



The Effects of Incentives on COVID-19 Vaccination Rates

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Executive Summary

As part of MITRE’s Moving Out on Vaccination (MOoV) initiative, this paper presents an impact analysis of incentives on COVID-19 vaccination rates in six U.S. incentive programs. Effectiveness was defined as increases in vaccination rates in the targeted population relative to baseline trends after incentives of different types were introduced. The six incentive programs included a combination of state-sponsored and commercial-business-sponsored incentives. Selection of these incentives to analyze was based on availability of data during the period of this analysis, with considerations for incentive types and diversity of targeted populations.

The MITRE Black Pearl research team¹ supported the MOoV initiative and analyzed publicly available data sets from the Centers for Disease Control and Prevention (CDC), the Census Bureau American Community Survey (ACS), the Kaiser Family Foundation (KFF), and the Johns Hopkins Centers for Civic Impact for the Coronavirus Resource Center (CRC). The team also obtained public data sets from several state government and commercial websites.

The availability of public data and the timing of incentive program announcements led the team to narrow its focus to lottery programs in four states—Ohio, Maryland, West Virginia, and the Commonwealth of Kentucky—and incentive programs offered by two commercial companies—Krispy Kreme and Kroger. The team examined percent changes in first doses in the days following the incentive program announcements in all four states relative to first doses received on the dates of the announcements. The team also examined shares of first doses by demographic population in Maryland and trends in surplus vaccine doses available in the four states. For the commercial incentives, the team applied regression analysis to compare counties with and without the stores.

It is important to keep in mind that factors not related to incentives (such as vaccine access and availability) can affect people's vaccination behaviors. So, while the team did note changes in vaccination uptake behaviors after incentives were introduced in some cases, the number of other factors at play only support calling these possible correlations, with incentives acting as contributing factors to changes in vaccination uptake behaviors.

¹ MITRE Black Pearl is a MITRE corporate initiative that leverages traditional and non-traditional data sources to deliver advanced analytics and intelligence.

Table 1. Key findings and recommendations

Key finding	Recommendation
<p>Results for state lottery programs were mixed. Two of the states examined, Ohio and Maryland, showed short-lived increases in first doses dispensed when compared to the overall U.S. and to geographically and demographically similar states without incentive programs, and two of the states, West Virginia and the Commonwealth of Kentucky, did not.</p>	<p>Because state COVID-19 vaccine incentive programs are so new in the U.S., their effectiveness is not yet definitively known. It is important to consider multiple factors when implementing one:</p> <ul style="list-style-type: none"> • Combine incentives with other strategies to increase population immunity, such as effective and accurate communications. • Realize that vaccination rates can be affected by multiple factors. Address as many factors as is feasible that might positively influence uptake, such as accessible vaccination sign-up/registration, convenient vaccination sites, adequate vaccination supply, and adequate personnel to administer vaccines, before announcing an incentive program. Monitor all factors closely during the incentive time frame and respond to any negative factors that arise.
<p>There was some evidence that state incentive programs may increase vaccine uptake among underserved populations.</p>	<p>Consider using incentive programs to increase vaccinations among minority populations.</p>
<p>Regarding incentives offered by commercial companies, data challenges prohibited close examination of effects from cash and grocery prizes by Kroger, and there was no evidence of increased vaccinations following the Krispy Kreme offering.</p>	<p>The team offers no recommendations regarding commercial incentives at this time.</p>

The Black Pearl research team recommends states consider implementing incentive programs, with potential outsized benefits among underserved populations. But the team cautions that the “jury is still out” in relation to understanding exactly how effective incentive programs will be in multiple circumstances, and therefore recommends that states combine incentive programs with other strategies, such as appropriate communication campaigns and behavioral interventions, and ensure that all controllable factors have been addressed before instituting incentive programs.

The team notes that the U.S. is still early in its deployment of COVID-19 vaccine incentive programs. Additional retrospective analyses will be needed to understand how effective they are at increasing vaccinations. The team hopes that this analysis will serve as a baseline for future analyses.

Table of Contents

1	Introduction and Approach	1
1.1	Methods.....	2
2	Key findings	2
3	Assumptions and data limitations	3
3.1	Assumptions.....	3
3.2	Data limitations	3
3.3	Effect of Vaccination Status on Vaccine Uptake.....	3
4	Research findings	4
4.1	State incentive programs.....	4
4.1.1	Percent changes in first doses relative to announcement dates.....	4
4.1.1.1	May incentive announcements	5
4.1.1.2	June incentive announcements	6
4.1.2	Findings by race, ethnicity, and gender in Maryland.....	7
4.1.2.1	Maryland first doses by gender	7
4.1.2.2	Maryland first doses by race	8
4.1.2.3	Maryland first doses by ethnicity	8
4.1.3	Examining COVID-19 vaccine surpluses relative to incentive timing.....	8
4.2	Commercial incentive programs	9
4.2.1	Krispy Kreme and Kroger.....	9
4.3	Advantages and concerns related to vaccine incentives	9
5	Conclusion/recommendations	11
6	References	13
Appendix A	Incentive programs examined	17
Appendix B	Differences between coincidence, correlation, and causation	19
Appendix C	List of COVID-19 incentive programs	20
Appendix D	Abbreviations and Acronyms	25

List of Figures

Figure 1. First-dose percent changes relative to announcement dates for Ohio and Maryland	5
Figure 2. First-dose percent changes relative to announcement dates for West Virginia and Kentucky	6
Figure 3. MD first-dose shares by demographics	7
Figure 4. Surplus vaccine trends relative to state incentive announcements	9

List of Tables

Table 1. Key findings and recommendations	ii
Table 2. Advantages and concerns related to vaccine incentives	10
Table 3. Key findings and recommendations	12
Table 4. Incentive programs examined by the Black Pearl research team	17
Table 5. Incentives offered by commercial companies	20
Table 6. Incentives offered by states.....	20

1 Introduction and Approach

In the first half of 2021, offering incentives emerged as a strategy in the U.S. to motivate individuals to get vaccinated against COVID-19. A chance to win a million-dollar lottery was Ohio’s incentive offering to adults, while teens who got vaccinated were entered into a drawing for a full-ride, four-year scholarship [1]. Other states have been offering similar benefits and prize incentives. Businesses announced food giveaways, gift cards, and discounts in hopes of increasing U.S. vaccination rates (Appendix A). Are these incentive strategies effective?

As part of MITRE’s Moving Out on Vaccination (MOoV) initiative, the MITRE Black Pearl research team² supported the MOoV initiative by performing an impact analysis to investigate the effectiveness of incentives on vaccination rates in six U.S. incentive programs. Effectiveness was defined as increases in vaccination rates in the targeted population relative to baseline trends after incentives of different types were introduced. The six incentive programs examined included a combination of state-sponsored and commercial-business-sponsored incentives. Selection of these incentives for analysis was based on availability of data during the period of this analysis, and considerations were made for incentive types and diversity of targeted populations. The programs included:

1. Maryland’s VaxCash [2]
2. Ohio’s Vax-a-Million [1]
3. West Virginia’s “Do it for Babydog” [3]
4. Kentucky’s Shot at a Million [4]
5. Krispy Kreme’s Be Sweet to Your Community COVID-19 Vaccine Offer [5]
6. Kroger’s #CommunityImmunity campaign [6]

See Appendix A for details of the programs.

