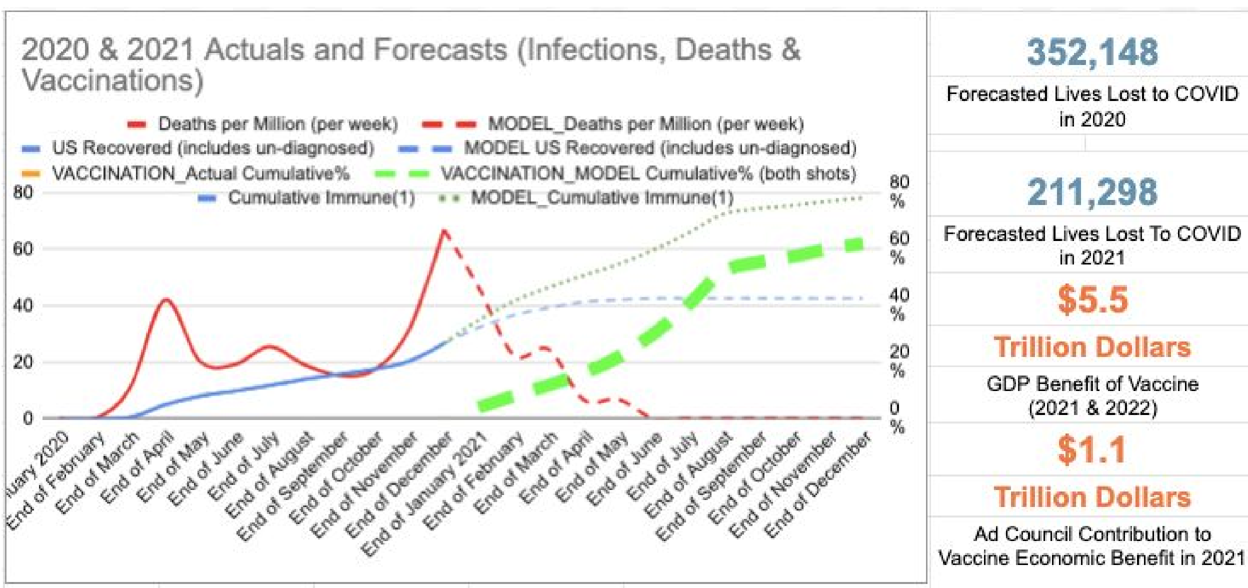
*Rex Briggs, Executive Chairman, Marketing Evolution*
*for Ad Council & COVID Collaborative, 15 Dec 2020*

# 2021 Forecast is Model (Briggs-3): Impact on Lives & Livelihoods

Briggs-3 2021 forecast, released in November 2020, is based on:

1. The successful vaccine trials and parallel path effort to produce large quantities of the Vaccine for the US population.
2. Infection Fatality Rates (IFR), fatality rates by age cohort, infection rates, and deaths using the same model approaches applied in Briggs-1 (March 2020) and Briggs-2 (September 2020).
3. Vaccination rates, especially among the 65+ population
4. "Marketing Contribution" based on Ad Council efforts is added to this model.

This whitepaper explains each aspect of the model and the underlying assumptions, including Lives Lost, Lives Saved, Livelihoods Saved (Economic Impact) and Ad Council's contribution to ending the pandemic.




The forecast chart shows solid lines for *actual* and dashed for *forecast*. The red line shows the ***lives lost*** per million per week due to COVID-19. The blue line shows the COVID-19 percent of the US that has **recovered***, including those un-diagnosed,* in the US. This blue line also represents the cumulative ***immune*** due to recoverises from infection.[1] The ability to estimate total infection rate (including un-diagnosed) is based on my model, which will be discussed in this paper. The dashed blue line is the forecasted recoveries from infection, which flattens out as increased vaccinations reduces the spread of the virus. The dashed heavy green line is a forecast of completed **vaccinations**. An orange line of **completed vaccinations** will appear in

[1] Cumulative immune assumes those infected and recovered have some level of immunity for 12 months. Given the novelty of the virus, this assumption will be revisited as more time passes and more data is available.

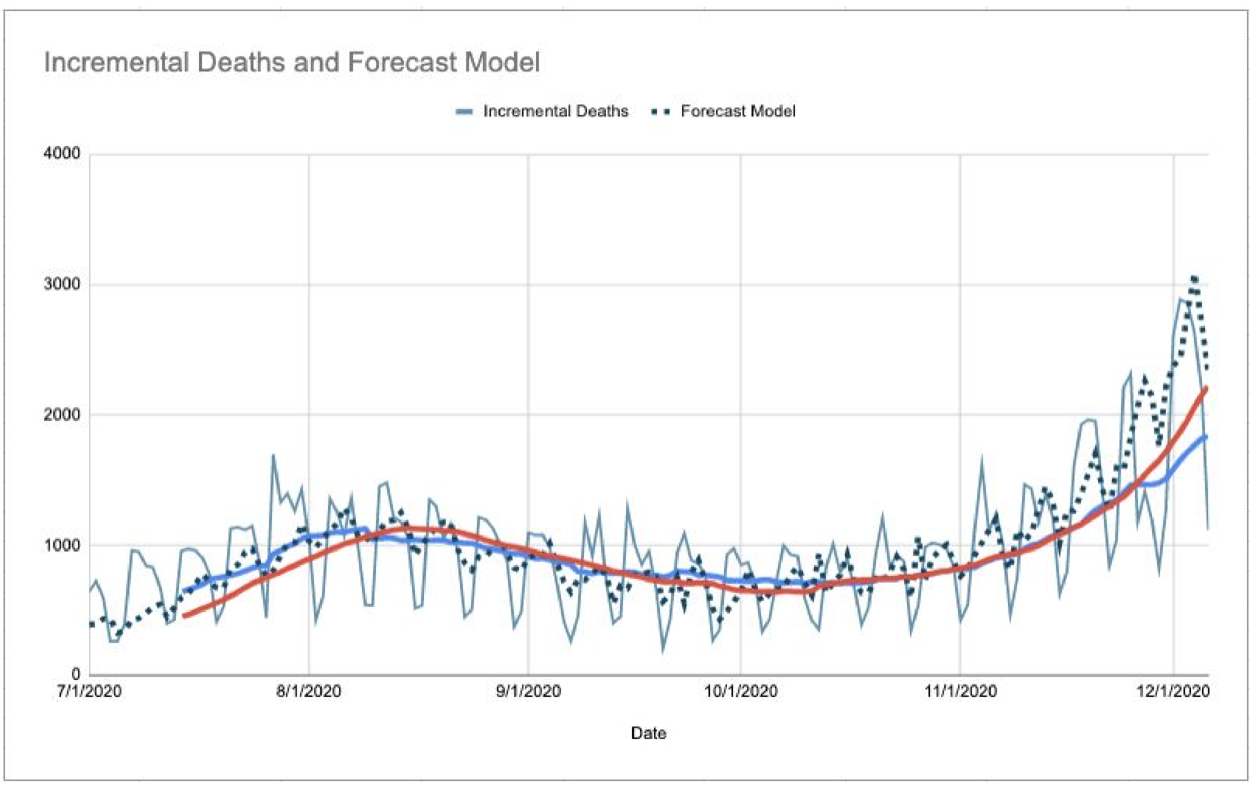
2021 as second dose injections are reported. The lighter weight green line represents cumulative percent of population **immune** -- which combines immune due to vaccination and immune due to infection recoveries. In 2020, the *cumulative immune* percent increases solely due to recoveries from infection whereas in 2021, the primary factor increasing immunity is forecasted to be ***immunization***.

There are open questions, such as, "How long is someone who has recovered from the coronavirus immune from reinfection?" For this model, I've assumed most remain immune for at least a year. And, "Can those who are inoculated get infected and transmit the virus?" For this model, I've assumed they cannot. If these assumptions are found to be wrong, I will update the model accordingly.

## Lives Lost Due To COVID Model:

The model is fed by the New York Times GitHub report of daily cases and deaths. The short-term forecast of deaths is based on a 21-day lag from case to deaths. From July 1 to December 10th, the model used a 1.7% 21-day lagged Case Fatality Rate (CFR). This has an $r^2$=.90 based on the 7-day moving average. The advantage of this simple model is the ease of explanation: "whatever the new cases are today, in 21 days, I forecast 1.7% of them will be dead from COVID-19."

