An Experiment Evaluating the Impact of Large-Scale, High-Payoff Vaccine Regret Lotteries

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One Sentence Summary
In an experiment with vaccine regret lotteries in Philadelphia, we find limited evidence of impact even when odds are raised.

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Abstract
We present a pre-registered experiment testing the effects of three, high-payoff (up to $50,000) vaccine regret lotteries in Philadelphia. In each drawing, residents of a randomly selected "treatment" zip code received half of the 12 lottery prizes (boosting their chances to 59-98x those of their neighbors). Our quasi-experimental results yield mixed estimates of the benefits of these lotteries for Philadelphia's overall vaccination rate. Our experimental results, however, offer a causal estimate of the limited return on even high-odds vaccine lotteries. Difference-in-difference regressions estimate the first treated zip code experienced an insignificant 11% jump in vaccinations compared to control zip codes. Pooling results from all three, we do not detect significant benefits from treatment, and our 95% confidence interval bounds the benefits at 9%.

Keywords: COVID-19, regret lottery, vaccination, vaccine hesitancy, field experiment, behavioral science, incentives

JEL Codes: D91, C93, I12, I18, Z18

With new COVID-19 variants on the rise, policymakers worldwide are in urgent need of effective strategies to motivate vaccine uptake *(1)*. In the United States, demand for vaccines has dropped precipitously since the late spring *(2)* and the herd immunity target of 70-80% vaccination *(3)* appears increasingly out of reach *(4)*. Other nations are likely to face similar challenges in the coming months or years *(5)*, creating a pressing need for evidence-based strategies to increase COVID-19 vaccination uptake locally, nationally, and globally.

We provide a timely evaluation of an increasingly popular approach for motivating vaccination: a vaccine lottery. In June 2021, we partnered with the City of Philadelphia[1] to launch the "Philly Vax Sweepstakes," which gave away nearly $400,000 in cash prizes to residents. Unlike other vaccine lotteries, we employed a "regret lottery" design -- residents of Philadelphia who were awarded prizes could only claim their prize if they had already received at least one dose of a COVID-19 vaccine. We also built in a novel experiment: three randomly selected zip codes in Philadelphia were given 59 to 98 times higher odds of winning prizes than others, and this feature of the lottery was highlighted in all media communications. Across pre-registered difference-in-differences analyses, we failed to find convincing evidence that this regret lottery meaningfully increased first-dose vaccination rates in either Philadelphia County (compared to adjacent counties or Pittsburgh's Allegheny County) or in the three randomly selected treatment zip codes (compared to other treatment-eligible zip codes). However, our experiment enabled us to precisely bound the expected benefits of geographically targeting incentives with elevated odds, which may help policymakers as they weigh implementing vaccine lotteries against other strategies to increase vaccination uptake.

[1] The geographic bounds of the City of Philadelphia and Philadelphia County are identical.

Vaccine lotteries build on past research and core insights from behavioral economics. Past experiments -- albeit with far smaller rewards and populations -- indicate lottery incentives can effectively change other types of health decisions *(6-8)*. Lotteries can be more cost-effective than direct payments because individuals tend to overweight small probabilities *(9-11)*, which leads them to overvalue their long odds of winning a lottery *(12)*.

Between May and July 2021, at least 17 U.S. states launched vaccine lotteries -- 14 with seven figure jackpots, and 3 with six figure cash prizes *(13)*. The first to launch was Ohio's Vax-A-Million program. While celebrated as a "resounding success" by Ohio State Governor Mike DeWine *(14)*, recent empirical evaluations are less conclusive. Specifically, four teams of researchers *(15-18)* concurrently led early investigations into the efficacy of the Ohio Vax-A-Million program, comparing it to various "control" combinations of other states. Two studies estimated that the lottery led to tens of thousands more vaccinations across the state *(16, 18)*, while two others concluded that the program did not produce any significant increase in vaccinations *(15, 17)*. These conflicting findings stem from the necessity of including comparisons to other states whose COVID-19 policies and underlying trends in vaccination differ, as well as the absence of design components within the lottery itself which might enable more robust causal evaluation.

Beyond Ohio, journalists are reporting mixed results from other state-run lotteries *(19)*. With organizations and governments worldwide looking for effective strategies to promote COVID-19 vaccination, there is an urgent need for more conclusive guidance. In this paper, we examine (1) whether lottery incentives designed using behavioral science insights can increase the rate of COVID-19 vaccination in a large urban center, and (2) how well these lottery incentives work when they are concentrated towards highly localized geographies.