The Black Pearl research team gathered and analyzed publicly available data between late May and early July in 2021. The scope of the research included evaluating the six incentive programs to examine correlations between vaccination rates in populations prior to and after incentive announcements and examining the availability of vaccine doses in Maryland, Ohio, Kentucky, and West Virginia. The research also included a literature review on prior, related studies and other factors contributing to the effectiveness of incentives.

Publicly available data sets analyzed for this report came from The Centers for Disease Control and Prevention (CDC), the Census Bureau American Community Survey (ACS), the Kaiser Family Foundation (KFF), and the Johns Hopkins Centers for Civic Impact for the Coronavirus Resource Center (CRC). Additionally, the team obtained related data sets from several state government and commercial websites, which were used to develop visualizations and to conduct analyses.

The audience for this report is MITRE sponsors and partners, and state and local public health communities who may consider investing resources in incentive strategies to encourage healthy behaviors in individuals in the interest of public health and safety. The Black Pearl research team

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intends for the insights from this report to provide context for and inform communities about trends in how demographic populations might respond to the programs.

1.1 Methods

The team used two different processes for analysis and used publicly available R and Python packages. For state-sponsored programs, seven-day rolling averages of daily first doses were used at the state level and national level to control for day-of-the-week differences in vaccination patterns. Then, percent change was calculated for each day relative to the baseline of the incentive announcement date. State trends were compared to national trends to identify deviations from baseline movement.

For the Krispy Kreme and Kroger incentive analyses, regression analysis was used to compare trends in vaccination rates between counties with and without stores after controlling for population, vaccine hesitancy rates, and prior COVID-19 vaccination trends.

2 Key findings

COVID-19 vaccine incentives are a novel topic in public policy. It is therefore not known to what extent incentives can drive increases in vaccinations, but there are some early indications that the right incentive might be able to help [7].

- Results for state lottery programs were mixed:
 - In the days following their incentive program announcements in May, first doses increased in Ohio and Maryland at higher rates than in the U.S. overall and when compared to similar states without incentives. Increases were seen two to three days after the incentive announcements.
 - Maryland's and Ohio's gains were short-lived.
 - The incentive programs announced in June in West Virginia and Kentucky may have had no impact on first-dose vaccination behaviors. Increases in first doses were not seen until five or six days after the announcements.
- Regardless of overall state trends, however, there is some evidence that state incentive programs can increase vaccine uptake among underserved populations and men:
 - Black and Asian residents increased their share of first doses relative to White residents after Maryland announced its program.
 - Hispanic or Latino residents also increased their share of first doses relative to non-Hispanic or Latino residents after Maryland announced its program.
 - Men made up an increased share of first doses (+2.3pp) relative to women after Maryland announced its program.
- Data challenges made it impossible to discern the effect of cash and grocery prizes by Kroger, and there was no evidence of increased vaccinations following the Krispy Kreme freebie.

3 Assumptions and data limitations

3.1 Assumptions

The team conducted its analysis with the following assumptions in mind:

- An anticipated surge COVID-19 cases fueled by the Delta variant [8] will fuel desires by state and local public officials to increase vaccination rates, so they will be considering incentives
- Because COVID-19 incentive programs are relatively new and part of real-world, ongoing events, direct causation statements cannot be made between incentive programs and their desired effects at this time.
- At the time incentive programs were announced in Ohio, Maryland, Kentucky, and West Virginia, vaccine supply was adequate in those states for eligible individuals who wanted to receive vaccines.
- An insignificant number of vaccinations administered within a state are to non-state residents, therefore the majority of adult vaccination rates captured before and after an incentive program announcement are attributed to residents of that state, which means they would be eligible for incentive benefits.

3.2 Data limitations

The team identified and used publicly available data sets to examine trends in vaccination rates after incentives were announced. Because the public data sets were maintained by other organizations, the team could not control when data collection started or ended, or the level of detail available in the data sets. For example, demographic information for state residents was inconsistent in availability. Maryland provided data for race, ethnicity, and gender for vaccinated residents, but Ohio did not.

Additionally, adolescents aged 12 years and older (12+) became eligible in May 2021 to receive vaccines in Ohio, Maryland, West Virginia, and Kentucky. COVID-19 vaccination data on adolescents were not available prior to announcement of their eligibility. As a result, this report does not examine correlations between adolescent vaccination trends and incentive announcements.

3.3 Effect of Vaccination Status on Vaccine Uptake

Another limiting factor to be considered when measuring the rate of vaccinations or overall vaccination uptake is the number of people who are eligible to be vaccinated at a given point in time.

A person's vaccination status falls into one of four *pools*:

- Eligible for vaccination but not vaccinated (eligible)
- Fully vaccinated (vaccinated)
- Partially vaccinated—i.e., having received one dose of a two-dose vaccine (partial)
- Ineligible for vaccination (ineligible)

The changing size and interactions among these pools affect vaccination counts and rate measurements, presenting additional challenges in observing impact of incentive programs.

At the simplest level, these four pools are not independent of each other. As more people become fully or partially vaccinated, the number of people in the eligibility pool will decrease. As more people are partially vaccinated, the pool of people eligible for full vaccination will increase.

Additionally, this is not a closed system. Eligibility for vaccination can be radically changed by external events and decisions. Vaccinations have been distributed in phases over time, with eligibility being determined by age, profession (e.g., health care), medical status, and other characteristics. Other considerations include external events that may influence vaccination rates, such as severe weather. This means that the eligible pool size may decrease as more people are vaccinated, but that pool size can also increase precipitously when new age groups become qualified to receive the vaccine.

For this analysis, the team chose to limit data to the adult population (aged 18+) to avoid mistakenly picking up on changes in the eligible pool as the age of eligibility expanded.

4 Research findings

The team analyzed the incentive programs based on type (state and commercial).

4.1 State incentive programs

Based on the availability of data and incentive programs announced during the period of analysis, the team examined four states—Ohio, Maryland, West Virginia, and the Commonwealth of Kentucky.

The team examined percent changes in first doses relative to announcement dates for each of the states; the share of first doses by gender, race, and ethnicity in Maryland; and vaccine surpluses in all four states.

4.1.1 Percent changes in first doses relative to announcement dates

Two of the states examined announced their incentive programs in May (Figure 1), and two announced their programs in June (Figure 2). The team examined the trend of first doses in adults (aged 18+) for each of the states, using first-dose data for the entire U.S. as a baseline to determine whether changes in each state were unique. States that had increased trends in first doses were also compared to first-dose data from three geographically and demographically similar states that didn't have lottery incentive programs as an additional baseline metric. The top three similar states were selected using FiveThirtyEight's³ state similarity metric. Of the states analyzed, those that announced programs in May saw positive trends in first-dose vaccinations two to three days after the announcements, whereas states with announcements in June did not show any increases until five- or six-days post-announcement. The team used data sets provided by the CDC to run this subsection's analysis.⁴

³ Similar states to Maryland (<https://projects.fivethirtyeight.com/2018-midterm-election-forecast/senate/maryland/>) and similar states to Ohio (<https://projects.fivethirtyeight.com/2018-midterm-election-forecast/senate/ohio/>)

⁴ <https://data.cdc.gov/Vaccinations/COVID-19-Vaccinations-in-the-United-States-Jurisdi/uns-k-b7fc>. Data last retrieved July 13, 2021

4.1.1.1 May incentive announcements

Ohio announced its incentive program on May 12. In the three days following, first doses in the U.S. and similar states—Indiana, Michigan, and Pennsylvania—declined approximately 15% relative to May 12 levels, as seen in Figure 1. However, Ohio’s percent change in first doses diverged from the U.S.’s and its similar states’—rising approximately 2% on May 14 (while the U.S.’s and similar states declined approximately 7% and approximately 5%), before falling on May 15 to be comparable to national levels. This hints that the incentive program may have prevented Ohio’s first-dose vaccination rates from falling as far as the U.S.’s and similar states’ rates in the days immediately following Ohio’s incentive announcement.