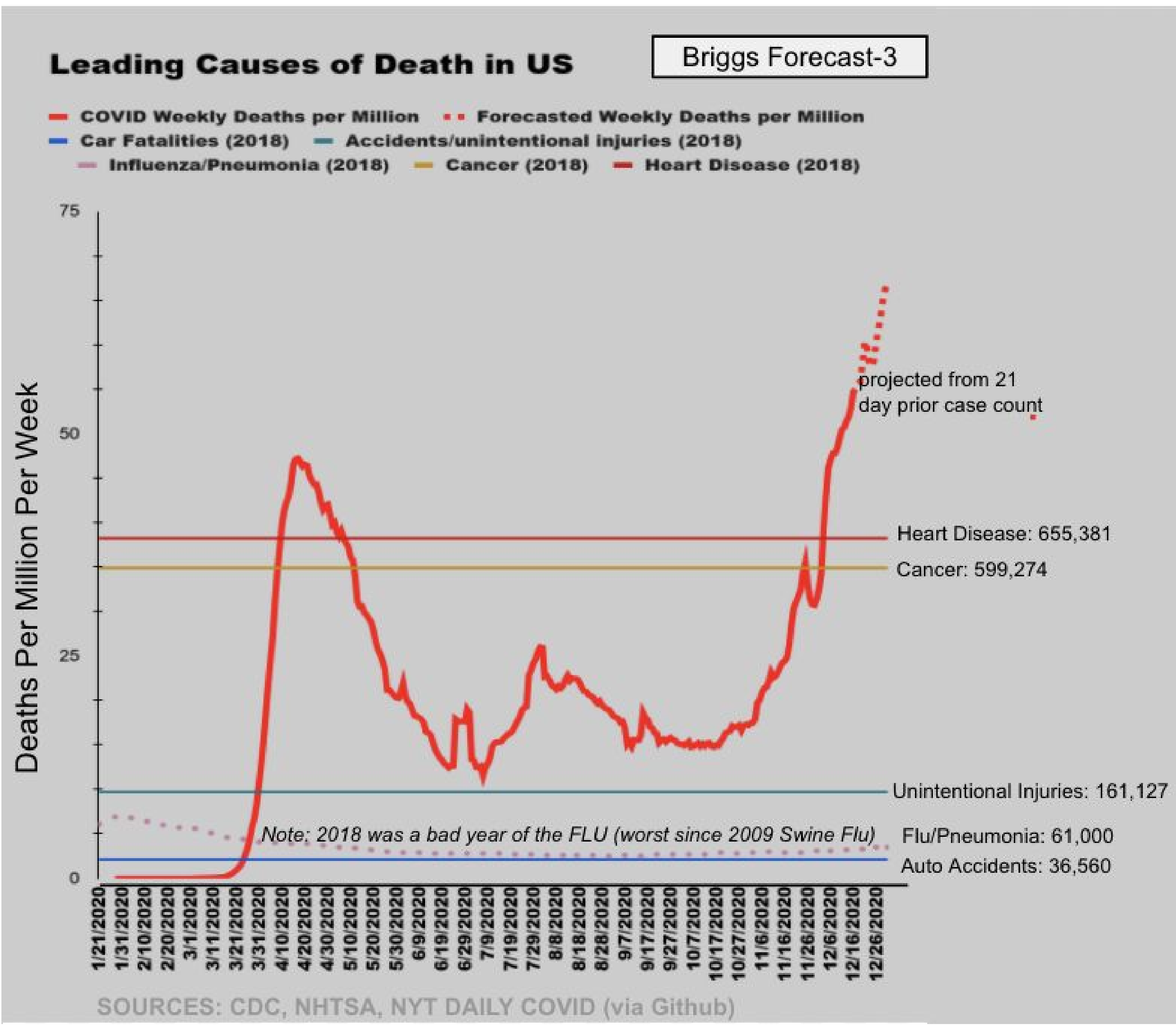
Out of the 156,373 deaths recorded from July to December 10, the model was only off by 21 deaths on a cumulative basis.



However, in December, the predicted deaths began to overshoot actuals, as seen by the red line (the model) and the blue line (the moving average actuals). Therefore, as of December 10th, the model uses the trailing 30 day average of 21-day lagged CFR.

Whatever the new cases are today, in 21 days, I forecast that we will see about the same percentage die as have died in the last 30 days (using the same 21-day lag). I would expect this model to slightly overshoot actual deaths as therapeutics improve. But, since the model uses a trailing 30 days of the 21-day lagged CFR, the model will automatically adjust to recent trends.

The forecast for lives lost at end of 2020 is therefore a summation of lives lost to date plus the short-term forecast model projecting additional deaths until the end of the year. The short-term forecast automatically updates each day as new deaths and confirmed cases are reported.

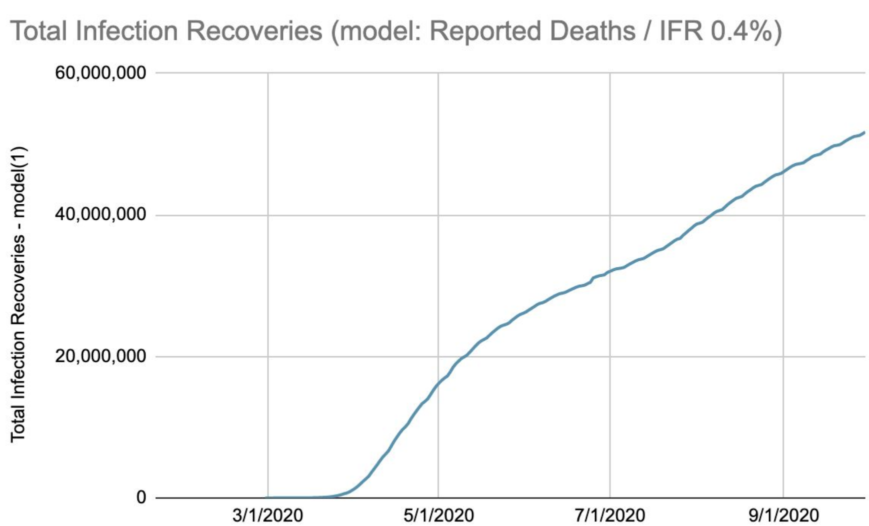


The longer-term forecast of deaths is based on forecasted infection rate and Infection Fatality Rate (IFR). Simply put, the forecast considers what percent of the US population will become infected, and what percent of these infections will result in death.

The IFR is based on my working paper analysis of the Diamond Princess Cruise, which measured IFR as 0.4%. My measurement of IFR in March is in line with subsequent serological studies quoted by the CDC in November based on data through September 2020.[2]

The reason I invested time in the Diamond Princess Cruise (DPC) analysis to get a good estimate of IFR is that IFR can be used to calculate the total infections in a population. Simply put, diagnosed cases are incomplete. Diagnosed cases depend on the willingness of people to get tested and the availability of testing. Diagnosed cases can miss mild or asymptomatic infections. Deaths, on the other hand, are easier to observe. There is no such thing as mild or asymptomatic death. Even if deaths are not always accurately linked to COVID-19 infections, there is a baseline of expected deaths, and excess death reporting provides another data point. By dividing COVID-19 deaths by the IFR, it produces a count of total infections 21 days prior (the 21 days is the average lag from infection to death I calculated in February based on data from Hubei).

Below is a chart of the Total Infections (including un-diagnosed) based on dividing reported COVID-19 deaths by my DPC calculated IFR of 0.4%. Note that by the end of September, my IFR calculated 55 million (17% of Americans infected) while the CDC calculated 53 million (16% of Americans infected with COVID-19).[3]




[2] Published 25 Nov 2020, Title: **Estimated incidence of COVID-19 illness and hospitalization — United States, February–September, 2020,** reports 52.9mm US infected/recovered by September 30. Using a 21-day lag for deaths (222,195k) equates to 0.42% IFR (close to my DPC 0.4% estimate).
[3] Wall Street Journal summary of CDC findings:
https://www.wsj.com/livecoverage/covid-2020-11-27/card/vNkshCuxwSGLw7zkSx4z

My initial forecast in Mid-March 2020, when there were less than 200 deaths from COVID-19, applied a range of IFR from 0.4% to 0.6% because it seemed probable that hospitals could get over-run and IFR may increase due to limitations in resources. When presenting the results to The ARF, I reviewed the expectation that New York City could become like Wuhan, with hospitals at a breaking point. A scenario of an IFR of 1.6% was demonstrated and it showed that 780k could die if our hospital systems nationwide became overwhelmed. At the same time, I presented that I expected Therapeutics to improve with time and experience, which would lower the IFR. The base case forecast in Mid-March assumed that 15% to 20% of the US would become infected by the end of 2020 with an IFR between 0.4% to 0.6%, resulting in an estimated 295,000 deaths by the end of 2020.

