Problem or question being addressed:	During the holidays, friends and families gather to celebrate, but a common concern has been how these activities may spread COVID-19. Last year, I conducted a study which collected data on cases before and after holidays to identify how infection was affected by holidays. I found that holidays generally caused an increase in COVID-19 infections. Independence Day, Halloween, and Thanksgiving resulted in the greatest spike of COVID-19 after the holiday. However, the vaccination has been released this past year and made available to ages above 12. How may the vaccine change the impact of holidays on COVID-19 surge? Will the same holidays show sharp increases in cases as prior to the vaccine, and will different states be impacted differently?
Hypothesis (for research project) • Objective (for engineering project):	1. Major holidays after the approval of the vaccine will cause less of a surge in COVID-19 compared to before last year. 2. The holidays which showed the sharpest increase last year may not be the same since the vaccine. 3. States with a higher vaccination rate will not show as severe a surge after holidays as states with low vaccination rates.
Description in detail of method or procedure (including chemical concentrations and drug dosages):	1. Data will be downloaded from the Johns Hopkins Database on GitHub and converted to an excel spreadsheet. This data set provides the daily case and mortality rate for each county in the U.S. since the beginning of the pandemic. It will also provide vaccination rates. 2. The following holidays will be studied: Independence Day, Halloween, Thanksgiving because they showed the greatest increase in cases after the holiday last year 3. Specific dates in one-week increments around the time of the holiday will be chosen to examine. The time windows are as follows: the week before the start of holiday and the first week after. 4. Data will be organized into Excel pivot tables. Total number of new cases during each of the weeks will be calculated by state and for the entire country, and it will be normalized by population. 5. Differences and ratios between the first week after vs. the week before will be calculated. 6. A national map will be created in Excel to show the total case count by state as of the end of January 2022. 7. Relative and absolute changes in new cases after holidays will be graphed for representative states. 8. Data on after vaccination approval (i.e., 2021) will be compared with data from last year (2020). 9. Correlation between state vaccination rates and severity of post-holiday spikes will be examined, as well as how certain holidays may have a different effect.

Bibliography: List at least five major references (i.e., science journal articles, books, etc. Web references must be from credible science or engineering sources.)

1. Johns Hopkins Database
https://coronavirus.jhu.edu/data/new-cases-50-states

2. Guglielmi G. Coronavirus and public holidays: what the data say. Nature. 2020 Dec;588(7839):549. doi: 10.1038/d41586-020-03545-1. PMID: 33328645

3. McCloskey B, Zumla A, Ippolito G, Blumberg L, Arbon P, Cicero A, Endericks T, Lim PL, Borodina M; WHO Novel Coronavirus-19 Mass Gatherings Expert Group. Mass gathering events and reducing further global spread of COVID-19: a political and public health dilemma. Lancet. 2020 Apr 4;395(10230):1096-1099. doi: 10.1016/S0140-6736(20)30681-4. Epub 2020 Mar 20. PMID: 32203693; PMCID: PMC7138150.

4. Mollalo A, Tatar M. Spatial Modeling of COVID-19 Vaccine Hesitancy in the United States. Int J Environ Res Public Health. 2021 Sep 8;18(18):9488. doi: 10.3390/ijerph18189488. PMID: 34574416; PMCID: PMC8467210.

5. Bush E, Chiwaya N. Covid-19 vaccination rates for kids echo regional disparities, worrying doctors. https://www.nbcnews.com/science/science-news/covid-19-vaccine-rates-kids-slow-worrying-doctors-rcna3804. Accessed November 26, 2021.

6. Malik AA, McFadden SM, Elharake J, Omer SB. Determinants of COVID-19 vaccine acceptance in the US. EClinicalMedicine. 2020 Sep;26:100495. doi: 10.1016/j.eclinm.2020.100495. Epub 2020 Aug 12. PMID: 32838242; PMCID: PMC7423333.

7. Cheong Q, Au-Yeung M, Quon S, Concepcion K, Kong JD. Predictive Modeling of Vaccination Uptake in U.S. Counties: A Machine Learning-based Approach. J Med Internet Res. 2021 Nov 1. doi: 10.2196/33231. Epub ahead of print. PMID: 34751650.

8. Mondal P, Sinharoy A, Su L. Sociodemographic predictors of COVID-19 vaccine acceptance: a nationwide US-based survey study. Public Health. 2021 Sep;198:252-259. doi: 10.1016/j.puhe.2021.07.028. Epub 2021 Jul 29. PMID: 34492505; PMCID: PMC8318686.