Maryland’s first doses diverged from the U.S.’s at higher levels in the days following its announcement on May 20 (Figure 1). On May 23, three days after the announcement, Maryland’s first doses increased by 10% while doses in the U.S. dropped by 4% and doses in similar states—Connecticut, Delaware, and New Jersey—showed little change. Within a week of the announcement, U.S. daily first doses fell nearly 26%, and states similar to Maryland declined by approximately 6%. Meanwhile, Maryland’s daily first doses peaked at nearly +20% on May 26, and never fell below initial levels during the first week after the announcement. The positive trend in Maryland as doses in the U.S. declined points to the possibility that Maryland’s incentive program underpinned rising first-dose vaccines while doses in the U.S. were falling. The positive trend in Maryland was also more prominent than that seen in similar states, implying that the incentive program may have uniquely increased first doses in Maryland.

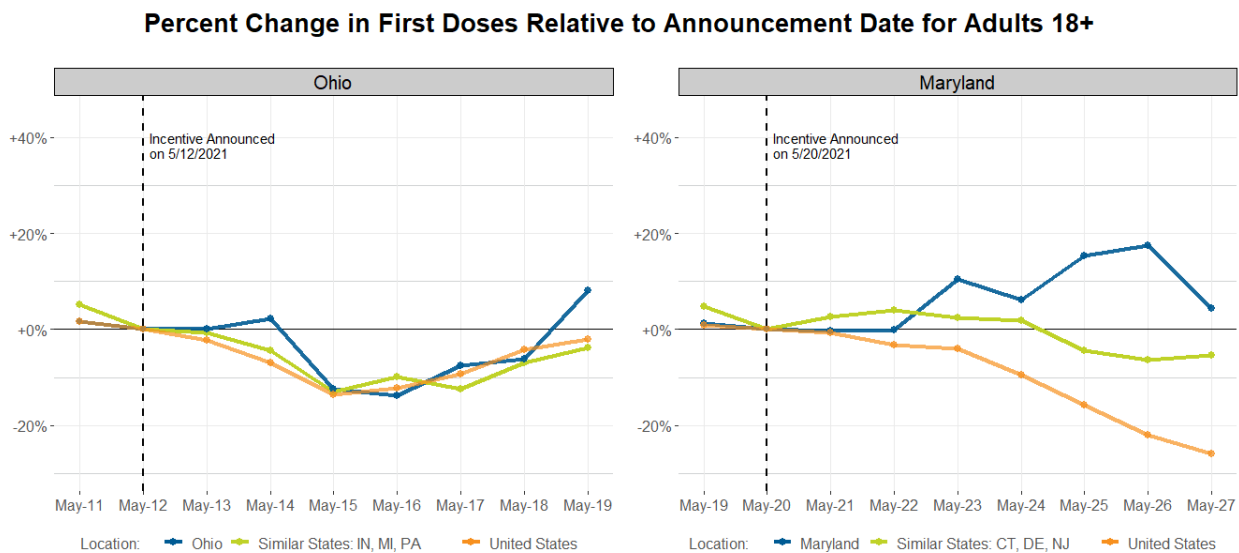


Figure 1. First-dose percent changes relative to announcement dates for Ohio and Maryland

The following summarize findings about the incentive programs announced in May:

- In the days following the two states’ incentive program announcements, first doses increased in Ohio and Maryland despite declining rates in the U.S. overall.
- These divergences from U.S. rates leave open the possibility that the incentive programs increased vaccinations in Ohio and Maryland. At the very least, there is no evidence that they negatively impacted vaccination rates.

- Compared to demographically and geographically similar states without incentive programs, Ohio and Maryland were able to better maintain positive trends in the days following their incentive program announcements.

4.1.1.2 June incentive announcements

When West Virginia announced its incentive program on June 1, daily first doses in the state immediately dropped at a more extreme rate than the U.S. as a whole (below -25% as compared to approximately -6% on June 2) (see Figure 2). For the next four days, West Virginia’s rate mostly stayed lower than the U.S.’s. The first time daily first doses in West Virginia rose above levels on the day of the announcement was June 7, six days after the announcement. This points to either a very delayed incentive bump or the possibility that the incentive programs either had no impact or negatively affected vaccination rates in West Virginia.

In Kentucky, which announced its incentive program on June 4, daily first doses did not diverge substantially from the U.S.’s trend during the four days following the announcement. The largest difference between the two during this time period occurred three days after the announcement, on June 7—Kentucky’s first doses increased approximately 12% from its doses on June 4, while U.S. doses increased only 7%. On June 8, both decreased to around 3% below June 4 first doses. The largest increase in Kentucky that deviated from national trends was seen five days after the announcement, on June 9. Similar to West Virginia’s, this delayed increase relative to national trends points to the possibility that either Kentucky’s incentive program had little effect on its population’s first-dose vaccination behavior or took longer to have an effect.

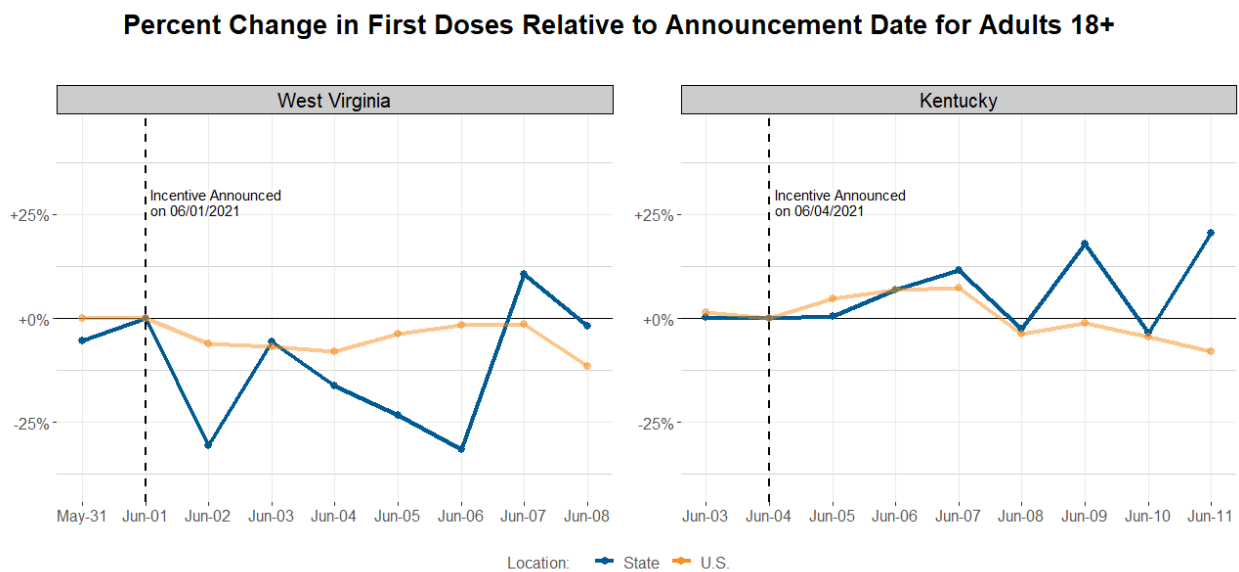


Figure 2. First-dose percent changes relative to announcement dates for West Virginia and Kentucky