The infection rate forecast of 15 to 20% at the end of 2020 was based on an initial R0 analysis that suggested the SARS-CoV-2 is at least twice as contagious as the flu, and could grow to a high percent of the US population if left unchecked. I considered prior pandemics, such as 1918 Spanish Flu (peaking at an estimated 25-30%) and the more recent H1N1 Swine Flu, which infected an estimated 18% of the US population. I analyzed data to understand what triggers Americans to change their behavior and found that as cases were reported in their county, people travelled less.[4] TSA airport data showed travel declined and OpenTable data showed restaurant reservations decreased. In other words, infection growth rate is moderated by citizens changing their behavior. In addition, the evidence showed that masks could reduce the spread, and stay-home/other quasi-quarantine measures were effective in other parts of the world -- it seemed reasonable to assume these would be applied in the US. At the same time, the US is highly decentralized and I factored in an uncoordinated national and local response as well as an uneven reception from a heterogeneous American population. Finally, my analysis of global cases by longitudinal data suggested a seasonality effect was likely, and the US and Europe would see a lull over the Summer, I was forecasting a second wave larger than the first. With all of these factors, I estimated we'd end the year with an infection rate between 15% to 20% with an IFR of between 0.4% and 0.6% (and perhaps lower if we took collective and coordinated national action to reduce the spread and managed to find more effective therapeutics).

In mid-March, when I presented my forecast, we had less than 200 deaths in the US and forecasting an increase of nearly 300,000 in less than ten months was sobering.

In September 2020, I raised the forecast to 20 to 25% infection rate (mid-point of 350,000 deaths at end of the year), based on two facts: First, masks and stay home initiatives had become politicized. Research from Pew showed a declining commitment to interventions to slow COVID, and polls showed a meaningful political divide.[5] Second, the US squandered the summer, thus allowing the background rate of active infections to enter the fall at a higher level than I had originally modeled in March.

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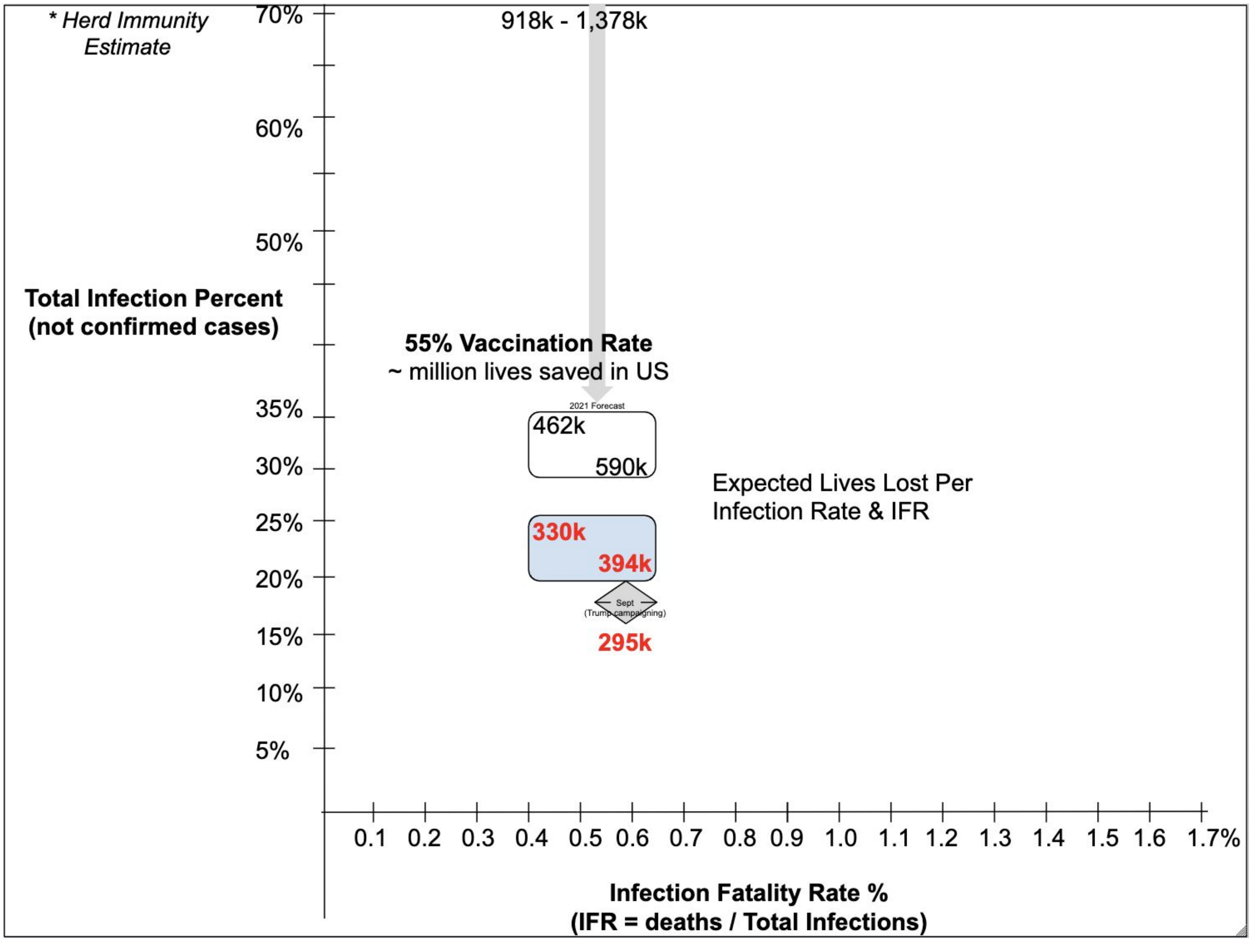
[4] See Briggs March 2020 Analysis of Mobility Data and response to COVID cases in county
[5] Source: https://www.pewresearch.org/science/2020/09/17/u-s-public-now-divided-over-whether-to-get-covid-19-vaccine/

As the chart illustrates, the initial forecast of 15-20% infection rate and 295,000 lives lost in 2020 was raised to a range shown in the blue square of 20-25% infection rate with 330,000 to 394,000 COVID-19 deaths by end of 2020. The chart also shows the forecast for 2021, for vaccines to put downward pressure on the virus, but not before the infection rate grows to between 30% and 35% of the US population.




I refined the model in November based on estimates of vaccine doses that would be distributed in the US, the phases in which different populations could get the vaccine, behavioral data on flu vaccination rates and polling data on vaccine intent. The model currently shows infection rates will likely exceed 35% in the first half of 2021.

As with the initial March forecast, I include a consumer psychology response to cases and deaths. The model forecast is described in my [Research World] article from November. In essence, I predicted that deaths per million per week would increase into mid-January. The colder weather would bring people indoors, and the holidays will bring people together (despite warnings not to do so).

