COVID-19 Vaccination Metrics: An Analysis of Doses, Income, and Politics in the USA

Donna Camille Velarde, Keyana Pregent, Gurpreet Doal, Christina Leung & Angaddeep Dhillon

Research Questions

Main Research Question:

- Hypothesis: There is a relationship between political influences, socioeconomic factors, and COVID-19 vaccination rates in the United States.

Sub Questions:

1. How did the number of vaccinations and boosters administered impact the administration of vaccines and death rates, among different age groups?
2. How do factors like political influence and socioeconomic levels affect the number of vaccine doses administered?

Outline

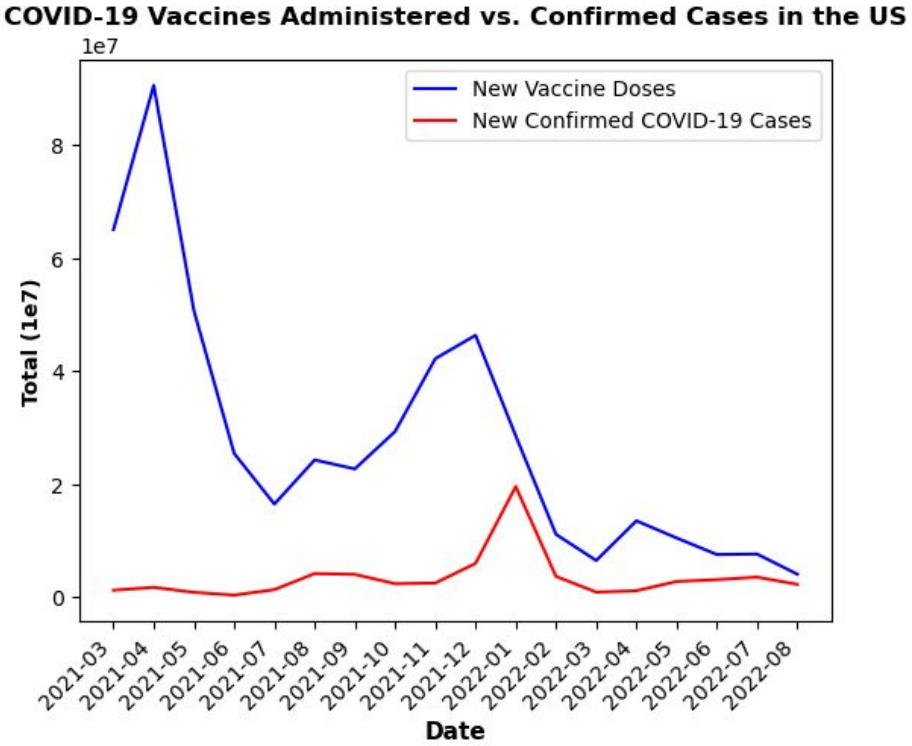
- Question 1 : Impact of Vaccination/Death Rates in age groups
  - Camille: Trends with Vaccine administered vs Confirmed COVID-19 cases
  - Keyana: Age vs vaccinations administered
  - Gurpreet: Death Rates
- Question 2 : Political and Socioeconomic Factors
  - Christina: Political
  - Angad: Socioeconomic
- Summary and limitations

Question 1

How do the number of vaccinations and boosters administered impact:

a) **Administration of Vaccines**
b) **Death Rates among different age groups?**

Q1: Vaccines Administered vs. COVID-19 Cases



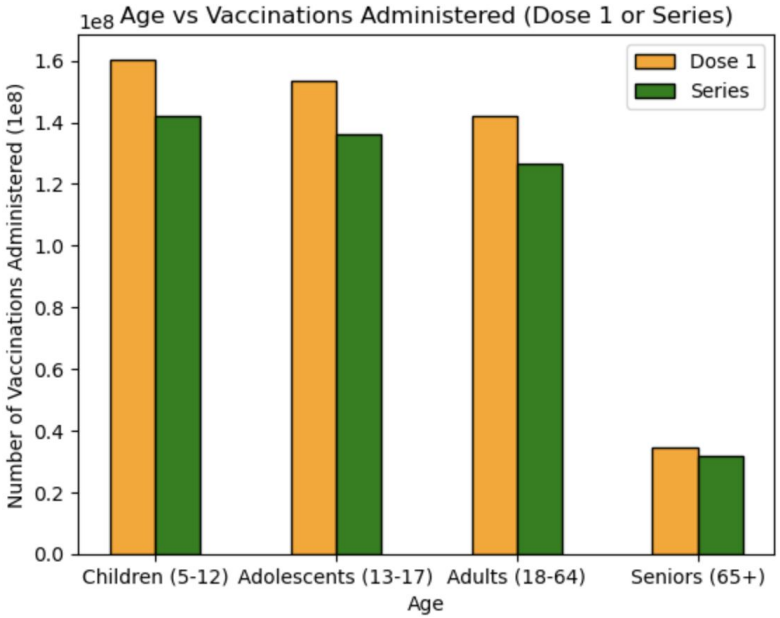
Time series plot findings:

- Between March 2021 and August 2022, the total of new **vaccine doses administered** was approx. **502,529,777**
- **Total Confirmed cases** = approx. **62,001,182**
- **Peak in March 2021** indicates when emergency use authorizations (EAUs) were in effect
- Confirmed cases consistently **below 10 million**, but **later increased** in November 2021
- **Downward secular trend** from March 2021 to July 2021
- **Upward trend** between September 2021 and December 2021
- Confirmed cases **peaked in January 2022**, but had a downward trend in months to follow

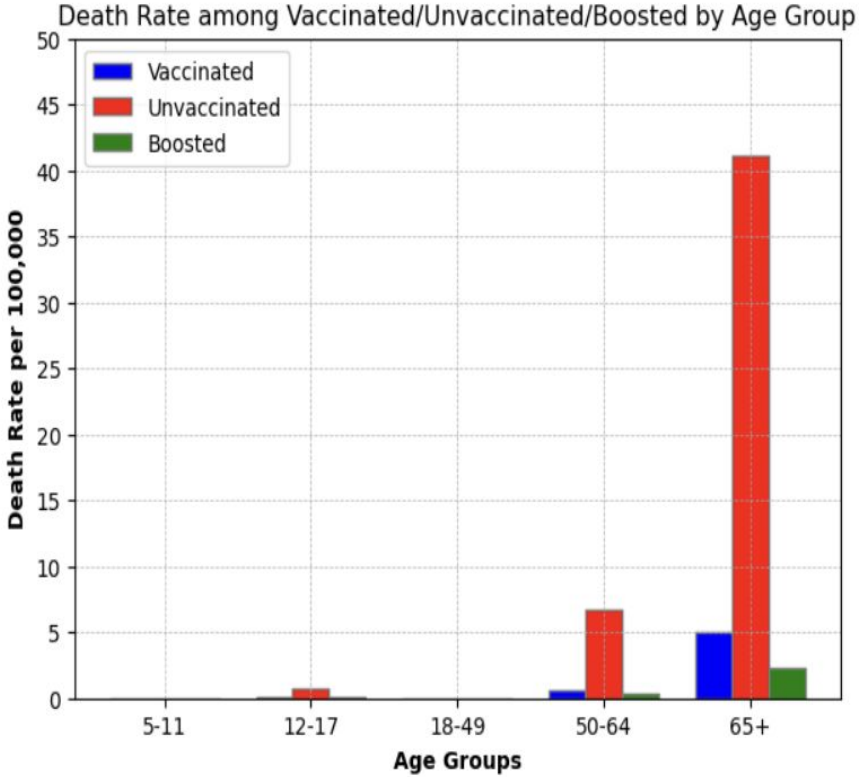
Q1: Age vs Vaccines Administered

Key Findings:

- Vaccinations were administered at higher quantities to those in the children (5-12) and adolescent (13-17) age groups.
- 160,468,933 vaccines were administered for a single dose, and 142,218,870 vaccines were administered for the series in the children age group.
- The senior age group (65+) had the lowest quantity of vaccines administered to them at 34,723,497 for dose 1 and 31,780,772 for series.
- In each age category, the number of vaccinations is higher for just a single dose administered than the completed series.



Q1: Death Rates



Key finding

The 65+ age group has the highest death rates across every 100,000 unvaccinated people, approximately 41,139 of them have died.

The 5-11 and 12-17 age groups have the lowest death rates, indicating that younger individuals have a lower risk of severe outcomes from COVID-19.

Vaccination greatly reduces the risk of death. In the age group 50-64, the death rate drops from 6,739.30 in those without vaccines to 626.95 in those who are vaccinated.