The principle finding of the team’s analysis of these June incentive programs was that they corresponded with delayed increases in daily first doses, occurring 5-6 days after the announcement, as well as negative trends in West Virginia. This indicates that the programs may have had no impact, a delayed impact, or even a negative impact on first-dose vaccination behaviors.

4.1.2 Findings by race, ethnicity, and gender in Maryland

After observing that Maryland and Ohio both experienced increases in first-dose vaccination rates soon after announcing their incentive programs, the team set out to observe which populations drove these increases. Maryland provided data for race, ethnicity, and gender⁵, but Ohio did not. So, the team analyzed first-dose vaccination behaviors by race, ethnicity, and gender in the state of Maryland, comparing demographic breakdowns on the date of the announcement (May 20) with those three days later (May 23), when first doses increased statewide (Figure 3).

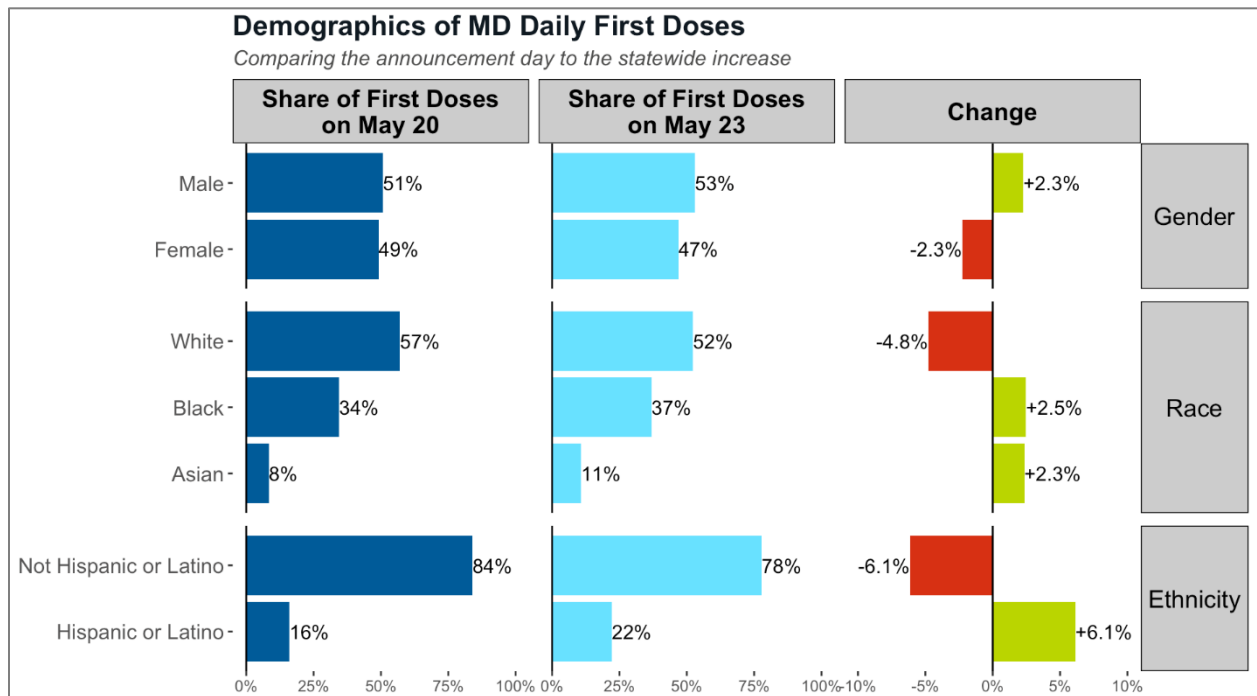


Figure 3. MD first-dose shares by demographics

The team analyzed gender by the categories of “Male” and “Female” and analyzed race by the categories “White,” “Black,” and “Asian.” The two ethnic categories analyzed were “Not Hispanic or Latino” and “Hispanic or Latino.”

4.1.2.1 Maryland first doses by gender

Male residents made up 51% of first doses on May 20, when Maryland announced its incentive program. Three days later, they had increased their share to 53%, indicating that the incentive announcement may have encouraged male residents to receive their first doses at higher rates than females.

⁵ Maryland provided three data sets for first doses by demographic group: one data set for race (<https://data.imap.maryland.gov/datasets/md-covid19-totalvaccinationsracefirstandsecondsingledose/explore>), one data set for ethnicity (<https://data.imap.maryland.gov/datasets/md-covid19-totalvaccinationsethnicityfirstandsecondsingledose/explore>), and one data set for gender (<https://data.imap.maryland.gov/datasets/md-covid19-totalvaccinationsgenderfirstandsecondsingledose/explore>). All data sets were last retrieved on July 13, 2021.

4.1.2.2 Maryland first doses by race

Race is “primarily a sociological designation that identifies a group sharing some outward physical characteristics and some commonalities of culture and history...”. [9]

The largest racial demographic in Maryland is White residents, who make up more than 50% of the population. Black and Asian residents, respectively, make up 30% and 6% of the population.

When Maryland announced its incentive program on May 20, White residents received 57% of the share of daily first doses. Black residents made up 34% of doses, and Asian residents were 8%. Three days later, on May 23, Black and Asian residents combined had closed the gap by nearly 5%. This points to the possibility that Black and Asian residents in Maryland were encouraged by the incentive program to receive their first doses.

4.1.2.3 Maryland first doses by ethnicity

“Ethnicity is a word for something you acquire based on where your family is from and the group which you share cultural, traditional, and familial bonds and experiences with...”. [9]

When Maryland announced the incentive program on May 20, non-Hispanic or non-Latino residents were receiving a significantly larger share of first doses compared to Hispanic or Latino residents (84% to 16%). Three days after the announcement, Hispanic or Latino residents had increased their share to 22%, pointing to the possibility that Maryland’s incentive program increased vaccine participation for Hispanic or Latino residents.

4.1.3 Examining COVID-19 vaccine surpluses relative to incentive timing

Given the range in timing of vaccine incentive programs, the team opted to investigate whether there were any trends between programs’ success and the timing of their announcements. A hypothesis was that the earlier incentive programs were likely more successful because they were announced at an optimal time in the vaccine supply and demand trends—specifically that they mobilized residents as demand dropped below supply.