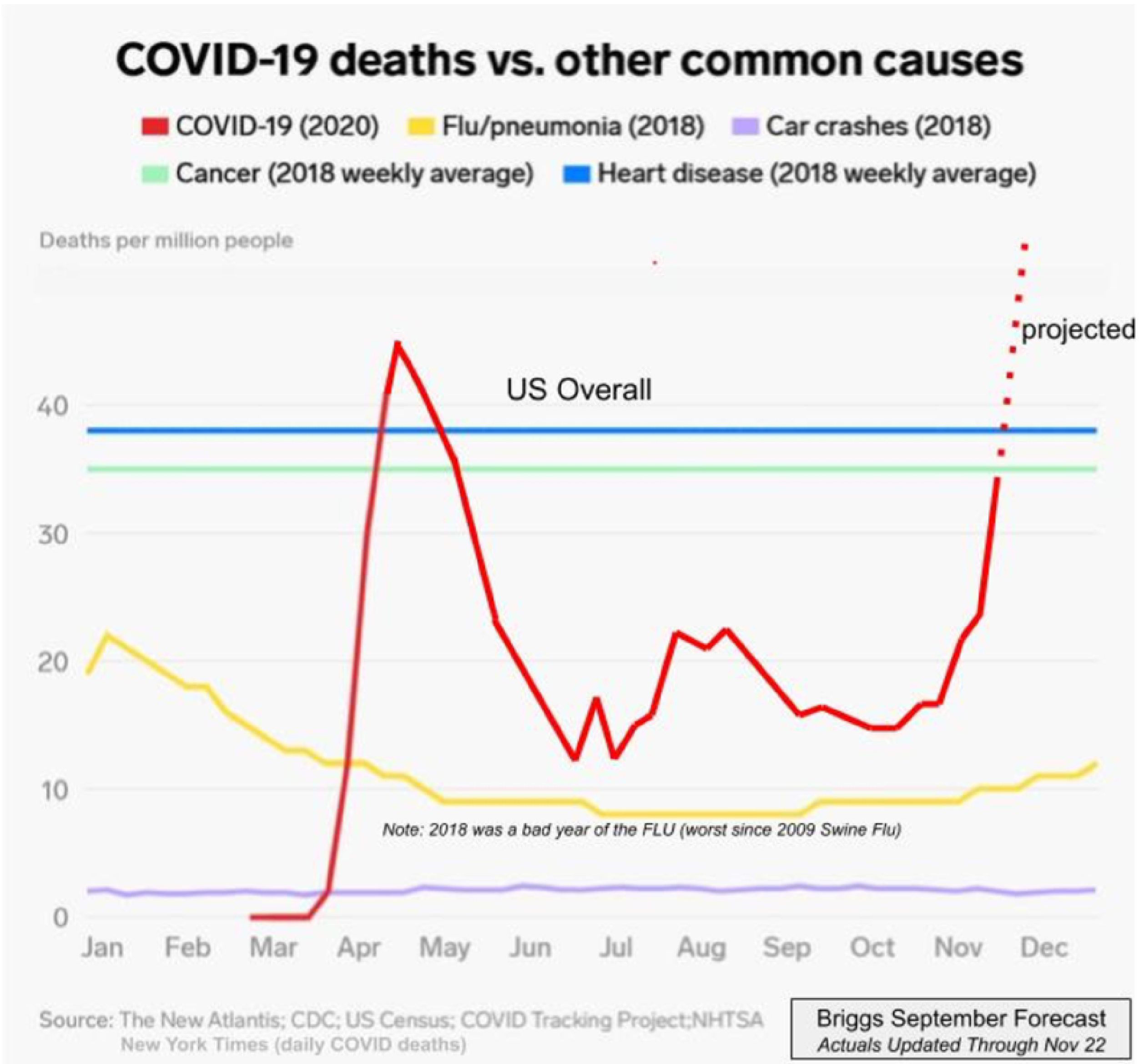
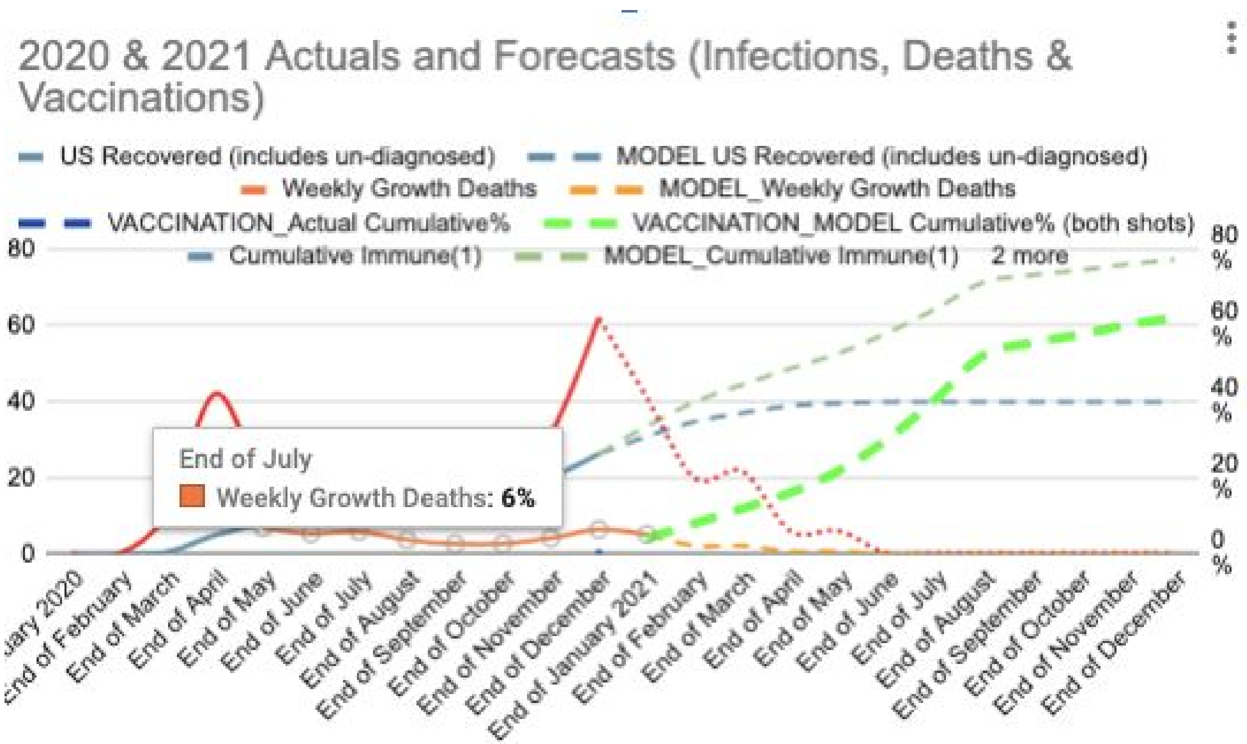



CHART NOTE: The original chart, as published in April by the New Atlantis, and used by the author on November 22, (as shown above) had an error in the Flu/pneumonia (2018) trendline. I went back to the source data used by The New Atlantis for all data sources and found the CDC data on 2018 Flu erroneously included ALL pneumonia, not just the Flu related pneumonia. This overstates the yellow line by more than 3x. In subsequent uses of this chart, I've updated the data accordingly. The chart on Page 3, which shows the daily actuals for December, shows the correct Flu/pneumonia deaths per million per week trendline.

As the death toll grows, and the Holidays pass, the expectation is consumers will hunker down until the next major extended family Holiday, Easter. At the same time, vaccinations will increase. One can hope that preventions like masks and social distancing will be seen as common sense rather than political statements.

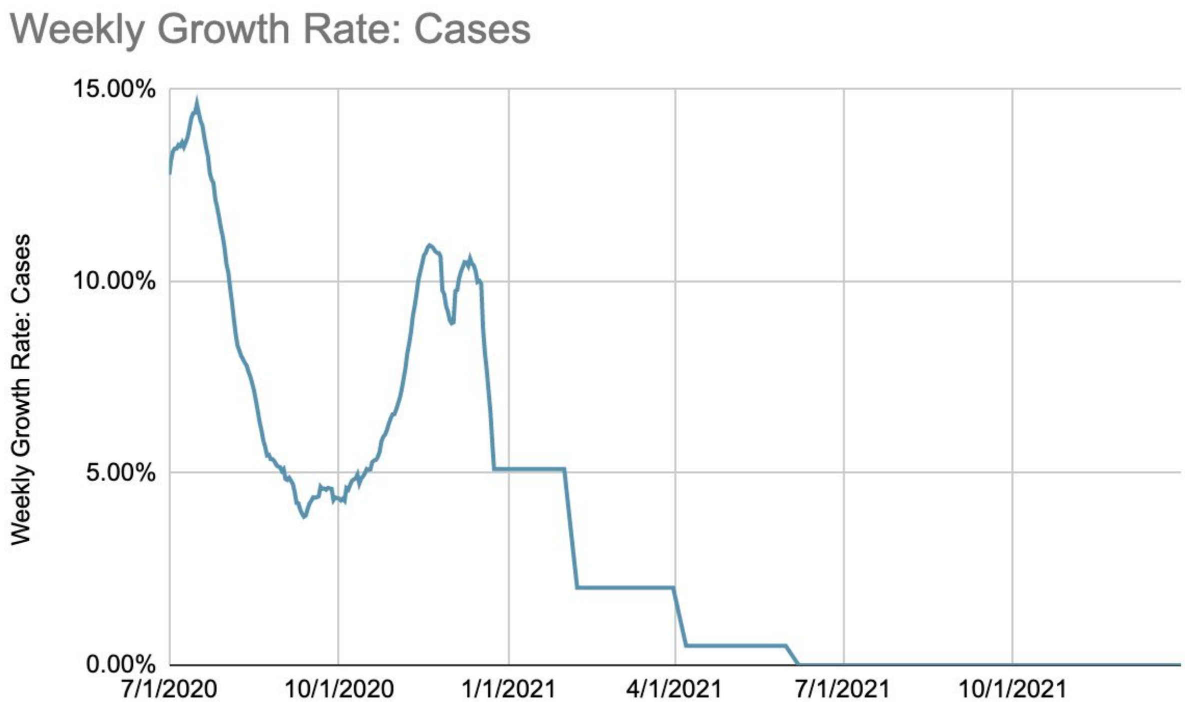
The solid orange line in the forecast represents the average weekly growth rate in the number of COVID deaths. The dashed line represents the forecasted growth rate. The rate stands at about 6% in December, and I am expecting it to decrease throughout the first half of 2021.




Since new cases predict new deaths with a 21 day lag,[6] the growth in cases drives the death forecast prediction. Over time, as the base of cases grows, there should be a natural decrease in the growth rate as the base of cases (the denominator) becomes larger. However, in the past two months, we've seen the growth rate more than double from 5.0% on October 15 to 10.5% on November 15 (the base went from 8,043,257 to 11,113,634). As of December 15, the weekly growth rate in cases is 10.0% (the base is now 16,771,562 - more than double the cumulative cases just two months earlier). I am expecting the weekly growth rate in new cases to decrease from about 10% growth over the past few months to 5% in January as we recover from the holiday surge in cases. I am further expecting weekly growth in cases to decline to 2% in February and March based on citizens responding to grim December and January death toll and a national mask mandate the Biden administration has suggested would be put in place as one of the first acts after assuming office. A growth rate of only 2% would be the lowest levels since the pandemic began in the US. In April, May and June, I am assuming the growth rate will decline to 0.5% as the combination of vaccination and infection recoveries crosses half the total US population.