Boosters further enhance protection. In the 65+ group, boosted individuals have a death rate of 2,320.06, much lower than the 5,037.54 rate of the merely vaccinated

Question 2

How do factors like political influence and socioeconomic levels affect the number of vaccine doses administered?

Q2: Political Datasets and Methodology

- H_1: average vaccination rates are different between states that voted Democrat compared with states that voted Republican

- Import Election results and CDC Dataset for Vaccines

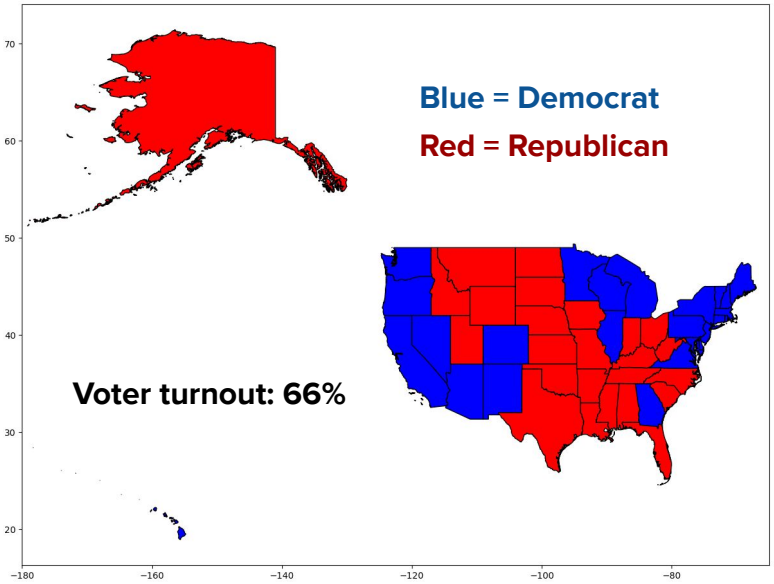
- Import GeoPandas which has US state geometry to plot

- Merge Datasets by State

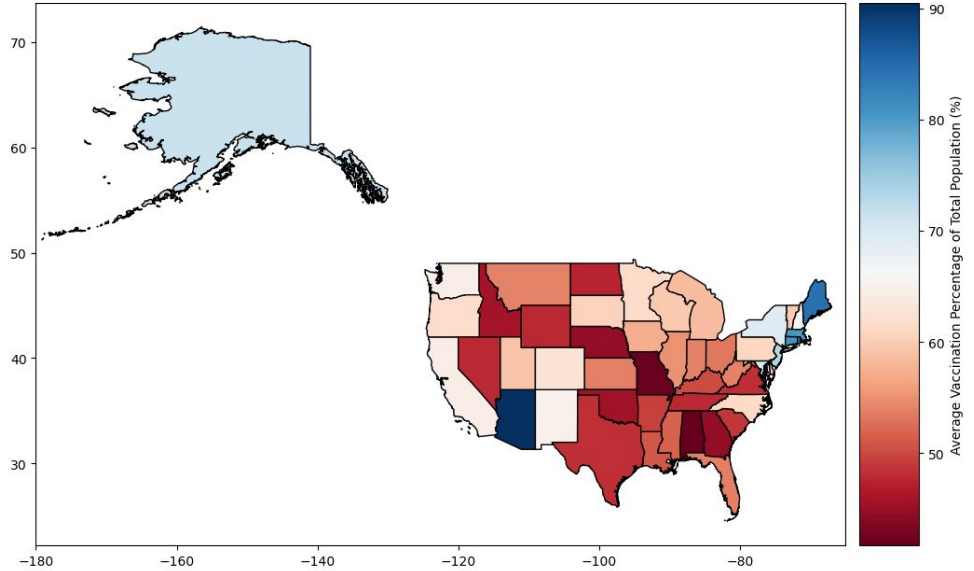
- Plot results

Q2: Correlation with Party Affiliation (p-value = 8×10^{-6})