The team used a data set from the Johns Hopkins Centers for Civic Impact for the Coronavirus Resource Center (CRC)⁶ to examine trends in surplus vaccine doses in Maryland, Ohio, West Virginia, and Kentucky. Supply was measured as the cumulative number of vaccine doses that arrived at state vaccination sites. Demand for vaccine doses was measured as the cumulative number of vaccine doses administered. Surplus was measured as the difference between supply and demand. A limitation of using this data set for demand is that it was likely an underestimate because it did not capture the demand of residents who were unable to obtain vaccine appointments.

Ohio, which was the first state to announce an incentive program, was also on the earlier side to see a peak in surplus vaccines, as illustrated in Figure 4. The Ohio incentive program was announced six days after the gap between supply and demand reached its highest point. Maryland, the next state to institute a lottery, announced its incentive program while the vaccine surplus in the state continued to grow. West Virginia and Kentucky both had later announcements that occurred after the vaccine surplus had plateaued or begun to decline.

⁶ <https://github.com/govex/COVID-19>. Data last retrieved July 16, 2021.

There were no consistent patterns around the timing of the incentive announcements in these states and their vaccine surplus trends. That said, Ohio was notable for instituting its incentive program right around the vaccine surplus peak.

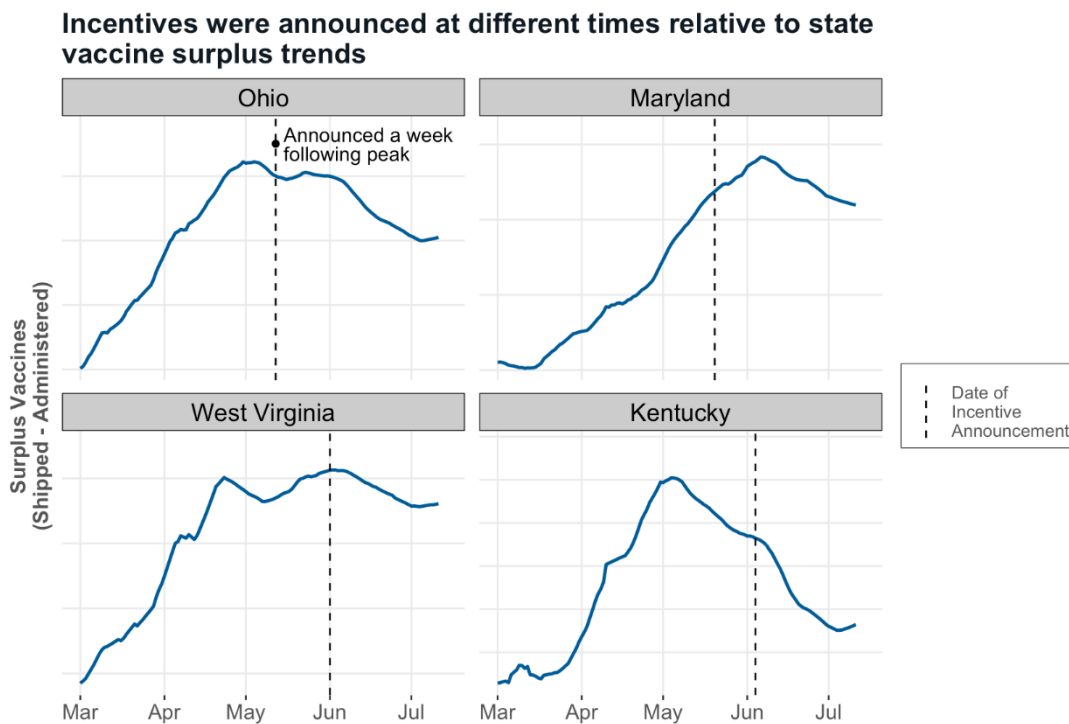


Figure 4. Surplus vaccine trends relative to state incentive announcements

4.2 Commercial incentive programs

4.2.1 Krispy Kreme and Kroger

In examining Krispy Kreme’s and Kroger’s incentive programs, the team did not find evidence of statistically significant increases in vaccination rates. Factors considered in the analysis were population, hesitancy rates, and prior vaccination trends. For Krispy Kreme, any perceived effects can likely be attributed to strong correlations between store locations and more populous counties. For Kroger, eligibility for the grocery gift incentive required individuals be vaccinated in a Kroger family pharmacy. Results were inconclusive for whether counties with Kroger family pharmacies had increased vaccination rates compared to counties without.

It is also notable to point out that Krispy Kreme’s incentive program was announced in March, which was before most states had expanded vaccine eligibility to include all adults.

4.3 Advantages and concerns related to vaccine incentives

Findings from literature review revealed mixed attitudes toward using incentives to promote vaccinations. While deploying vaccine benefit programs may increase vaccinations, thereby reducing overall harm from COVID-19 and protecting disadvantaged populations (e.g., ineligible children, unvaccinated adults, and those with conditions reducing vaccine efficacy) [10], there

are opposing arguments that suggest incentives are a form of coercion, impede individual liberties and decision-making, and are a misuse of public taxpayer money.

Table 2 summarizes some advantages and concerns associated with incentive programs. Each viewpoint includes a description and potential response to concerns. These factors are useful to consider when evaluating incentives as a strategy to encourage vaccination for a particular community.

Table 2. Advantages and concerns related to vaccine incentives

Advantages	Description
Generate universal appeal	Most individuals value money, which gives monetary incentives a universal appeal [11] and provides a broader reach to motivate the masses.
Leverage public endorsements from key leaders	Support recommended strategies for building confidence in COVID vaccines [12] [13]. State leaders in Ohio, Maryland, West Virginia, and Kentucky launching incentives in their respective states to advocate for and encourage vaccinations of their residents is an example of this.
Employ perceived value as a motivator	Can be motivators for those who are undecided or have taken a “wait and see” position. Incentives can provide that extra push to motivate individuals if they feel they will get something of much greater value than the effort they put into getting the vaccine. The perceived value of possibly winning a life-changing prize becomes motivational even when the probabilities are low [14].
Generate media coverage and excitement	Incentives can generate attention and excitement around vaccinations during pandemic fatigue. Often, there is increased coverage on the internet and in news media, social media, and other outlets, resulting in increased vaccination awareness [10] [13].
Work with complementary interventions	Incentives do not have to be used exclusively. They can be coupled with other strategies to maximize vaccination uptake, such as targeted strategic communications, partnerships with community organizations, addressing equity disparities, and instituting mandates (schools and workplaces) [12] [13].
Reward all vaccinated persons equally	Rewards and benefits can be provided to early adopters and latecomers equally, minimizing penalties for individual decisions [10].
Concerns	Description and response
Are coercive	The notion that incentives coerce or exploit individuals. <u>Response:</u> Offering a benefit cannot coerce because, unlike a threat, an offered benefit does not threaten to deprive someone of anything they are otherwise entitled to, which is a fundamental requirement to constitute coercion [15]. Including messaging related to choice in parallel with incentives can help address this concern [16].