[6] 21 days is based on my Hubei analysis in February of symptoms to death lag (see column AQ), plus the average 1 week lag from exposure to symptoms estimated by Yale Medicine. This time lag may change with better therapeutics and should be periodically revisited.

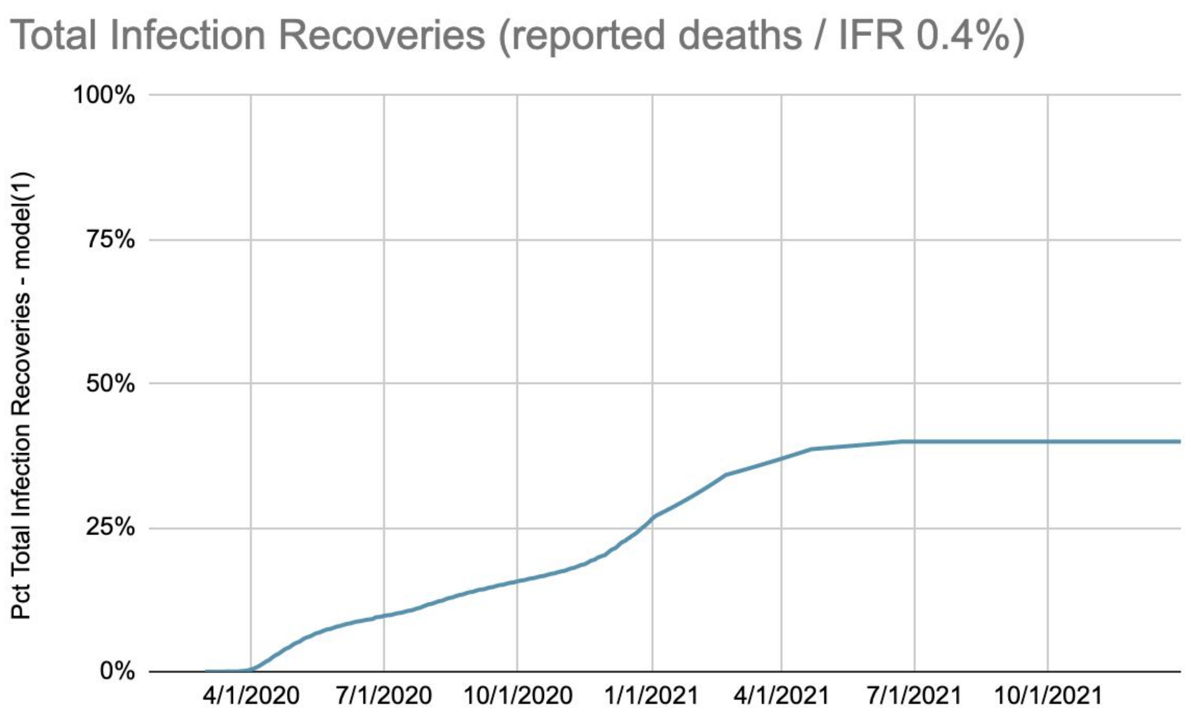
While I do expect consumer behavior to change after the December Holidays, 5% case growth rate in January may be optimistically low given the past 60 days. Two percent for February and March and 0.5% for April, May and June may also be optimistically low.




My 2021 assumptions for the weekly confirmed case growth rate in January (5.0%), February and March (2.0%) and April, May, June (0.5%) are modeled judgement based assumptions. *If it turns out that infections do not produce natural immunity that endures for a year, or vaccinations do not ramp up quickly in Q1, or citizens do not hunker down after the Holidays, then resetting the forecasted growth rate will be necessary as the model will undershoot the death rate in 2021*. Considering the model is forecasting **211,298** additional deaths due to COVID in 2021, **most of the deaths will occur in Q1**, I hope that my assumed growth rate in January of 5% turns out to be too high rather than too low. I will be evaluating case growth on the week of January 10th to determine if a re-forecast is necessary.

*Herd immunity* occurs when there are so few people that are susceptible to infection that the R0 decreases below 1.0 and the virus fails to replicate at a rate to sustain its growth. **The goal of the Ad Council and COVID Collaborative is to achieve a 70% or better vaccination rate in the US by the end of 2021.** Considering that natural immunity may not last for a year, the only way to achieve sustained immunity could be with vaccinations, therefore, the 70% or better goal is a sound marker of success to end the COVID Pandemic. However, if natural immunity sustains for 12 to 18 months in most people, the model shows we could hit herd immunity with as little as 55% vaccinated. This is because the model expects over 30% of the US to be infected by the end of January, and around 40% by the end of Q2.

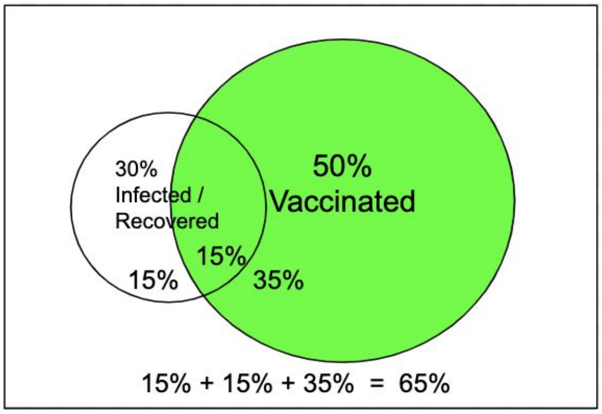
To the extent my IFR is correct, I can accurately estimate total infections by simply dividing total fatalities by the IFR and accounting for the 21 day lag in infections to deaths. Doing so produces the following result.

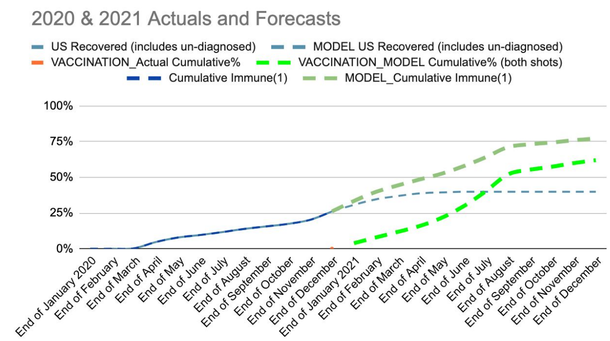



This infection rate produced by the original Briggs model accurately predicts the COVID-19 progression through September as [cited by the CDC]() in November.[7]

To calculate progress toward herd immunity, the model applies a random duplication of vaccinations to those already infected. For example, if 30% have already been infected (meaning that 70% are not immune), and vaccination rates hit 50%, then the net immune will be 65% (by the random duplication logic, half of the 30% already infected will also be vaccinated).

[7] While my dividing reported deaths by my IFR aligns with the most recent CDC analysis, there are different opinions of total infections based on different serology studies. The measurement of infection rate is complicated because there is a decay in detectable antibodies, which means serology studies have to include decay modeling, which can be complex.




While the model expects downward pressure on the growth rate of the virus due to vaccination and natural immunity, given that we do not know how long immunity lasts, I will be monitoring for reinfection rates and will incorporate reinfection into the model should natural immunity prove to be less than 18 months.

## Lives Saved

The calculation of *Lives Saved* from the vaccine counts the total number of people vaccinated and multiplies the count by an attack rate of 70%, efficacy of 95% and an IFR of 0.4%.

The attack rate is the most debatable assumption in the Lives Saved model. The efficacy of 95% is based on clinical trial data. The IFR, as noted previously, is based on my analysis of the Diamond Princess Cruise and confirmed by the Fall 2020 CDC/Oxford Serology study.[8] The attack rate is debatable because there are a range of experiences from closed-populations, where the virus infects more people or less people depending on the behavioral choices people make. For example, in the Amazon of Brazil, attack rates of 75% have been reported in small relatively isolated villages.[9] The virus can spread quickly. A choral group practicing in Washington state had an 87% attack rate after only a few hours together.[10] On the other hand, when the virus was detected on the Diamond Princess Cruise, quarantine was instituted and less than 30% of the people were ultimately infected. Extensive contact tracing of a college group that attended spring break festivities had an attack rate under 30%.[11] The household attack rate is estimated to be 17%.[12] Still, the US will end 2020 with approximately 25% of the

[8] Source: Estimated incidence of COVID-19 illness and hospitalization — United States, February–September, 2020
[9] Source: Three-quarters attack rate of SARS-CoV-2 in the Brazilian Amazon during a largely unmitigated epidemic (https://science.sciencemag.org/content/early/2020/12/07/science.abe9728)
[10] Source: CDC: High SARS-CoV-2 Attack Rate Following Exposure at a Choir Practice — Skagit County, Washington, March 2020
[11] Source: CDC: https://www.cdc.gov/mmwr/volumes/69/wr/pdfs/mm6926-H.pdf
[12] CDC Household attack rate estimate, October, 2020:
https://www.cdc.gov/library/covid19/102320_covidupdate.html#:~:text=Clinical%20Infectious%20Diseases%20(October%2012,from%203.9%25%E2%80%9336.4%25.

population infected, and it seems reasonable to assume, without a vaccine, the virus could spread to infect approximately 70% of the population over the next two years.

