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Vaccination Effectiveness and Covid Observations

We will explore how effective vaccinations are to help lower case counts, and deaths. First, we will look at the total cases. And make some general observations in relation to covid.

Figure 1 shows the timeseries of people getting vaccinated. Partial means they received one shot of a 2-shot vaccination. You can see that there are not many people who do not get both shots, after they get the first, and follow a same growth pattern. We added the red and yellow lines to show when the vaccine becomes widely available and generally used. We see the rate at which cases are increasing, decrease after the redline. However, we do not see the booster helping prevent covid case growth.

Figure 2 reflects the significant rise in weekly covid vaccinations that occurred in the beginning of 2021 following emergency approval of coronavirus vaccines in December of 2020. After peaking at about 12 million vaccinations/week in 4/2021 weekly vaccinations decreased and floated around 2 million/week. So far, in the beginning of 2022, there has been significant fluctuations in weekly vaccination levels, moving from 6 million in 2/2022 to -5 million in 3/2022. You also see how the increase in total vaccinations reaches a max quickly, showing that everyone who really wanted to get vaccinated did, and not many others are choosing to.

Figure 2 also shows the weekly cases in the US. At the red line, when vaccines reach over 1% of the population in the United States, the change of cases per week starts decreasing, which shows that vaccinations are helping fight off covid. The curve had already flattened out a little coming from quarantine, which probably helped as well. The booster vaccination release did not help bring down cases. At the yellow line the cases per week are actually at a low. As you can see below in figure 3, there is not as much urgency to get the booster. In a two-month time frame, the original vaccination had 75% more people vaccinated. This also shows that potentially only the population of people who really need

or want the booster got it, and the rest basically are okay without it seeing as the curve of booster shot flattens out.

This massive spike in covid cases per week (figure 3), around January 2022, Omicron became prominent, and is found to be the most infectious variant. This supports omicron being extremely infectious, but also shows that a lot of people are prone to the disease still (from vaccine/immunity decreasing or variant adapted to vaccine), and a lot of people traveling as more restrictions lifted. In addition, this is right after holiday season, so that must have attributed to it as well, as many people missed the previous Christmas.

Figure 4 shows the weekly vaccinations. We see that a little before 2021-05, the vaccinations per week reaches a max, and by the 2021-07, it becomes quite constant and eventually goes to 0. This shows that the 2/3 of the US population who want or need to get the vaccine did, and now there are not many more getting vaccinated. That 1/3 without the vaccine has chosen not to get vaccinated in general.

Figure 5 shows the same thing but for the booster vaccine. The 85 million people who got the booster in the US, got it within a 2-month time frame and like the original vaccine, those 85 million are most likely going to stay more less the only 85 million people who get it. Unless, there are intense mandates to get the booster, it does not seem like many people feel urgency to get the booster.

Now, we will compare the vaccination rates (vaccines per 100,000 people) to covid case rates (covid cases per 100,000 people) and fatality rates (covid fatalities per 100,000 people) in each of the states in the US.

Figure 6 and 7, both show vaccination to covid case rates, however figure 7 only counts cases after the vaccine reaches 1% of the US population. So looking to see if there is a relationship between high vaccination rates and lower covid case rates, we see there is somewhat of a general trend. Figure 7, however only counts cases after the vaccine is readily available.