Concerns	Description and response
Exploit disadvantage persons	<p>Belief that incentives exploit persons who are poor. Individuals who are less well-off may have more need for the offered benefit.</p> <p><u>Response:</u> Vaccination protects recipients rather than heightening their risk. Recipients get a “double benefit”: protection from COVID-19 along with a benefit, gift card, or lottery ticket. Additionally, encouraging vaccination by offering benefits helps mitigate economic inequity [10] [13].</p>
Distort individual decision-making	<p>Belief that incentives distort or corrupt medical decision-making by introducing inappropriate or irrelevant motivations [10] [13].</p> <p><u>Response:</u> Cash benefits can improve decision-making by offsetting financial distractions (e.g., lost wages and cost of childcare and transit) and allow individuals to focus on protecting themselves and their families [10].</p>
Waste of public funds	<p>View that incentives are unnecessary and large benefit payments may waste public funds [10].</p> <p><u>Response:</u> Can be addressed by offering benefits no greater than needed to encourage vaccinations [10]. Benefit programs can be evaluated for efficacy and cost-effectiveness and be rigorously compared with alternative options.</p>
Create expectations for future rewards	<p>View that incentives are priming the pump for people to expect these rewards in the future [11].</p> <p><u>Response:</u> There is no empirical evidence for this. Any empirical evidence needs to be weighed against the value of stemming the pandemic [10].</p>
View vaccine as risky or undesirable	<p>The notion that incentives are offered because vaccines are risky or do not have much value. Literature showed that offering a low-amount benefit undermines the value of the vaccine, whereas offering a large amount may lead some to infer that the vaccine is riskier than they otherwise assumed [17].</p> <p><u>Response:</u> Can be addressed by using appropriately valued benefits that resonate with the groups that are being targeted [10].</p>

5 Conclusion/recommendations

This paper has presented the findings of an impact analysis of the effects of incentive programs on COVID-19 vaccinations. The availability of public data and the timing of announcements led the Black Pearl research team to narrow its focus to lottery programs from four states—Ohio, Maryland, West Virginia, and the Commonwealth of Kentucky—and incentive programs offered by two commercial companies—Krispy Kreme and Kroger. The team examined percent changes in first doses in the days following the incentive program announcements in all four states relative to first doses received on the dates of the announcements. The team also examined

shares of first doses by demographic population in Maryland and trends in surplus vaccine doses in the four states.

It is important to keep in mind that factors not related to incentives (such as vaccine access and availability) can affect people's vaccination behaviors. So, while the team did note changes in vaccination uptake behaviors after incentives were introduced, the number of other factors at play only support calling these possible correlations, with incentives acting as contributing factors to changes in vaccine behaviors.

Table 3. Key findings and recommendations

Key finding	Recommendation
Results for state lottery programs were mixed. Two of the states examined, Ohio and Maryland, showed short-lived increases in first doses dispensed when compared to the overall U.S. and to geographically and demographically similar states without incentive programs, and two of the states, West Virginia and the Commonwealth of Kentucky, did not.	Because state COVID-19 vaccine incentive programs are so new in the U.S., their effectiveness is not yet definitively known. It is important to consider multiple factors when implementing one: <ul style="list-style-type: none"> • Combine incentives with other strategies and interventions to increase population immunity, such as effective and accurate messaging. • Realize that vaccination rates can be affected by multiple factors. Address as many factors as is feasible that might positively influence uptake, such as accessible vaccination sign-up/registration, convenient vaccination sites, adequate vaccination supply, and adequate personnel to administer vaccines, before announcing an incentive program. Monitor all factors closely during the incentive time frame and respond to any negative factors that arise.
There was some evidence that state incentive programs may increase vaccine uptake among underserved populations.	Consider using incentive programs to increase vaccinations among underserved populations.
Regarding incentives offered by commercial companies, data challenges prohibited close examination of effects from cash and grocery prizes by Kroger, and there was no evidence of increased vaccinations following the Krispy Kreme offering.	The team offers no recommendations regarding commercial incentives at this time.

In short, the Black Pearl research team recommends states consider implementing incentive programs, with potential outsized benefits among underserved populations. But the team cautions that the “jury is still out” in relation to understanding exactly how effective incentive programs will be under different conditions, and therefore recommends that states combine incentive programs with other strategies and interventions, such as appropriate communication campaigns, and ensure that all controllable factors have been addressed before the incentive programs are instituted.

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Appendix A Incentive programs examined

Table 4. Incentive programs examined by the Black Pearl research team

Program	Date announced	Eligible	Details	Reason for selection
Krispy Kreme Donuts' Be Sweet to Your Community COVID-19 Vaccine Offer [5]	3/22/2021	Adults & adolescents	Guests who present a vaccination record card showing at least one dose can receive a free doughnut.	One of the very first nationwide COVID-19 incentive programs to be introduced. Comparison with similar commercial-business-sponsored incentives.
State of Ohio's Vax-a-Million [1]	5/12/2021	Adults & adolescents	Residents aged 18+ who receive their first dose can enter to win one of five \$1M prizes. Residents aged 12-17 who receive their first dose can enter to win full-ride scholarships to any OH state college or university.	First state-sponsored COVID-19 incentive introduced. Comparison with similar state-wide lottery incentives.
State of Maryland's VaxCash [2]	5/20/2021	Adults	Residents aged 18+ who have been vaccinated are automatically eligible to win \$40K in one of 40 daily lottery drawings. The prize for the final drawing is \$400k.	Close ties to MITRE's MOoV engagement with Prince George's County Health Department. Comparison with similar state-wide lottery incentives.
State of West Virginia's Do it for Babydog Lottery [3]	6/1/2021	Adults & adolescents	Residents aged 18+ who receive their first dose can enter to win one of several weekly prizes (including \$1M cash prize, trucks, weekend getaways, lifetime hunting and fishing licenses, hunting rifles, and shotguns) or win the \$1.588M grand prize. Residents aged 12-17 who receive their first dose may enter to win full-ride scholarships to any WV state college or university.	Comparison with similar state-wide lottery incentives. Diversity of incentive type and targeted demographic.
Kroger COVID-19 Vaccine Offer [6]	6/3/2021	Adults	Participants aged 18+ who receive at least one dose at a Kroger Family Company location can enter in weekly drawings for \$1M or groceries for a year.	Nationwide COVID-19 incentive program. Comparison with similar commercial-

Program	Date announced	Eligible	Details	Reason for selection
				business-sponsored incentives.
Commonwealth of Kentucky's Shot at a Million [4]	6/4/2021	Adults & adolescents	Residents aged 18+ who receive at least their first dose may enter to win \$1M. Residents aged 12-17 who receive at least their first dose may enter to win full-ride scholarships to any KY state college, university, technical, or trade school.	Comparison with similar state-wide lottery incentives.

Appendix B Differences between coincidence, correlation, and causation

Ideally, an impact analysis such as this team has conducted relies on a direct link between an intervention (e.g., an incentive program) and the desired effect (e.g., increase in daily vaccinations). The best situation is one where the intervention is the only change in the environment before a measured change in the outcome is observed. Such a situation allows us to say that the intervention caused the change.

Assignment of causation is a statement that a sequence of events (e.g., intervention is followed by outcome) would reliably repeat under the same conditions in the future. The intervention is considered a necessary condition for the outcome to occur in a given environment. However, determination of causation almost never happens cleanly in the real world of social activities. The complexity of human behavior, new external influences, and variability in the environment inevitably lead to some level of change in the measured outcome.