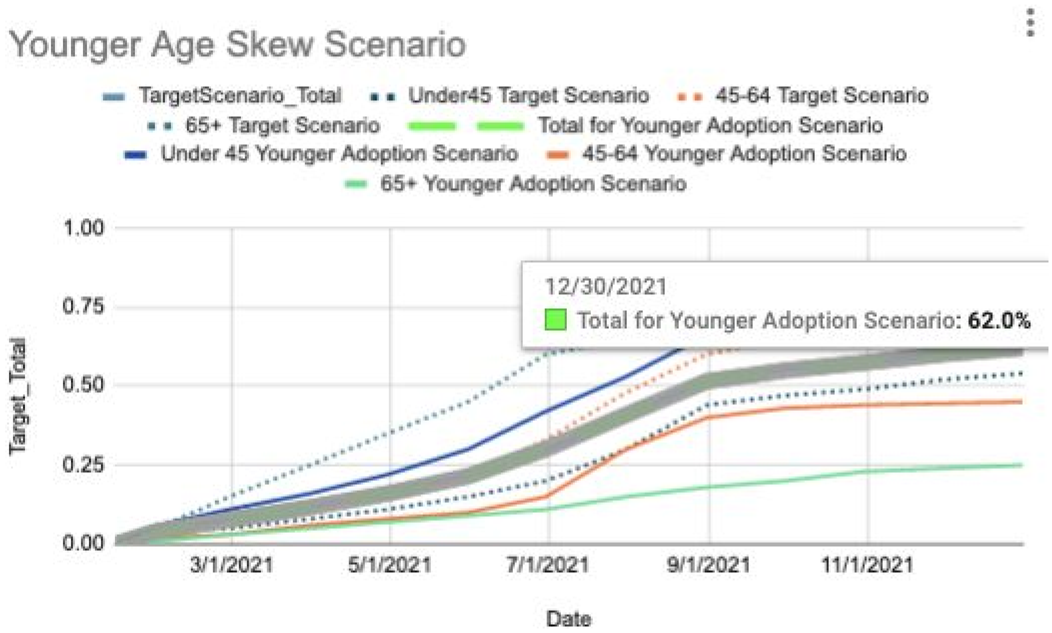
Some may consider the "Lives Saved" calculation conservative for two reasons:

1. The attack rate could be set to higher than 70%
2. The benefit of herd immunity, whereby those vaccinated reduce the likelihood that others that do not get vaccinated are shielded from infection and death. For example, if 30% do not get vaccinated, the virus should burn out due to the 70% that were vaccinated. If we consider those not vaccinated, but who are shielded by those that are vaccinated, **a total of 926,807 lives would be saved** (275,336 more lives than the base case scenario).[13]

The base case forecast for 2021 uses a 62% vaccination rate by the end of the year and calculates the Lives Saved only among those vaccinated. The number of lives saved due to the Vaccine is **currently forecasted to be 651,441**.


The age distribution of who gets vaccinated matters. For example, holding the overall population vaccination rate consistent at 62% by end of 2021, but varying the age distribution such that only 20% older people (65+) chose to get vaccinated while 80% of younger people (under 45) get vaccinated would result in **384,333 fewer** lives saved.

[13] This calculation uses the 70% attack rate and 0.4% IFR and applies it to the entire US population.



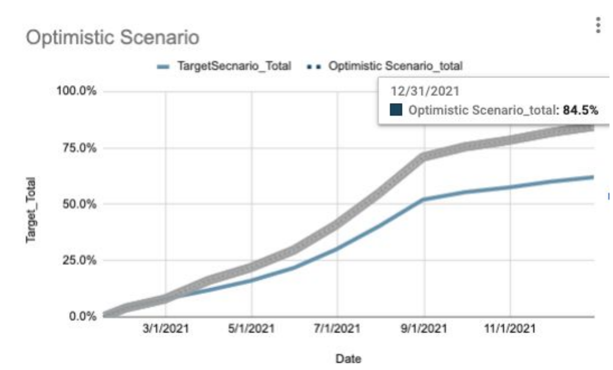

The reason for this significant difference is the fatality rate based on age. I first observed these differences in February 2020, when I analyzed the [first 50 deaths in Hubei](). The pattern was the same when China's CDC published the death statistics by age on the first 1,000 deaths and it is similar to the pattern in the US when the CDC published data on the first 250,000 deaths. That is, people 65+ are about 100 times more likely to die of COVID compared to those under 45 years of age.

| *Souce: CDC Feb 1 to Nov 28, 2020* | Number of People (1) | Number of deaths | % of Deaths | **Index vs Population** |
|---|---|---|---|---|
| TOTAL | **331,002,647** | **249,541** | **100%** | **0.99** |
| Under 45 | 193,110,823 | 7,122 | 3% | **0.05** |
| 45 to 54 | 40,631,605 | 12,701 | 5% | **0.41** |
| 55 to 64 | 42,211,413 | 30,875 | 12% | **0.96** |
| 65 to 74 | 32,173,890 | 53,579 | 21% | **2.19** |
| 75–84 years | 16,188,936 | 67,305 | 27% | **5.47** |
| 85 years and over | 6,685,980 | 77,959 | 31% | **15.34** |
| | | | | |
| 45-64 | 82,843,018 | 43,576 | 17% | **0.69** |
| 75 or older | 22,874,916 | 145,264 | 58% | **8.35** |
| 65 or older | 55,048,806 | 198,843 | 80% | **4.75** |
| RATIO OF 65+ to Under 45 (65+ / under 45 = Ratio) | | | | **98** |

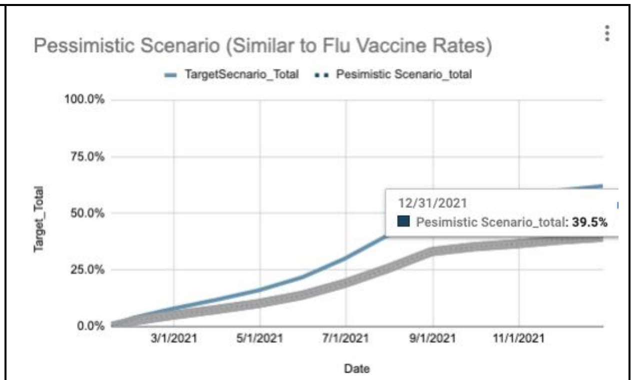
(1) Number of people by age cohort applies to the 331,022,647 census estimate (consistent with use throughout the Briggs Model, whereas [CDC report]() used 328,239,523 figures.)

There are alternative scenarios for vaccination rates. The goal of the Ad Council and COVID Collaborative is 70% (or better) US vaccination rate by end of 2021. [Dr. Anthony Fauci has said we should be shooting for 85%](#) US vaccination rate by the end of the year.

The Briggs model includes an optimistic scenario of 85% US Vaccination rate, which would save 888,239 in total (an incremental 236,888 lives over the base case scenario). There is also a pessimistic scenario with a 40% vaccination rate (which is just a little less than the Flu Vaccine average over the past eight years). This pessimistic scenario saves a total of 414,553 lives (236,888 less lives than the base case scenario).