We included a twist on standard lotteries in the Philly Vax Sweepstakes by adding a chance for regret, which behavioral scientists have found to be particularly motivating. Specifically, our "regret lottery" capitalizes on people's general desire to avoid losses to a greater degree than seeking equivalent gains *(12)* and to avoid anticipated regret *(20-25)*. In a regret lottery, everyone is eligible to win, but winners can only claim their prize if they have completed the target behavior. Theoretically, the anticipatory regret of missing out provides additional motivation to complete the target behavior beyond the expected value of the lottery prize itself. Alone and in combination with other strategies, regret lotteries have been used to successfully motivate a variety of health behaviors, including weight loss *(26)*, physical activity *(27-28)*, adherence to medical treatments or protocols *(29-31)*, and completion of surveys or assessments *(32-33)*. But the scale of these studies is often small (median N=209, max N=6,228) *(34)*.

We rigorously evaluate what happens when regret lotteries are deployed at scale to encourage COVID-19 vaccination with prizes that are an order of magnitude larger than those studied by past researchers in controlled settings.[2]

METHODS

Sweepstakes Design and Implementation

To assess whether regret lotteries can increase COVID-19 vaccination rates and whether narrow geographic targeting of incentives improves lottery efficacy, we analyzed the impact of the Philly Vax Sweepstakes on weekly first-dose vaccination rates in collaboration with the City of Philadelphia. The sweepstakes consisted of a series of three, high-payoff regret lotteries for

[2] While many states are holding vaccine lotteries, they are not leveraging a regret lottery design; names are drawn from databases of vaccinated residents, so there is by definition no anticipatory regret of having to decline a jackpot due to non-vaccination.

nearly $400,000 in prizes. Drawings were held every two weeks between June 7 and July 19, 2021. In each of the three drawings, 12 prizes were awarded to Philadelphia adults who had received a first dose of their COVID-19 vaccine: six $1,000 prizes, four $5,000 prizes, and two $50,000 "grand prizes".

All adult residents of Philadelphia who received at least one dose of the COVID-19 vaccine were eligible to win a prize in the Philly Vax Sweepstakes. The sweepstakes drawing pool was seeded with the names and contact information for 1,064,805 Philadelphia adults from a purchased commercial database *(35)*. As a safeguard, residents could also actively register for the sweepstakes online at phillyvaxsweeps.com or by phone. Both registration channels were managed by a professional sweepstakes vendor, Universal Promotions, Inc. By the close of the Sweepstakes, 73,865 people had actively registered (see Figure 1 for registration volume and Supplementary Materials for more on how the Sweepstakes was advertised). Winners' names were drawn from a deduplicated database.

Residents whose names were drawn but who had not received their first dose of the COVID-19 vaccine before midnight on the day before the drawing were ineligible to claim a prize. We reached out to each resident whose name was drawn using all available contact information.[3] If proof of first-dose vaccination could not be verified by the jurisdiction in which they received it, a new name was drawn for that prize. By design, this feature of the lottery created the potential for regret.

The Philly Vax Sweepstakes featured an experimental component: three Philadelphia zip codes were randomly selected for "treatment," defined as vastly increased odds of winning the sweepstakes, and seventeen were randomly selected as "controls". Specifically, in each of the

[3] Residents had at least 48 hours to claim their prize after being successfully contacted. If they did not, or if they could not be successfully contacted after all available means were exhausted, a new name was drawn.

three drawings, half of the winners at each prize level came from one zip code that was randomly drawn from the twenty Philadelphia zip codes with the lowest per capita vaccination rates as of May 27, 2021 (11 days before the sweepstakes) *(36)*. The "treatment zip code" was announced two weeks before the drawing in which its residents would have heightened odds of winning prizes, and residents of this zip code enjoyed 59 to 98 times higher chances of winning a prize[4] for that drawing (based on the zip code's population) compared to other Philadelphians. This feature allowed us to evaluate the impact of increasing some Philadelphians' chances of winning, the salience of the regret feature, as well as target lottery resources towards underserved communities.

The Philly Vax Sweepstakes officially launched on Monday, June 7, 2021, with a press conference featuring the Mayor of Philadelphia and the announcement of the first treatment zip code. The sweepstakes was a featured story on at least 5 local news channels *(37-41)* and was a front-page story in the most prominent local newspaper, the *Philadelphia Inquirer (42)*, with over 34 different news outlets publishing original stories at some point during the six-week program (see Supplementary Materials for the full list of news articles). Nearly 30,000 Philadelphia residents actively registered for the sweepstakes on June 7th alone (see Figure 1 for registrations over time and Supplementary Materials for more on how the Sweepstakes was advertised). Every two weeks over the subsequent six weeks a new treatment zip code was randomly selected and announced, with the second announced on Monday, June 21 and the third announced on Tuesday, July 6 (Monday, July 5 was a national holiday). The sweepstakes ended with the third and final drawing on Monday, July 19th.