Assigning causation then becomes, at best, assigning probable causation when events are close in time to each other. Vaccination rates, like so many other human activities, change with the day of the week, the weather, and a score of other factors that can interfere with assigning even probable causation. And, in fact, the statistical techniques that are used in impact analysis look for degrees of correlation, not probable causation. When events are correlated, they usually (but not perfectly) occur together in a discernible pattern. Events of interest may occur together because of another, unobserved event that is the underlying cause for the original events that were under study. Correlation is a weaker statement of association than causation, but it can be used as a proxy for discussing the impact of incentive programs on subsequent vaccination rates.

At some point though, so many factors are at play in the environment that the data will not even support correlation. It might be that the start of an incentive program results in a single day of increased vaccinations. If the increase is not sustained over time or found in other nominally similar locales, it might just be a coincidence.

Sometimes events occur together or in a desired sequence, but without guarantees that they are correlated much less causally related. Uncertain data or small changes in vaccination rates can lead us to label these changes as coincidence.

For impact analysis, it is important to differentiate among coincidence, correlation, and causation. For example, assume an incentive program to enhance vaccine uptake starts on Monday. Fifty additional nurses are hired to dispense vaccine on Monday, and the vaccination rates go up on Tuesday. Did the incentive program bring people to the vaccination site, or was it knowing that wait times would be shorter with the expanded pool of vaccinators? Was there a third, external event such as a news report on increased cases of COVID in the area that increased the vaccination rates and also spurred authorities to sponsor an incentive program (correlation)? Or did people just decide that Tuesday was the day to get vaccinated (coincidence)?

There are no hard and fast rules. Assigning causation, correlation, or coincidence after the analyses are completed is a matter of interpretation and experience—and awareness of the differences among these three types of conclusions.

Appendix C List of COVID-19 incentive programs

Table 5 and Table 6 provide a sample list of COVID-19 incentive programs offered by commercial companies and by individual states. The lists are current as of July 13, 2021. Full lists and updates can be found at:

<https://www.vaccines.gov/incentives.html>

<https://www.nga.org/center/publications/covid-19-vaccine-incentives/>

Table 5. Incentives offered by commercial companies

Company	Incentive
Bright Horizons	Free childcare for 10 million workers at participating organizations to get vaccinated and recuperate — call 833-545-1081 or visit the Bright Horizons website for details
KinderCare	Free childcare to help parents and caregivers both get vaccinated and recuperate — call (866) 337-3105 or visit the KinderCare website for details
Kroger COVID-19 Vaccine Offer	Participants aged 18+ who receive at least one dose at a Kroger Family Company location can enter in weekly drawings for \$1M or groceries for a year.
Krispy Kreme	Free Original Glazed doughnut per day, no purchase required. Qualified guests include anyone who has received at least 1 of the 2 shots of the Moderna or Pfizer COVID-19 Vaccine or 1 shot of the Johnson & Johnson COVID-19 Vaccine.
Learning Care Group	Free childcare to help parents and caregivers both get vaccinated and recuperate — call (833) 459-3557 or visit the Learning Care website for details
YMCA	Free childcare for parents and caregivers during vaccination appointments — contact your local YMCA to confirm availability
Lyft	Free rides to vaccine appointments for some — visit the Lyft website to see if you qualify.
Uber	Free rides to vaccine appointments for some — call (855) 921-0033 to see if you qualify

Table 6. Incentives offered by states

State	Incentive
Alabama	The Talladega Superspeedway is offering people aged 16 and older who choose to be tested and/or vaccinated the thrill of driving their car or truck on the 2.66-mile track. Drivers and their riders will take two laps behind a pace car at highway speed, including the 33-degree-high banks.
Arkansas	<ul style="list-style-type: none"> Executive branch state agency employees who get at least one dose of the COVID-19 vaccine by July 1 will receive a \$100 bonus. Starting May 26, Arkansans who get a COVID-19 vaccination can receive a \$20 Arkansas Game and Fish certificate for fishing/hunting licenses or a \$20 lottery ticket that could win a million dollars.

State	Incentive
California “Vax for the Win”	<ul style="list-style-type: none"> • Ten winners selected on June 15 to win cash prizes of \$1.5 million each. Any Californian aged 12 or over who has had at least one dose of the vaccine will be eligible to win — no entry necessary. If a minor wins, the funds will be put into a savings account until they turn 18.
Colorado “Comeback Cash”	<ul style="list-style-type: none"> • The Colorado Department of Corrections has announced it will provide \$500 to any of its more than 6,000 staff members who get fully vaccinated against the coronavirus. • Colorado Comeback Cash — The Colorado Lottery will conduct a random weekly drawing on behalf of the Colorado Department of Health & Environment to identify one vaccinated Colorado resident each week to win a million-dollar cash prize. All Colorado residents aged 18 and older who have received at least one dose of COVID-19 vaccine, as determined by eligibility rules, are automatically entered into the drawing. • Coloradans aged 12 to 17 can now win \$50,000 toward college tuition or other postsecondary education. Each week for five weeks, five eligible Coloradans will each be selected to win a \$50,000 scholarship. Teens who have received at least one dose of a COVID-19 vaccine may be eligible for the scholarship drawing.
Connecticut	<ul style="list-style-type: none"> • The Connecticut Restaurant Association is partnering with Governor Ned Lamont and the State of Connecticut to launch the #CTDrinksOnUs campaign, where participating Connecticut restaurants will offer complimentary drinks to vaccinated patrons beginning May 19. • #CTSummer OnUs: Residents can enjoy events held across the state and possibly free food in certain restaurants and venues.
Delaware Wins	<ul style="list-style-type: none"> • Delawareans 12 to 17 who receive a vaccine in Delaware will be entered into a raffle for a full scholarship to a Delaware university. • Delawareans 18 and older vaccinated in Delaware between May 25 and June 29 will have the opportunity to win cash prizes. • Other prizes include tickets to Firefly, four-day vacations at destinations in Delaware, a dart pass for a year, and free tolls within the state of Delaware. • All Delawareans who have been vaccinated in Delaware are eligible to win \$302, 000 and two low-number license plates. • Delaware officials are offering to reimburse bars, restaurants, and shops that offer discounts, freebies, or other incentives to customers who get vaccinated.
Guam	<p>If you are fully vaccinated on Guam and live there, you can enter for a chance to win one of six cars, \$10,000 cash, or other great prizes weekly starting on June 16 until Liberation Day (July 21).</p>
Hawaii #HiGotVaccinated	<p>Residents who receive at least one COVID-19 vaccination shot of Moderna or Pfizer or Johnson & Johnson, are eligible to enter from any island/county in Hawaii. Samples of prizes include airline tickets, gift cards, free food, tickets to theme parks, etc.</p>
Idaho	<p>State employees receive 4 hours of paid leave if they have received or choose to receive the vaccine.</p>