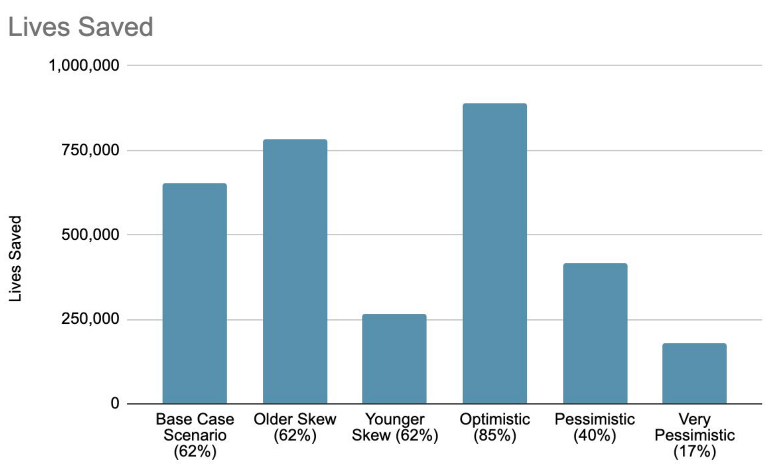



888,239 Lives Saved




414,553 Lives Saved

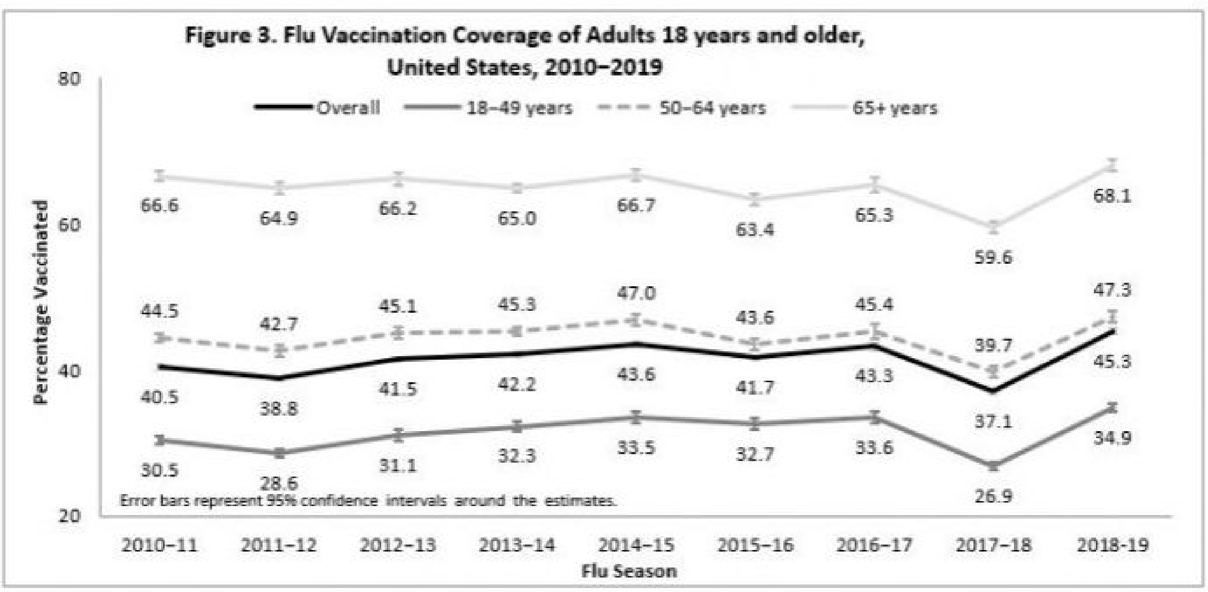
Finally, a really pessimistic scenario is included, with only a 17% vaccination rate by the end of the year. This scenario saves 177,666 lives, and is 473,775 less than the base case scenario. Each of these scenarios follows the base cases age cohort forecast, with those 65+ getting the vaccine sooner and at a higher rate than other age cohorts.



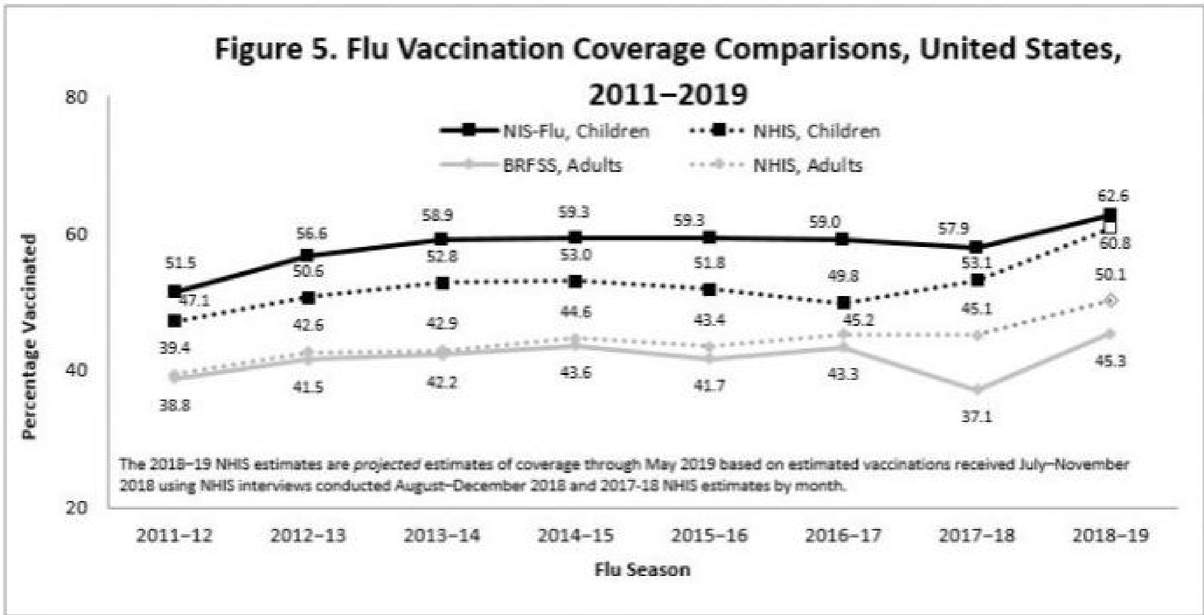
## Vaccination Ramp Rate

I started with the historical Flu vaccination rates, as reported by the CDC. The overall rate is 45.3% based on the 2018-19 Flu season. The average vaccination rate over the past eight flu seasons is 41.2% ("Figure 3" from the CDC report) The reported Flu vaccine rates are a little higher in the NHIS Adult data set ("Figure 5" from the CDC report), with an average of 43.9% over the last eight seasons. A meaningful difference between the Flu Vaccine and COVID-19 vaccines (thus far) is that children receive the Flu vaccine at a rate higher than adults, but with COVID-19, children are not currently authorized to get the vaccine.

Children under 16 represent 20% of the total US population. I have not fully processed the implications of 20% of the US population being ineligible for the vaccine and am awaiting more data on whether those vaccinated are able to become infected and transmit the virus or not. I am also waiting to see if COVID vaccines are made available to children in the future. Depending on these findings, I may re-forecast for 2021.




Source: Flu vaccination rates, as reported by the CDC




Source: Flu vaccination rates, as reported by the CDC

Both Flu vaccination data sets show an uptick in vaccination rates following the very bad 2017-18 Flu season. Considering that COVID-19 has killed 6 times more than compared to a bad Flu year (2017-18),[14] and 10 times more than a typical Flu year, I would expect more people to get vaccinated against COVID.

Another input into the vaccination base case scenario is polling data, which currently show approximately 60% of American adults with intent to get vaccinated.[15] We expect the efforts of Ad Council and local and state agencies to improve the vaccination intention rate. That said, not all those with intent convert. Our benchmark conversion from people who say they "Definitely will" buy a product or use a service in a survey is only about 75%. ***In other words, the Ad Council's 70% or better vaccination goal is ambitious.*** The base case scenario of 62% of vaccination is by no means a certainty. It will take coordinated efforts to achieve the base case scenario of 62% vaccination by the end of the year, and extremely successful communications to achieve the 70% or better Ad Council goal by end of 2021.

A final input in the vaccination ramp model is **doses available**. I have taken press release and analysis information about the production rates, approval of Moderna, and my own ramp-up for dose availability. I've made the following assumptions:

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[14] CDC reports 61,000 deaths from 2017-18 Flu season, which they note is the worst Flu season since 2009 H1N1 Swine Flu. Source: https://www.cdc.gov/flu/about/burden/past-seasons.html. A typical Flu Season kills 20,000 to 35,000 whereas COVID-19 has killed over 415,000 on an annualized basis, since April 1, 2020.
[15] Poll: December 1 to 6, 2020, NPR/PBS/Marist

| | Doses Required in Millions each Month | Cumulative People Vaccinated |
|---|---|---|
| January | 25.8 | 12.9 |
| February | 26.4 | 26.1 |
| March | 25.8 | 39.0 |
| April | 27.5 | 52.8 |
| May | 37.9 | 71.7 |
| June | 53.9 | 98.7 |
| July | 68.8 | 133.1 |
| August | 77.0 | 171.6 |
| September | 22.0 | 182.6 |
| October | 13.8 | 189.5 |
| November | 17.1 | 198.0 |
| December | 13.2 | 204.6 |

As additional information on dose production becomes available, I will compare the forecast assumptions and may update the forecast if there is a short-fall in availability.