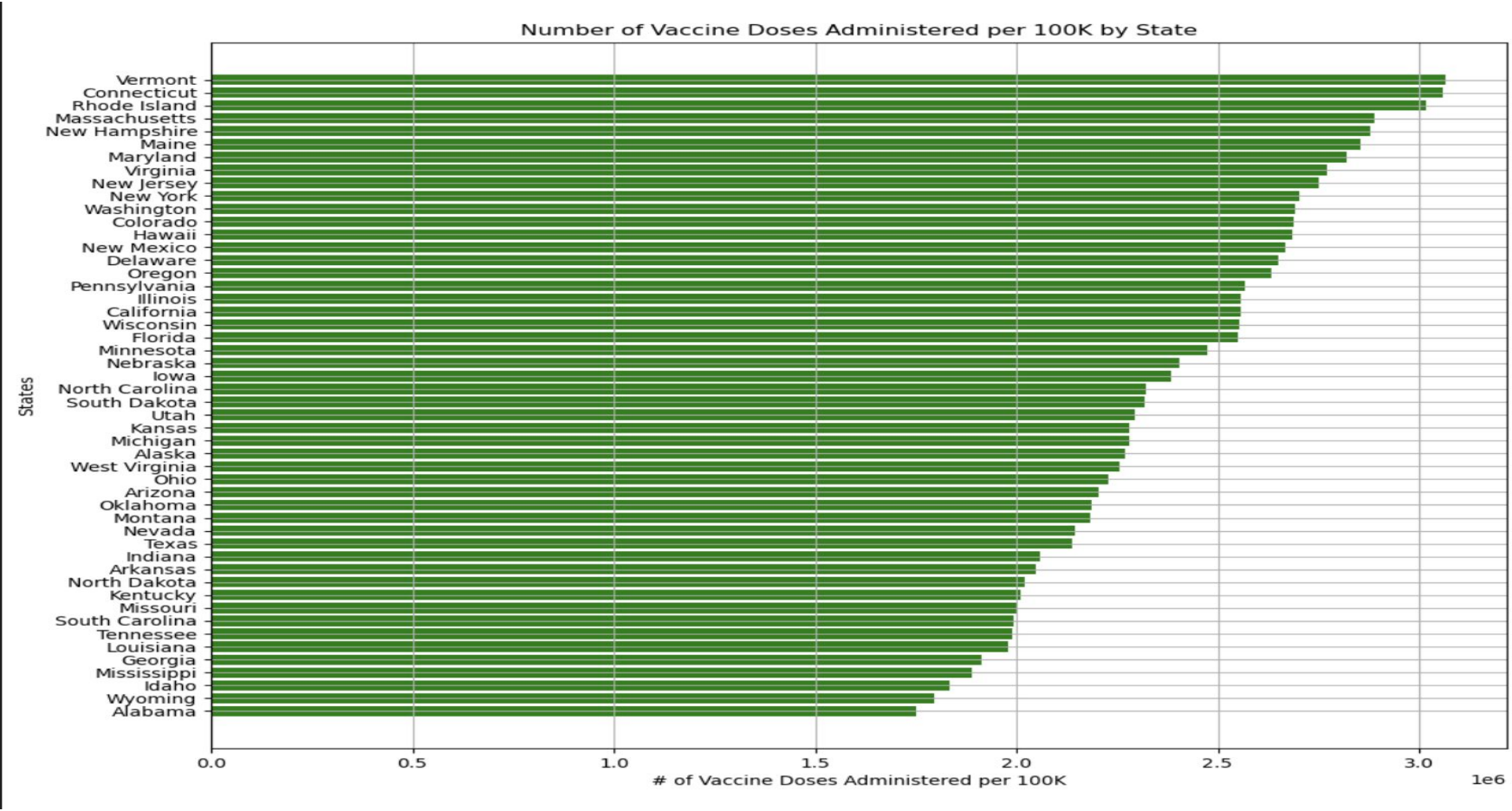
2020 Electoral College Results



Fully Vaccination Rates in US

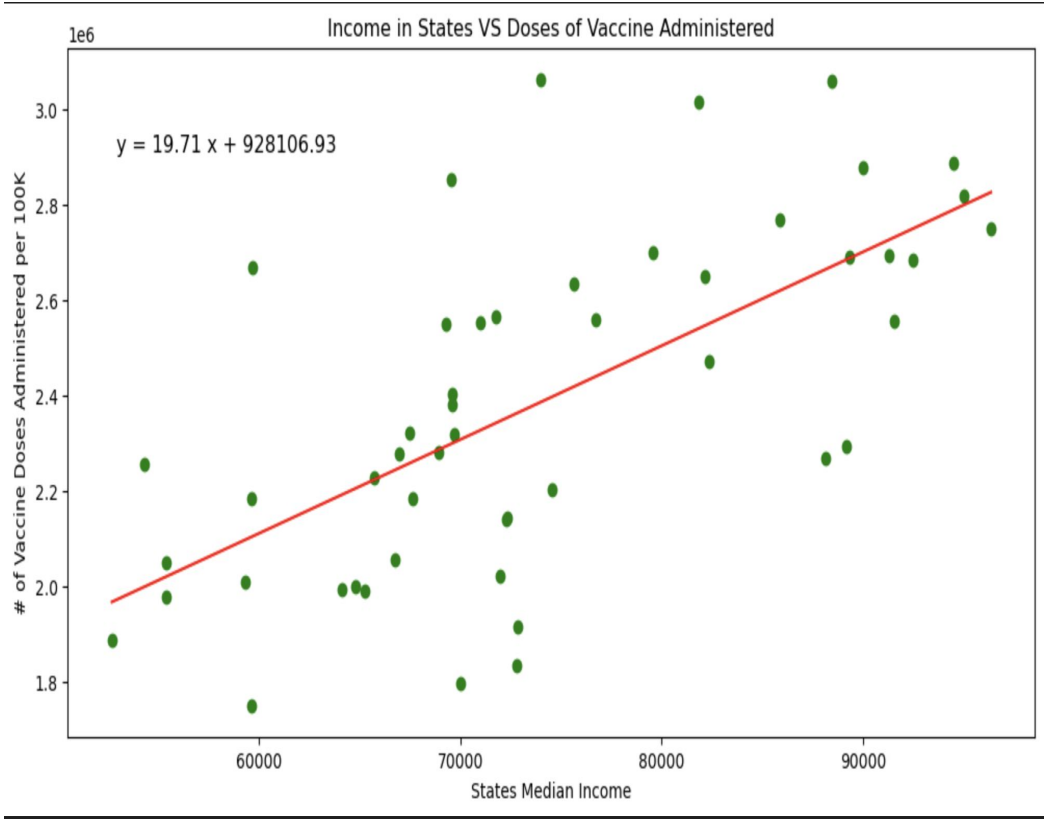


Q2: Socioeconomic Influence (Median Income)



Q2: Socioeconomic Influence

- Correlation coefficient of **r = 0.65** indicates a moderate to strong positive correlation between median income and the number of vaccine doses administered per 100,000 people.



Summary

- Between March 2021 and August 2022
    - Higher volumes of vaccines were administered during March 2021
    - As vaccines increased between September 2021 and December 2021
        - COVID-19 cases increased starting November 2021 and peaked in January 2022
    - A seasonal trend occurs in 2021 and 2022 between July and August as cases are slightly elevated during these months
- Younger age groups vaccinated more than older age groups
- Single dose was administered more than series
    - Single dose mean is higher than mean for series

Summary

- Death rates highest in 65+ group
  - Reduced with vaccination and boosters
- 5-11 age group had minimal death rates
- Unvaccinated had higher death rates across all ages
- Vaccination and booster doses reduce severe outcomes
- Strong correlation with party affiliation and vaccination rates
  - p-value: $8x10^{-6}$
  - map also shows overlap between vaccinated/less vaccinated states
- There is a positive correlation between median income and does administered per 100K

Limitations

- Time Series analysis does not contain data on newer vaccines and the limitations between age groups
- Election turnout rate only 66%, missing 34% of population who are eligible to vote
- Fully Vaccinated data as of May 10, 2023
- Many of our plots do not include error bars, should at least have error bars within 1 stdev
- Dataset age ranges were broad
    - significant variations within these groups i.e.) the risk profile for 18-year-old might be different from a 49-year-old
- Dataset includes 31 health departments and represent 72% of the total U.S. population
    - 28% of the U.S. population is not represented

Limitations

- Influence of socioeconomic factors like education, and access to healthcare were not considered in this analysis
- Use of Median income as a standalone indicator also account for certain limitations such as:
    - Lack of Granularity
    - Oversimplification

Citations

- Google COVID-19 Open Data
- CDC Vaccination Geographical Location
- CDC Vaccinations by County
- 2020 Election Results

- COVID-19 Vaccinations in the United States,Jurisdiction
- US Census Bureau Income Data
- Rates of COVID-19 Cases The impact of vaccination on Death Rates (cdc.gov)

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