State	Incentive
Illinois	Illinois will give out 50,000 free Six Flags tickets to anyone who has been vaccinated through a partnership with Six Flags Great America payment.
Indiana	State health officials announced that anyone who gets vaccinated at specially designated sites will receive a box of Girl Scout cookies along with the shot.
Kentucky “Shot at a Million”	Kentuckians 18 years old and older who have received at least their first dose of a Moderna or Pfizer COVID-19 vaccine, or the one-dose Johnson & Johnson vaccine, may enter to win one of three \$1 million drawings. Kentuckians 12 to 17 years old who have received at least their first dose of the Pfizer COVID-19 vaccine may enter to win one of 15 full scholarships to a Kentucky public college, university, technical, or trade school, which includes tuition, room-and-board, and books.
Louisiana	The Louisiana Department of Health is offering the chance to win \$100,000 every week starting July 9 and a grand prize of \$1,000,000 at the end of the month to all Louisiana residents aged 18+ who have chosen to receive at least one dose of the COVID-19 vaccine. Louisiana residents aged 12-17 who have gotten at least one dose of the vaccine are eligible to win one of nine \$100,000 scholarships.
Maine “Don’t Miss Your Shot”	Vaccinationland Sweepstakes, a statewide COVID-19 vaccination incentive program that will reward one vaccinated winner with \$1 for every person vaccinated in Maine by July 4. Available for those 12 and older. Registration required. The prize is \$883,075 as of June 22.
Maryland “VaxtoWin”	A partnership between the Maryland Lottery and the Maryland Health Department to provide \$2 million in prize money for Marylanders who get vaccinated.
Massachusetts “Mass VaxMillions”	Fully vaccinated residents who are 18 or older will have a chance to win one of the five \$1 million prizes, while those between the ages of 12 and 17 will be eligible to win one of five \$300,000 scholarship grants.
Michigan “Shot to Win”	Residents aged 18 and older who have received one dose of vaccine are eligible to register for a combined total of \$5 million in cash. Incentive announcement made July 1.
Minnesota “Your Shot to Summer”	<ul style="list-style-type: none"> • Your Shot to Summer: Minnesotans who get vaccinated between Memorial Day weekend through June 30 will be eligible to choose a reward from nine different options. The incentives are state park passes, fishing licenses, and tickets to fairs and amusement parks. There is also the possibility to receive a \$25 Visa card. • Cheers to the Vaccine: Minnesotans 21 years of age and older who have received at least one COVID-19 vaccine dose will be eligible for a free or discounted drink at participating establishments starting May 28 through June 30.
Nevada “Vax Nevada Days”	Each week of Vax Nevada Days the Project will conduct random drawings to identify vaccinated Nevada residents as winners of cash, post-secondary education saving plans, state parks annual permits, or fishing licenses (the “Promotion”). Winners will be announced weekly starting July 8, 2021, with the winner of the GRAND PRIZE OF \$1,000,000 announced August 26, 2021. Vaccinated Nevada residents will have nearly 2,000 opportunities to win.

State	Incentive
New Jersey	<ul style="list-style-type: none"> • Shot and a Beer: In partnership with the Brewer’s Guild of New Jersey, the Governor’s Office launched the “Shot and a Beer” program to encourage eligible New Jerseyans aged 21 and over to get vaccinated. Any New Jerseyan who got their first vaccine dose in the month of May and took their vaccination card to a participating brewery received a free beer, courtesy of the participating brewery. This program ended May 31. • Vax and Visit: Beginning May 27 through July 4, the New Jersey Department of Environmental Protection will offer a State Parks Vax Pass – allowing free access to State parks, including Island Beach State Park – good through Dec. 31, 2021.
New York	<ul style="list-style-type: none"> • Governor Andrew Cuomo began a promotion that would provide free tickets to Mets games from May 24 through June 17 and to Yankee games from May 7 through June 6 for newly vaccinated people, along with another promotion that gave residents free weekly subway passes. • Vaccination program that will provide free NYS Lottery scratch-off tickets to individuals 18 and over with a grand prize of \$5 million. • Every person who receives the COVID-19 vaccine, either a first dose or single dose of Johnson & Johnson, anywhere in New York State this week is eligible to receive a free two-day pass to any state park.
New Mexico “Vax 2 the Max Sweepstakes”	<p>Five weekly drawings will award one \$250,000 winner from each of the state’s four public health regions, for a total of \$1 million in cash prizes each week. A grand prize of \$5 million will be awarded at the conclusion of the sweepstakes, in early August, to one winner drawn from the statewide pool of vaccinated New Mexicans who have opted into the sweepstakes.</p>
North Carolina	<p>North Carolinians 18 and over who have received at least one dose of a COVID-19 vaccine will be automatically entered into four drawings for a chance to win a \$1 million cash prize. Youth between the ages of 12 and 17 who have received at least one dose of the COVID-19 vaccine will be automatically entered into four drawings to win \$125,000 towards post-secondary education. The \$125,000 can be used at any post-secondary institution.</p>
Ohio “Vax-a-Million”	<ul style="list-style-type: none"> • Ohioans aged 18 and older will be entered into “Ohio Vax-a-Million,” a weekly drawing with a prize of up to \$1 million. A total of five weekly drawings for each prize will take place, with the first winners being announced May 26. Winners must have received at least one dose of a COVID-19 vaccine by the date of their respective drawing. • Ohioans 17 and under who are eligible to receive a COVID-19 vaccination will be entered into a drawing for a full, four-year scholarship to any of Ohio’s state colleges and universities, including full tuition, room and board, and books. A total of five weekly drawings for a full, four-year scholarship will take place, with the first winner being announced May 26.
Oregon	<p>Oregonians 18 and older will have the chance to win \$1 million or one of 36 prizes of \$10,000 — with one winner in each county in Oregon. Oregonians aged 12 to 17 will have a chance to win one of five \$100,000 Oregon College Savings Plan scholarships. All Oregonians who have</p>

State	Incentive
	received at least one dose of a COVID-19 vaccine by the draw date will be entered to win.
Virgin Islands	In addition to the general vaccination drawing for \$100,000 for 10 weeks open to all residents, the Government of the Virgin Islands will also sponsor a drawing limited to employees who work in the Territory’s Education system and will feature three cash prizes in each district: \$25,000 for 1st place; \$10,000 for 2nd place and \$5,000 for 3rd place.
Washington “Shot of a Lifetime”	The Washington State Lottery will be conducting a giveaway series during the month of June, working with state agencies, technology companies, sports teams, and higher education institutions across the state to offer myriad different prizes to vaccinated individuals.
West Virginia “Do It for Babydog”	<ul style="list-style-type: none"> • The giveaway will include a \$1.588 million grand prize, a \$588,000 second prize, weekly drawings for \$1 million, full scholarships to any West Virginia state college or university, custom-outfitted trucks, weekend vacations at state parks, lifetime hunting and fishing licenses, custom hunting rifles, and custom hunting shotguns. • West Virginians 12 to 17 years of age, who have received at least their first dose of the Pfizer COVID-19 vaccine, may enter for a chance to win one of five, four-year full-ride scholarships, including room-and-board, tuition, and books, to any West Virginia state college or university. • West Virginians 18 years of age and older, who have received at least their first COVID-19 vaccine if receiving the Pfizer or Moderna vaccines or one dose if receiving the Johnson & Johnson vaccine, have a chance to win one of several large prizes.

Appendix D Abbreviations and Acronyms

Term	Definition
ACS	Census Bureau American Community Survey
CDC	Center for Disease Control
CRC	Coronavirus Resource Center
DA	Data Analytics
J&J	Johnson & Johnson/Janssen
KFF	Kaiser Family Foundation
MOoV	Moving Out on Vaccines