## Livelihoods Saved (Economic Impact)

Impact on livelihoods is a simplified analysis examining the: 1) change to GDP in 2020 versus the consensus forecast pre-pandemic, 2) a two year forward GDP growth predicated on successful vaccination, and 3) application of the US Government's dollar value per life calculations to lives lost due to COVID. A "*lost wages* due to the pandemic" calculation is another way to approach the economic impact. Due complexities in under-employment, unemployment, workforce participation and average wages, I have not attempted this calculation at this time.

1) Change to GDP in 2020 versus the consensus forecast pre-pandemic:

   In 2019, the US GDP was estimated at $21.44 Trillion.[16] The pre-pandemic consensus forecast for GDP Growth in 2020 was 2.0% to $21.87 Trillion.[17] Due to COVID, the

[16] Source: Investopedia
[17] Survey of Professional Forecasters consensus

economy did not grow. Instead, the US economy shrank by 3.5% (Consensus estimate[18]) to $20.69 Trillion - even after congress pumped $2 Trillion into the economy via the CARES Act. Therefore, I calculate the financial cost of the pandemic to the economy as **$3.18 Trillion** ($1.18 Trillion loss in GDP versus expected 2020 GDP + $2 Trillion CARES Act.)

2) Two-year forward GDP growth predicated on successful COVID vaccine

   The Conference Board issued a year-over-year 2021 GDP growth estimate of 3.6% predicated on successful vaccination.[19] We've used a two year horizon for the following reasons: First, without a vaccine, it would take an additional two years to reach the same herd immunity levels (which may not even be possible if natural immunity lasts less than three years). Second, returning to close to the US same GDP trajectory will take two years of 3.5% growth or better -- I've estimated 3.5% GDP growth for 2022, which puts the US GDP at $22.18 Trillion at the end of 2022, about $120 Billion below where it would have been had the US economy continued to grow at the 2% level predicted pre-pandemic. The value of a vaccine restoring the economy, by this calculation is **$1.5 Trillion**. This calculation may understate the value of the vaccine, because additional government spending would likely be necessary to avert further decline or stagnation in GDP, and such investments are not included in this equation.

   Therefore, the economic gap between successful deployment of vaccines and no vaccine should include an estimate of government spending necessary to maintain GDP in the absence of a vaccine. I've assumed GDP would shrink in 2021 and 2022 without a vaccine, and additional Government aid similar in size to the CARES Act would be needed over the next two years ($4 Trillion in total) to maintain GDP. Based on this assumption, the difference in successfully deploying a vaccine versus not having a vaccine is **$5.5 Trillion.**

3) Dollar Value of A Life Calculation

   The US Government's dollar value per life ranges from $7.4 million (EPA) to $9.6 million (FAA) with an average of $8.7 million per life.[20] If we consider the forecast for lives lost in 2020 (352,148) it equates to **$3.06 Trillion**. This is fairly close to the first calculation, "Change to GDP" of $3.18 Trillion.

   Considering the forecast of 651,441 lives saved due to vaccinations, this equates to **$5.7 Trillion**. This is fairly close to my Two-year forward GDP Growth with a vaccine versus without a vaccine.

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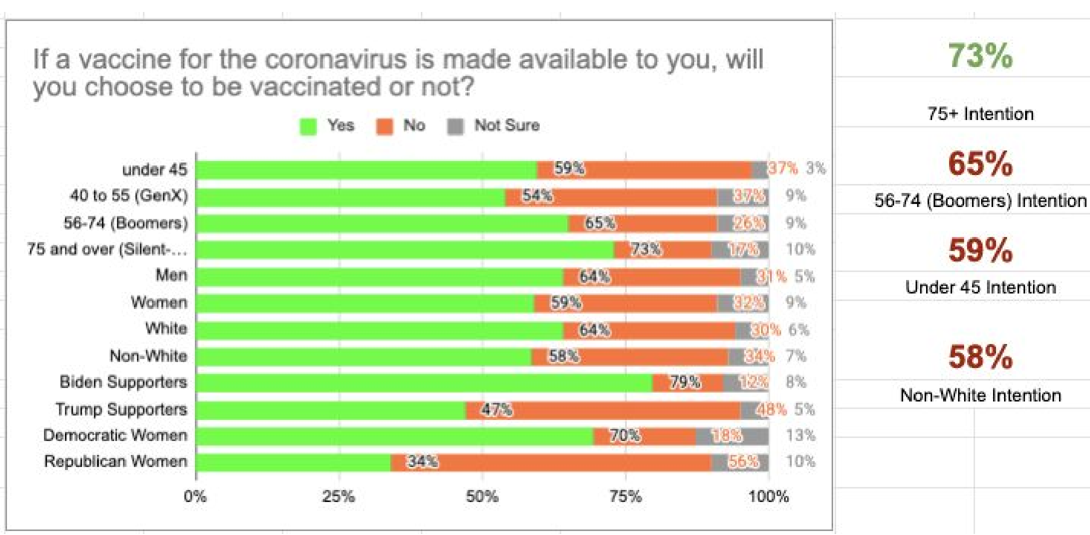
[18] Goldman, Kiplingers, The Conference Board
[19] Source: Conference Board (https://conference-board.org/research/us-forecast)
[20] Source: New York Times: https://www.nytimes.com/2020/05/11/upshot/virus-price-human-life.html

In summary, I estimate that COVID-19 has cost the US nearly 350,000 lives in 2020 and about $3.2 Trillion dollars. I estimate a successful broad-based deployment of COVID-19 vaccines will save over 650,000 lives and be worth $5.5 Trillion for our economy. Broad based COVID-19 vaccinations will save lives and livelihoods. The Ad Council's contribution is expected to influence about 20% of the vaccinations, thereby saving over 55,000 lives and $1.1 Trillion dollars in economic value.

## Advertising Contribution

There is no question that an effective communication strategy will need to be executed to close the gap between current citizen intent to be immunized and the goal of 70% or better. Considering that typical Flu vaccination rates among the adult population is well below the goals for the COVID vaccine, it reinforces the point that advertising has a significant role to play in informing, educating, and persuading. The Ad Council is taking point on a national effort to end the pandemic.

Advertising and detailing[21] is key to ending this pandemic. The model has an initial benchmark contribution of 20%, which is drawn from research on blockbuster pharmaceutical releases. The contribution of advertising will migrate to a calculation based on the differential vaccination rates by ZIP code or region, to the extent the data is available on vaccinations and advertising delivery. The Ad Council will also analyze brand lift studies and longitudinal intent to behavioral data sets. There are many factors to integrate in the model, including age, sex, race/ethnicity and the political leanings of the population -- all of which currently show meaningful differences in the intent to take the vaccine when made available.

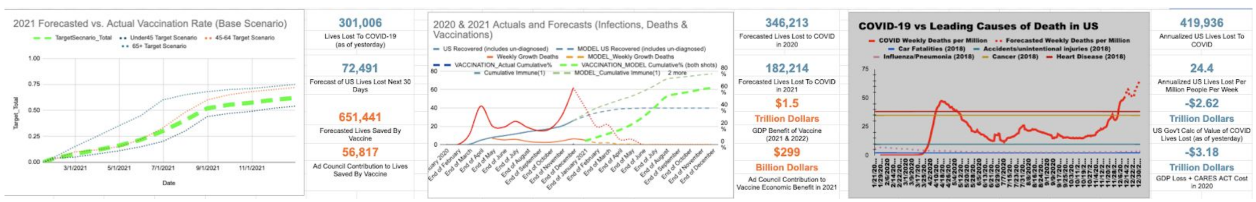



[21] Detailing is the pharmaceutical industry of directly presenting details of a treatment to the medical staff that is expected to prescribe a treatment so the staff is educated on the indications and prepared to answer common questions from patients. In this case a broad outreach to trusted medical professionals such as doctors and pharmacists to provide vaccine detailing may be important as people may seek information about the COVID vaccines from a broad range of medical professionals.

More information will be provided on the specifics of the Ad Council contribution calculation as additional data is gathered and feasibility of various approaches to measurement is resolved.

## Live Dashboard, Weekly Forecast Notes

A live dashboard is available to track the forecast model versus actuals. In addition, The ARF has agreed to host a 15 minute weekly Zoom & YouTube discussion of the latest news that could affect the forecast. Contact the author for access to these resources, or follow @rexbriggs on twitter for announcements.




CAVEATS: The Ad Council and COVID Collaborative, along with state and local health departments and NGOs are critical to achieving a vaccination rate for COVID-19 (45% above a typical Flu vaccine rate). There are many risks to achieving this forecast, from inability to achieve the vaccine production ramp, misinformation that dissuades the population from getting the vaccine, unexpected side-effects that could emerge over-time and with greater scale. At the sametime, there are unknowns about how long those who have recovered remain immune, as well as a range of questions about personal and governmental response as the pandemic evolves. Therefore, this forecast will be updated periodically to reflect significant news that I believe warrants re-casting the model.