Proceedings of the 2nd International Conference on Biological Engineering and Medical Science (ICBioMed 2022), Part I
DOI: 10.54254/2753-8818/3/20220227

The Impact of Monetary Incentives on COVID-19 Vaccination Rates in the US

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Abstract. Despite the usage of prizes, gift cards, and cash to incentivize COVID-19 vaccinations across US states during the COVID-19 pandemic, research on the impact of monetary incentives on vaccine behavioral decisions is conflicting and limited. There is little to no existing literature on whether public health driven financial incentives increase COVID-19 vaccine intake even though this approach has been adapted by state public health departments in varying degrees. This research investigates if there is significant association between state monetary incentives and COVID-19 vaccination status. Upon establishing strong correlation between monetary incentives and COVID-19 vaccination status using statistical methods and analysis, a linear regression model was developed to evaluate which types of monetary incentives were most effective in increasing statewide vaccination status. With the plethora of pandemic health data instigated from scientific and governmental learnings, big data and computational tools hold the key to crafting evidence-based public health infrastructure that will fully prepare future generations for tackling the next unforeseen health crisis.

Keywords: biomedical and health informatics, disease control

1. Introduction

A key challenge public health officers in the US faced during the coronavirus pandemic was the gap between real time big data and public health policy implementation. Though proven studies on containing cases and reducing the spread of the virus in epidemics guided state policy decisions administered by public health departments [1], lack of evidence-based pandemic research made it difficult for public health leadership to determine which state level actions would lead to the maximum number of lives saved, thus resulting in a number of different actions, ranging from school closures, lockdowns, and vaccine monetary incentives to be issued throughout the past two years of insurmountable heartbreak and death [2]. This chasm between pandemic-related data and public health policy will continue to persist unless data-driven, computational research on the coronavirus pandemic can be transformed into policies for mitigating future health crises. There is an opportunity where big data in public health could revitalize one approach to ending a pandemic: increasing vaccination status.

Since the release of COVID-19 vaccines in January 2021, one of the biggest obstacles in ending the pandemic is vaccine hesitancy. With only 58% of the US population fully vaccinated at the end of 2021 [3], some states implemented monetary incentives for individuals who received both doses. Literature

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on the impact of monetary incentives, however, is mixed. While research conducted in Sweden found that cash payments increased vaccination rates by 4.2%, [4], another study conducted by the National Bureau of Economic Research found that financial incentives did not meaningfully increase vaccination rates [5]. There is little existing literature on this topic and differing conclusions on the role of incentives in vaccine uptake. The purpose of this research is to determine if there is correlation between monetary incentives and vaccination status and which incentives were most effective in increasing vaccination rate at the state level.

2. Methods

With no centralized database that outlines different monetary incentives used across the US, the first step was developing a dataset by manually researching incentives implemented by state public health departments. Monetary incentives were researched for each state and categorized into Lottery (statewide lotteries in which vaccinated individuals were entered), Payments (cash payments or gift cards given to vaccinated individuals), and Prizes (non-cash prizes provided to vaccinated individuals). The data in this dataset was binary; 1 for if the state had the monetary incentive and 0 for if the state did not. A fourth column in the table, Score, was the sum of the three monetary incentives and used to track which states had how many monetary incentives implemented.

This statewide monetary incentive data was appended to data from Mayo Clinic's US COVID-19 Vaccine Tracker [3], gathering percentages of statewide fully vaccinated and at least one vaccine across the 50 US states. Fully vaccinated individuals were defined in the dataset as individuals who received both doses of the COVID-19 vaccine or received the Jansen and Jansen vaccine, which was one dose. At least one vaccine individuals were defined in the dataset as individuals who received the first dose of the COVID-19 vaccine. All Mayo Clinic data was collected from the last day of February 2022 because most states had no vaccine incentives until late 2021.

Variance inflation factors were calculated for each of the three monetary incentives to ensure independence among the monetary incentives before moving forward with hypothesis testing and linear regression model building. The Score column, the number of monetary incentives a state, was used as the independent variable; fully vaccination status and at least one vaccine status as the dependent variables for two separate hypothesis tests.

To determine whether there was correlation between monetary incentives and statewide vaccination rates, two hypothesis tests were conducted on state fully vaccinated status and state at least one vaccine status. Using a 95% confidence interval, a double tailed t-test on was performed to determine whether there was any significant correlation between monetary incentive and vaccine status.

Table 1 (Left). Normally Distributed Graph of Critical Value Range and t-statistic for Relationship between Monetary Incentive and Fully Vaccinated State Status.

Table 2 (Right). Normally Distributed Graph of Critical Value Range and t-statistic for Relationship between Monetary Incentive and At Least One Vaccine State Status.

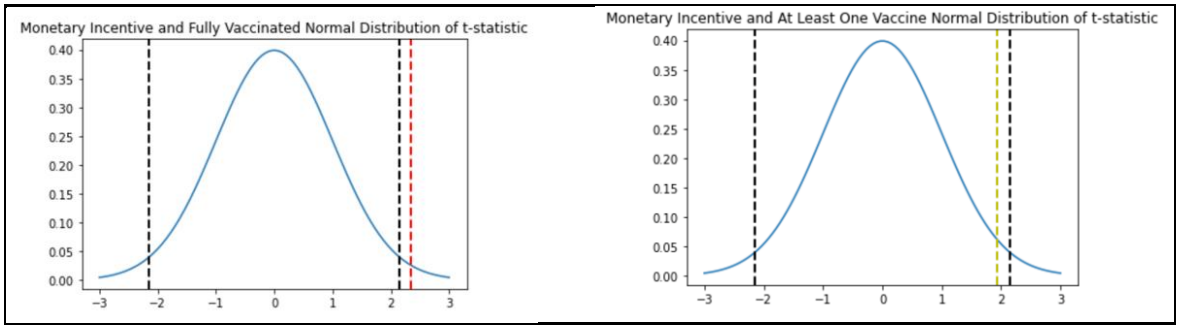

Figure 1. Normal Distribution of t-statistic for Fully Vaccinated Status and At Least One Vaccine Status.