[4] These odds were calculated based on the adult residential population residing in the treated zip code for each of the three drawings. Residents of the first treated zip code (19126) had 1 in 2,081 odds of winning, or 98 times the chances of residents in other parts of Philadelphia (1 in 203,542). Residents of the second treated zip code (19133) had 1 in 3,304 odds of winning, or 61 times the chances of residents in other parts of Philadelphia (1 in 202,307). Residents of the third treated zip code (19142) had 1 in 3,427 odds of winning, or 59 times the chances of residents in other parts of Philadelphia (1 in 202,184).

Data and Measures

Our primary outcome was the number of first-dose vaccinations of adults ages 18 and older in the county or zip code of interest each week per 100,000 people[5]. We calculated weekly vaccinations per 100,000 people by dividing the total first-dose vaccinations for adults in the geography of interest (zip code or county) for a given week by the total adult population in that region according to the American Community Survey *(43)* and then multiplying by 100,000. First-dose vaccinations included the single-dose Johnson & Johnson vaccine. The number of weekly first-dose vaccinations in each Philadelphia zip code for residents ages 18 and older was provided by the Philadelphia Department of Public Health *(44)* on August 18, 2021. Data on first-dose vaccinations at the county level (Bucks, Delaware, Montgomery, and Philadelphia Counties) were downloaded on August 17, 2021 from the COVID-19 database maintained by the Centers for Disease Control and Prevention *(45)*.[6] See Supplementary Materials for robustness checks of our analyses using alternative data sources.

Analysis

We evaluated the impact of our regret lottery treatment using two sets of difference-in-differences analyses comparing weekly vaccinations per 100,0000 adult residents over time. First, to evaluate the impact of the Philly Vax Sweepstakes on Philadelphia's COVID-19 vaccination rates, we compared the difference in vaccination rates between Philadelphia County

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[5] We focused on individuals who were 18 years old or older when calculating the vaccination rate because individuals had to be at least 18 years old to participate in the Philly Vax Sweepstakes.

[6] These data are published daily in the form of the cumulative totals of adults (those 18 and over) who have received at least one dose (one or two doses of Moderna, one or two doses of Pfizer, or single-dose of J&J) and adults who are fully vaccinated (two doses of Moderna, two doses of Pfizer, or single-dose of J&J). To calculate weekly first-dose COVID-19 vaccinations, we first calculated the number of partially vaccinated individuals (only one dose of Moderna or only one dose of Pfizer) by subtracting the number of fully vaccinated individuals from those with at least one dose. We isolated the number of individuals receiving their first dose of the Moderna or Pfizer vaccine and their single-dose of the J&J vaccine in any designated week by subtracting the number of fully and partially vaccinated individuals on the last day of the prior week from those on the last day of the designated week.

and adjacent counties (Bucks, Delaware, and Montgomery Counties) as well as between Philadelphia County and Pittsburgh's Allegheny County before versus during the sweepstakes. Second, to evaluate the impact of "treating" three zip codes with vastly increased odds of a prize, we compared the difference in vaccination rates between our treatment zip codes and our control zip codes before versus during the two-week period of the sweepstakes when a particular treatment zip code had higher odds of winning.

Prior to implementation, the design for the Philly Vax Sweepstakes was reviewed and approved by the institutional review boards (IRBs) of the University of Pennsylvania and the City of Philadelphia. Our study's analysis plan was pre-registered at osf.io/gxsa4.

RESULTS

Participants

The total population under study included 3,827,656 adults: 1,241,810 adults in Philadelphia County (our treated county) as well as 501,425 adults in Bucks County, 442,201 adults in Delaware County, 652,573 adults in Montgomery County, and 989,647 in Allegheny County (our control counties). Figure 2 shows a map of Philadelphia and its surrounding counties, highlighting the locations of our three treatment zip codes in Philadelphia -- 19126, 19133, and 19142 -- and our seventeen control zip codes. These treatment and control zip codes comprised the twenty Philadelphia zip codes with the lowest per capita vaccination rates as of May 27, 2021. Table 1 provides summary statistics on the demographic composition of residents of these communities as well as the percent of the population with at least one COVID-19 vaccination prior to the start of the Philly Vax Sweepstakes on June 6, 2021.