Figure 7: We see more of a trend than the previous graph, showing vaccinations do have a correlation to vaccination rates. In addition, a lot of the dark color states show a good trend of incident rates decreasing as vaccination rates increase (NC, AZ, FL, IL, WA, CA). An outlier here like New York city, high vaccine rate, high testing rate, and high incident rate. This is probably the way New York is structed, many people in a condensed area, and potentially interacting many more people.
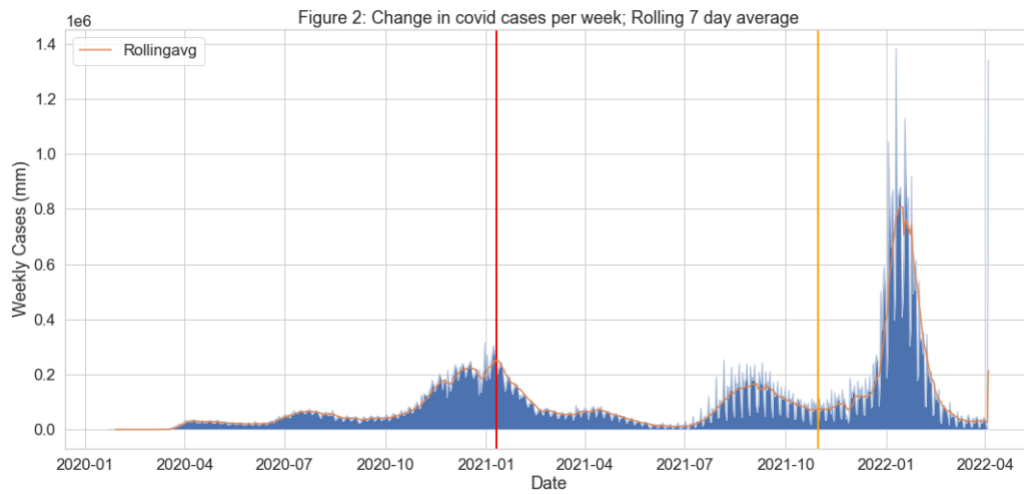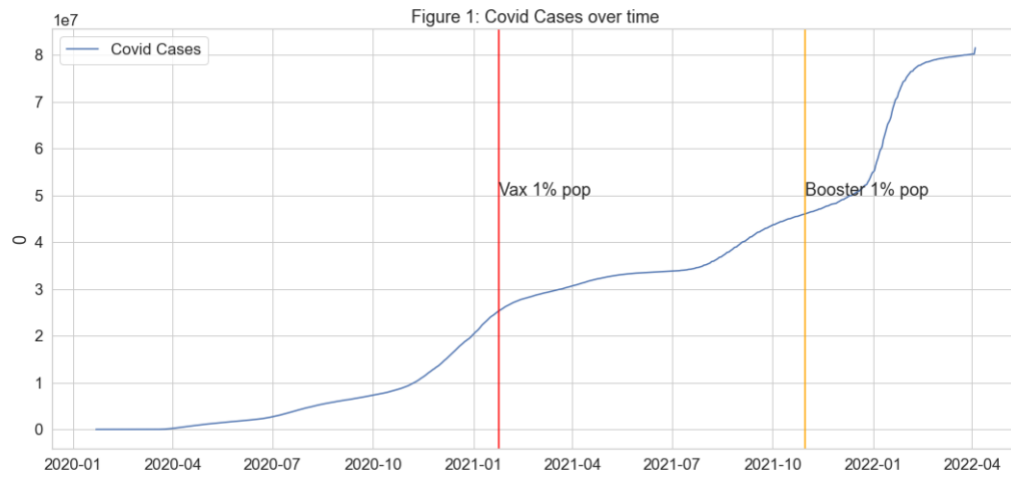
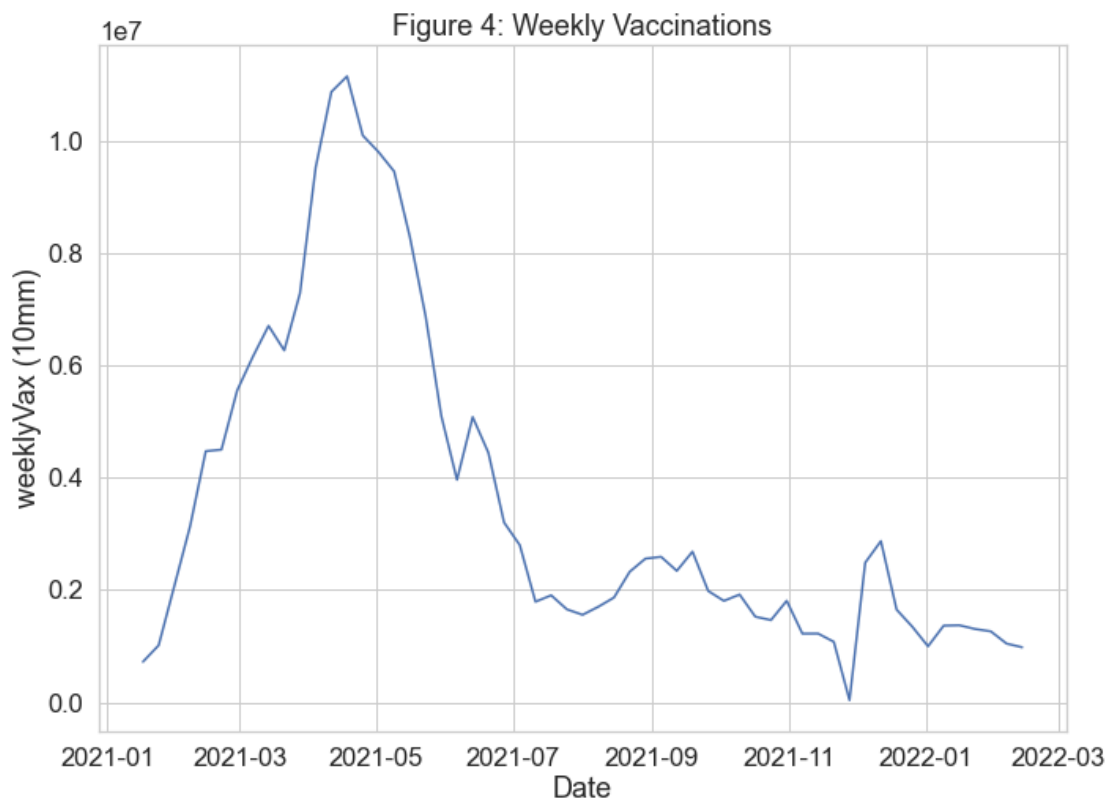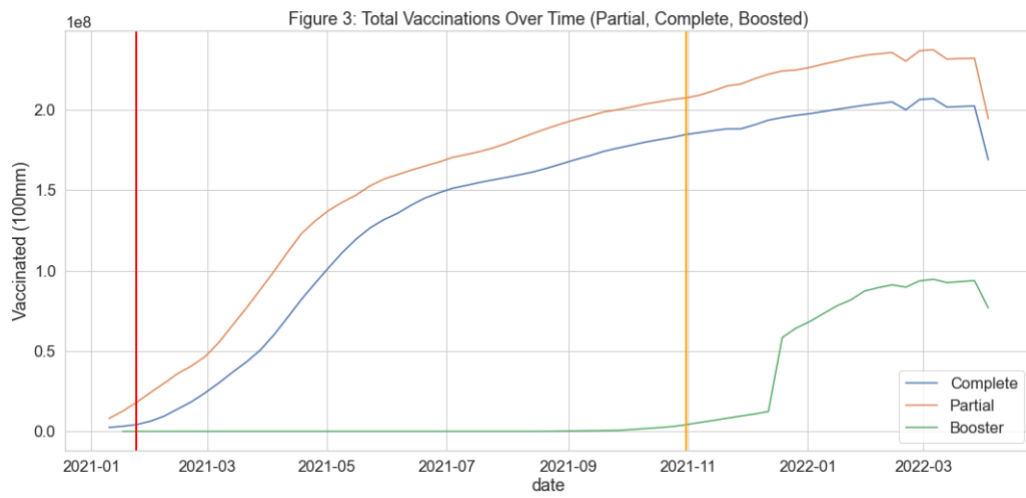Finally, let's look at Vaccination ratio to death ratio in states in America.