For fully vaccinated status, the null hypothesis was rejected; there is evidence at the 5% significance level to conclude that there is significant correlation between monetary incentives and fully vaccinated

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status. However, for at least one vaccine status, the null hypothesis failed to be rejected; there is enough evidence at the 5% significance level to conclude that there is no significant correlation between monetary incentives and people receiving at least one vaccine.

Since correlation was only proven between monetary incentives and full vaccination status, a linear regression was ran on monetary incentives and state wide full vaccination percentage.

3. Results

Overall, the most used monetary incentives across states are cash payments, where states are twice as likely to use cash payments as opposed to prizes and lotteries. More than 44% of states that have implemented cash payments have a fully vaccinated rate greater than the national average. On average, states used at least one of the three types of monetary incentives for boosting vaccination rates. However, even with the implementation of at least one vaccine monetary incentive, fully vaccinated status across the US differed greatly, showcasing high variance across US states.

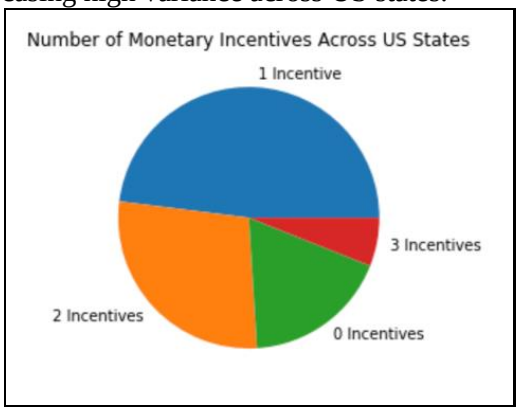

Figure 2. Breakdown of Number of Monetary Incentives Implemented in US States (Feb 2022).

Significant correlation was found between lotteries and fully vaccinated status ($P < 0.10$). States with no lotteries can expect a 4.75% increase in fully vaccinated status if they do implement lotteries; states with no prizes can expect a 3.82% increase in fully vaccinated status if they do implement prizes. States with no payments who implement payments can expect no change in fully vaccinated status.

Table 1. Results of Linear Regression on Monetary Incentive Type and Full Vaccination Status.

Monetary Incentive Type	Coefficient	P-Value
Lottery	4.75	0.106
Payment	-0.36	0.888
Prize	3.82	0.146

4. Discussion

The results of the hypothesis test demonstrate that monetary incentives have an impact on incentivizing people to get fully vaccinated, but the same cannot necessarily be said for receiving at least one vaccination. Reasons for why this dichotomy exists are due to other confounding variables that influence whether a person receives a second dose of a vaccine, such as low supply of the vaccine, unavailability of appointments, misinformation, geographical or environmental barriers preventing people from receiving the second vaccine, political and personal beliefs, employer vaccine mandates, and political or social events that may have impacted viewpoints on the pandemic [6][7].

Furthermore, despite being the most popular choice for vaccine monetary incentive among public health departments in the US, payments were the least effective in increasing full vaccination percentage. Instead, lotteries have the biggest impact on state wide full vaccination status, followed by prizes, and

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then payments. A possible explanation for why lotteries are most effective is that the monetary incentive is larger in value than prizes or payments. However, instigating lotteries lead to a 5% vaccine uptake increase at the most, which would be most beneficial in a state with a larger population. Whether a 5% vaccine uptake for implementing a state wide lottery is cost beneficial should ultimately be decided on a state by state basis [8], where decisions regarding financing for monetary incentives and infection rates will fall on public health leaders.

5. Conclusion

Due to conflicting existing literature on whether there is a relationship between monetary incentives and vaccination rate, the relationship between state monetary incentives and vaccination rates was examined to determine the effectiveness of monetary incentives on state wide vaccination rate. There is significant correlation between fully vaccinated status and the more monetary incentives a state employs; the most effective incentive in influencing state vaccination status being lotteries. However, further discussion on the cost-benefit tradeoff of implementing lotteries over other types of monetary incentives must be considered before implementing health policy solutions that inform public health leaders on mitigating future health crises.

Acknowledgments

We would like to express our gratitude to Dr. Tomas Aragon, Director of the California Department of Public Health, Denise Razo, Chief Public Health Officer of the City of Detroit, and Srija Srinivasan, Deputy Chief of San Mateo County Health, for their support and public health expertise that helped guide the direction of our research. We would also like to thank Dr. Regina Nuzzo and Dr. Kristin Sainani for providing feedback on the technical decisions undertaken in the linear regression. We also are tremendously grateful to the Clinical Informatics Management program at Stanford University School of Medicine for their support throughout our research.

Finally, we would like to show our deep appreciation to our friends and family for their support and encouragement from the beginning to the end of this research.

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