Effect of the Sweepstakes on Vaccination Rates in Philadelphia vs. Surrounding Counties as Well as Allegheny County

In an attempt to measure the effect of the Philly Vax Sweepstakes on COVID-19 vaccination rates in Philadelphia County, we compared the weekly first-dose vaccinations in Philadelphia County per 100,000 people during the sweepstakes with the weekly first-dose vaccinations in adjacent Pennsylvania counties (Bucks, Delaware, and Montgomery Counties, following (Roberto et al., 2019 *(46)*[7]) and in Pittsburgh's Allegheny County. Because calculating standard errors in difference-in-differences regressions when there is a limited number of clusters poses challenges *(47)*, we begin by visualizing raw weekly vaccination data. As shown in Figure 3, Panels A and B, there was a slight initial uptick in vaccinations in Philadelphia County following the announcement of the Sweepstakes compared to surrounding counties and, for one week (the second week of the Sweepstakes), compared to Pittsburgh's Allegheny County. While these show at most a 50% boost in one atypical week's first-dose vaccinations per 100,000 people (from a baseline of 1,419 per 100,000 people), neither appears sustained. Further, Philadelphia County's vaccination rate was trending upward compared to surrounding counties at the time of the Sweepstakes, so it's likely the Sweepstakes was not wholly responsible for the small initial improvement in Philadelphia's vaccination rate compared to surrounding counties.

In an attempt to statistically model the data visualized in Figure 3, we ran two ordinary least squares (OLS) regressions. Our regressions presented in Table 2 predict weekly first-dose vaccinations of adults per 100,000 by county with fixed effects for each week of the year, an indicator variable equal to 1 for Philadelphia during the six weeks of the sweepstakes (June 7 through July 19, 2021), and fixed effects for each county. Model 1 includes Philadelphia and its

[7] Unlike Roberto et al. (2019), we do not include Baltimore, Maryland as a comparator because Maryland launched its own statewide sweepstakes to motivate COVID-19 vaccination in May 2021.

surrounding counties, and Model 2 includes Philadelphia and Allegheny County. The difference-in-differences literature has emphasized the importance of clustering standard errors at the geographic level *(47)*. However, these standard errors can be biased when the number of clusters is small *(48)*. In fact, our empirical approach is in some ways more akin to an event-study than a traditional difference-in-differences design given the small number of clusters. For event studies, it is common to cluster the standard errors by time to account for correlations across time for the different geographic units. In an attempt to be conservative in how we estimate standard errors, we run each model three times and report the maximum standard errors produced when clustering by week, clustering by region (county in this case), and using simple robust standard errors. This approach has been used by other researchers *(49)*.

As shown in Table 2, over the course of the six-week sweepstakes, Model 1 estimates that the first-dose weekly vaccination rate in Philadelphia county rose by a marginally significant 383 extra vaccinations per 100,000 people compared to the adjacent counties of Bucks, Delaware, and Montgomery (95% CI: [-52; 819], p=0.080) while Model 2 estimates that the first-dose weekly vaccination rate in Philadelphia county fell by an insignificant 116 vaccinations per 100,000 people compared to Allegheny County (95% CI: [-899; 667], p=0.756). These estimates suggest, respectively, a 27% increase or a 8% decrease relative to Philadelphia's pre-sweepstakes first-dose vaccination rate -- estimates that are so different as to be generally uninformative. Further, Figure 3, Panels A and B suggests a parallel trends violation of the analysis from Model 1, which means estimates from this model are likely biased upwards.

Effect of the Sweepstakes on Treatment Zip Codes vs. Control Zip Codes

Our experiment within the Philly Vax Sweepstakes allows for a much more precise assessment of the impact on vaccination rates for our randomly selected treatment zip codes (where residents had increased odds of winning the vaccine lottery). To evaluate this, we conducted a similar set of analyses at the zip code level. We compared the difference in weekly first-dose vaccinations per 100,000 people in each of our three treatment zip codes and in each of our 17 control zip codes, before versus during the two weeks leading up to a drawing when treatment zip code residents had vastly elevated odds of winning (73 times higher than their neighbors in other zip codes, on average). Again, we begin by visualizing raw weekly vaccination data for each of the treatment zip codes during their treatment period. As shown in Figure 4, Panels A and B, there was an initial, albeit unsustained uptick in vaccinations of roughly 40% (from a pre-sweepstakes baseline of 569 per 100,000 people) in the first treatment zip code (19126) following the announcement of the Sweepstakes compared to the control zip codes. However, as shown in Figure 4, Panels C and D, the second treatment zip code (19133) did not experience any such uptick compared to our control zip codes. Neither did the third treatment zip code (19142), as shown in Figure 4, Panels E and F.