Figure 8: We are looking at death to vaccination ratio, to see if vaccinations help lower the number of deaths. Here we are looking at the total death fatality from all covid, and we do not see much of a trend. (go to next figure)

Figure 9: Looking at only the death ratio after vaccines came out, allows us to see if vaccinations helped prevent deaths. Looking at it, there is a general trend of having a high vaccination rate lowers death.

In conclusion, covid vaccines help temporarily to help bring down cases; however new variants, immunity wearing off, and little reception to the booster, allows covid cases to continue to rise and increase. However, what we do see is that the vaccines help massively in bringing down the fatality rates in covid, most likely because people who could die due to a condition, got the vaccine and booster, and are now less likely to die from covid.

Appendix:

Figure 1: Covid Cases over time

Figure 2: Change in covid cases per week; Rolling 7 day average

Figure 3: Total Vaccinations Over Time (Partial, Complete, Boosted)

Figure 4: Weekly Vaccinations
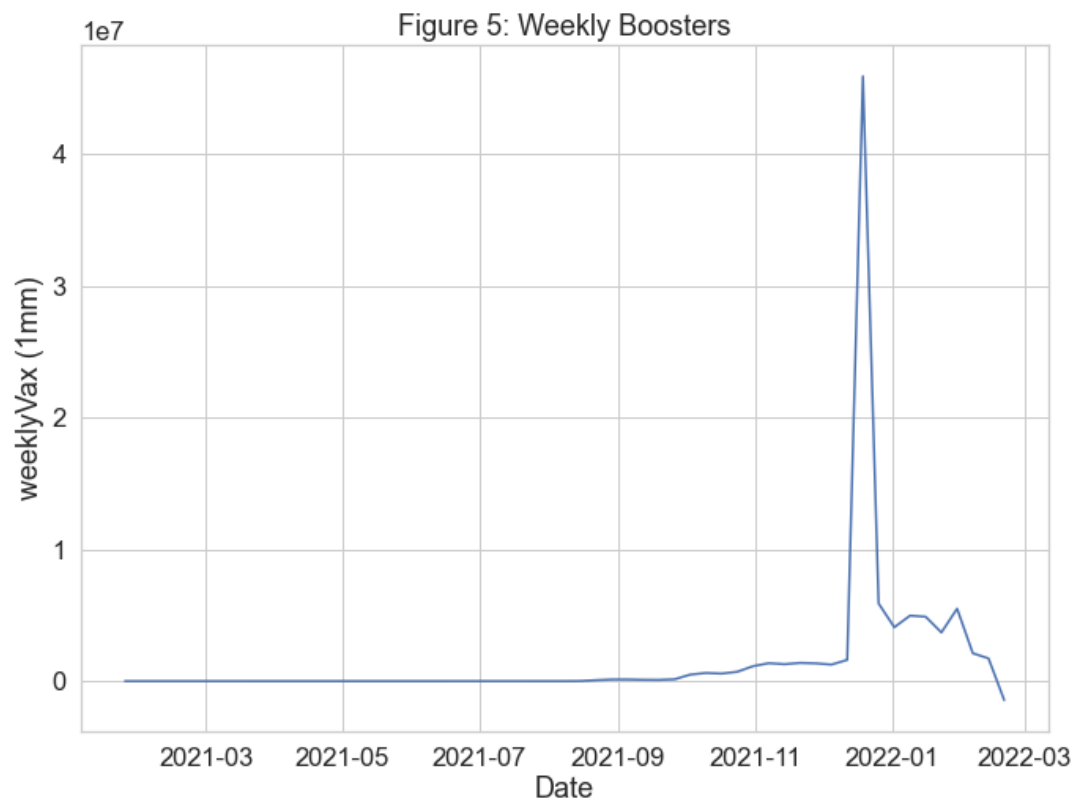
Figure 5: Weekly Boosters
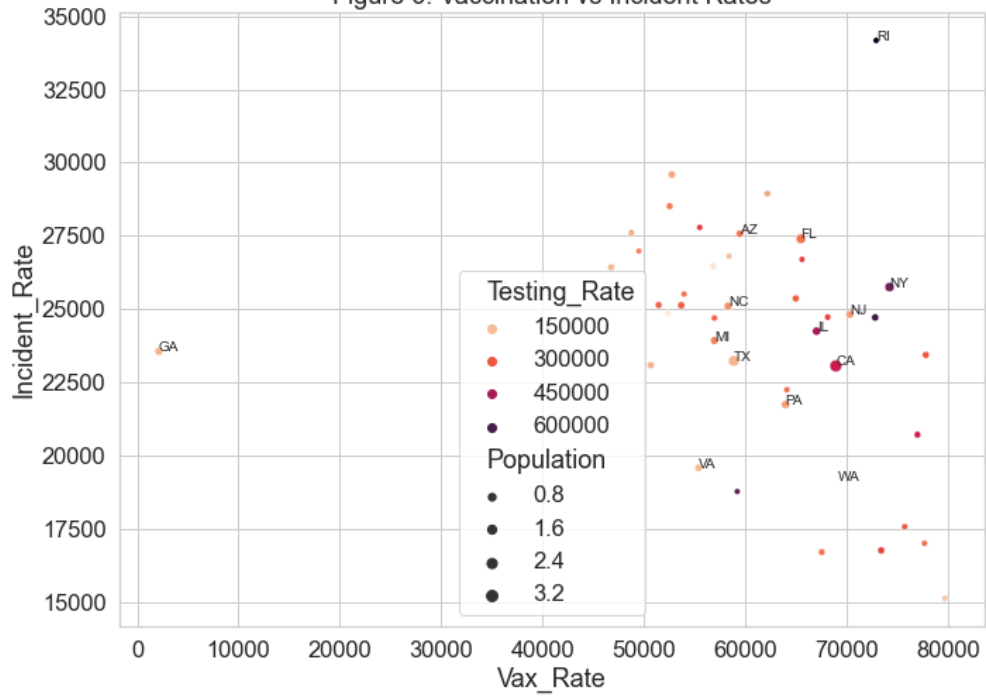
Figure 6: Vaccination vs Incident Rates
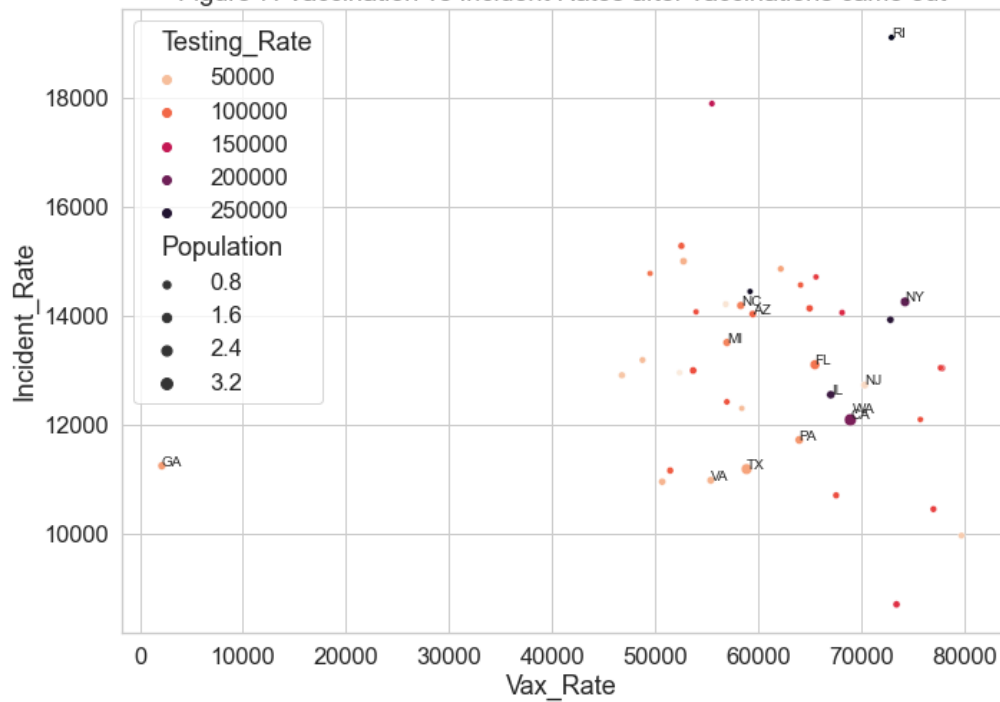

Figure 7: Vaccination vs Incident Rates after vaccinations came out

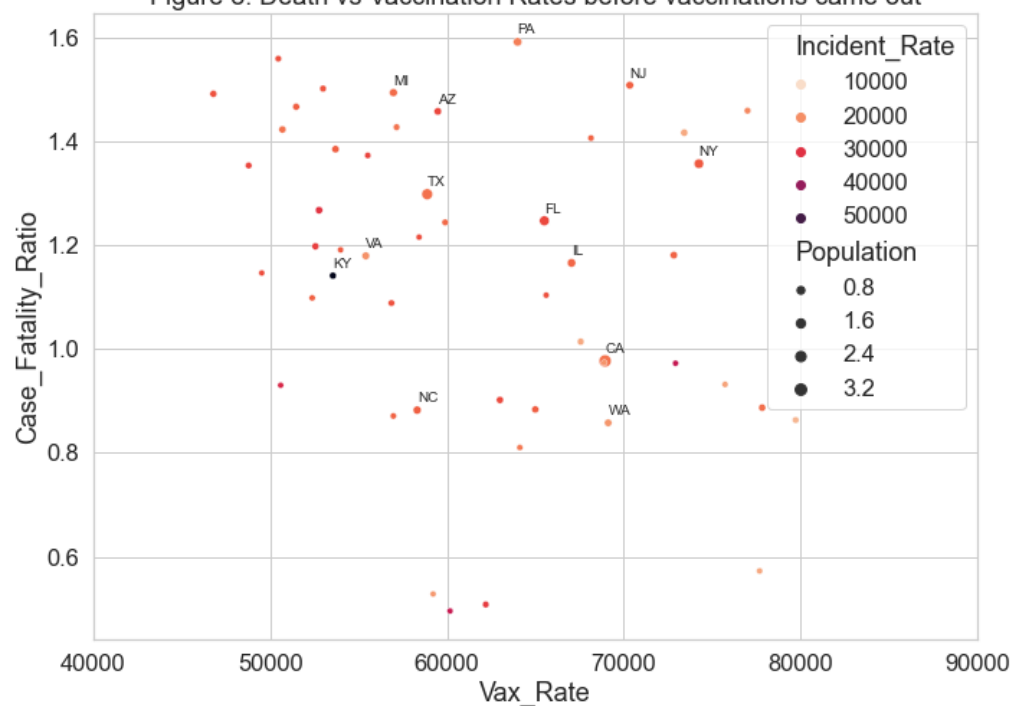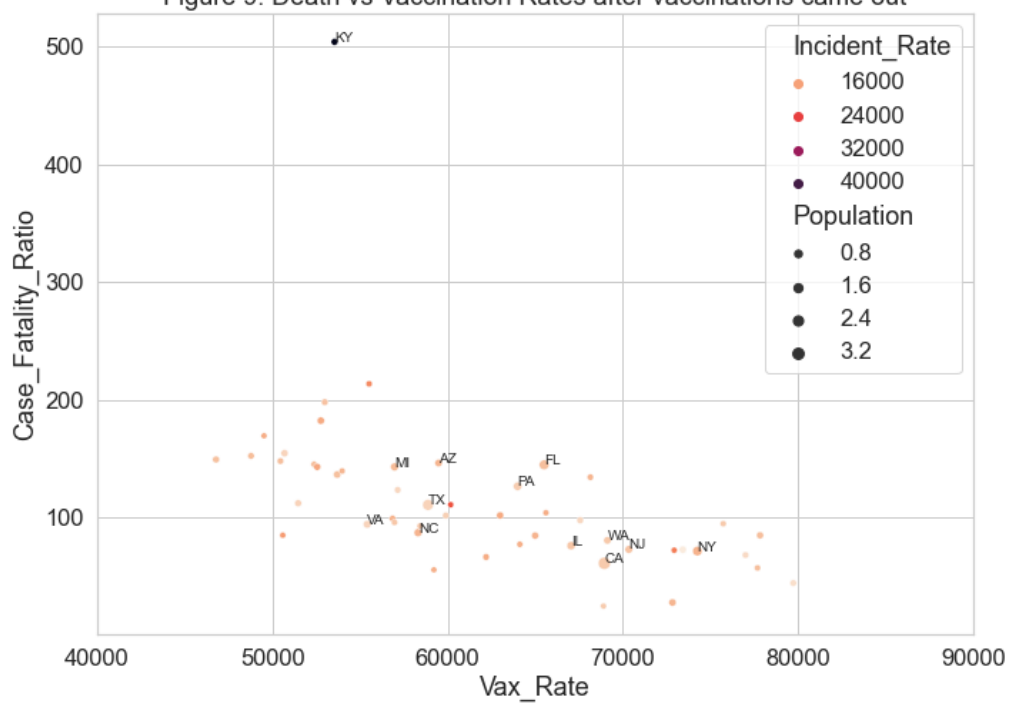Figure 8: Death vs Vaccination Rates before vaccinations came out

Figure 9: Death vs Vaccination Rates after vaccinations came out

Data Sources:

Covid Data

https://github.com/bansallab/vaccinetracking/tree/main/vacc_data

https://github.com/CSSEGISandData/COVID-19/tree/master/csse_covid_19_data

State abbreviations

https://gist.github.com/rogerallen/1583593