To statistically model the data visualized in Figure 4, for each of our three treatment zip codes, we estimated a separate OLS regression predicting weekly first-dose adult vaccinations per 100,000 people in that zip code and all control zip codes. Our predictor variables were zip code fixed effects, week fixed effects, and an indicator variable that took on a value of 1 for the two weeks when Philadelphians in the treatment zip code in question had higher odds of winning a prize. To be conservative, standard errors were calculated using the same method as our county-level analysis. We ran each model with clustered standard errors by zip code, clustered standard errors by week, and robust standard errors and then reported the model with the largest standard errors in Table 3.

Table 3, Models 1-3 report the regression-estimated effects of the treatment on the first, second, and third treatment zip codes, as compared to our 17 control zip codes. Model 1 shows that the first treatment zip code (19126) experienced an insignificant increase of 61 vaccinations per 100,000 residents (or 11%) in the two weeks of the relevant treatment period (the two weeks leading up to a drawing in which residents of this treatment zip code would have 98 times other Philadelphians' chances of winning a prize; 95% CI: [-16; 137], *p*=0.119). The second treatment zip code (19133) experienced an insignificant increase of 19 vaccinations per 100,000 people in the two weeks of the relevant treatment period (the two weeks leading up to the drawing in which its residents would have 61 times other Philadelphians' chances to win; 95% CI: [-85; 123], *p*=0.705). Finally, the third treatment zip code (19142) experienced an insignificant decrease of 102 vaccinations per 100,000 people during its two week treatment period (the two weeks leading up to a drawing in which residents of this treatment zip code would have 59 times other Philadelphians' chances of winning a prize; 95% CI: [-244; 41], *p*=0.148).

In Table 3, Model 4 we present a prespecified pooled model assessing the combined effect of all three treatment periods on all three treatment zip codes. The pooled vaccination rate in treatment zip codes in the two weeks following the announcement of their elevated chances to win declined by an insignificant 4 vaccinations per 100,000 people compared to control zip codes during the same time period (95% CI: [-99; 92], *p* = 0.936).

DISCUSSION

Overall, the findings from our experiment suggest that regret lotteries may not be a reliably effective tool for policymakers hoping to encourage vaccination at this phase of a population-wide vaccine roll-out. At the start of our Sweepstakes on June 7, 2021, 64% of Philadelphians who were 18 years of age and over and 33% of those residing in our three treatment zip codes had received one dose of a COVID-19 vaccine *(36)*. We find that the chance of winning up to $50,000, even when elevated relative to that of other residents, was not enough to robustly change unvaccinated Philadelphians' vaccination decisions.

Much like recent evaluations of the Ohio vaccine lottery, our quasi-experimental results at the county level are challenging to clearly and causally interpret. Our imprecisely estimated difference-in-differences regression results suggest that weekly first-dose adult vaccinations in Philadelphia County rose by 383 per 100,000 people or 27% compared to adjacent counties (Bucks, Delaware, and Montgomery Counties) during the Philly Vax Sweepstakes, but fell by 116 vaccines per 100,000 people or 8% compared to Pittsburgh's Allegheny County. Taking these estimates together and given that Philadelphia vaccination rates were already climbing relative to surrounding counties and Allegheny County prior to the start of the Sweepstakes, evidence for a strong jump in vaccinations caused by the Sweepstakes is equivocal.

However, our zip code level experiment provides a more precise and informative set of results. On average, treated zip codes experienced no increase in weekly first-dose adult vaccinations compared to our control zip codes. According to the 95% confidence interval from our regression estimating the impact of giving residents of these treated zip codes an average of 73 times the chances of other Philadelphians of winning prizes in a given drawing (or a 1 in 2,791 chance of winning compared to a 1 in 202,675 chance; see Table 4), we project that "treating" a zip code generated at most an increase of 92 weekly vaccinations per 100,000 people, or a 9% boost (95% CI: [-99; 92]). Looking at each of the treated zip codes separately, we see that the first treated zip code saw a small, insignificant 11% jump in vaccinations (perhaps because it drew the most media attention of the drawings, see Supplementary

Materials), but when pooling our data across treated zip codes, we do not detect any such positive change. Overall, providing far greater lottery odds did not seem to be able to produce meaningful, consistent, and sustained increases in vaccination behavior during the treatment period.

This study builds on past research by evaluating a series of regret lotteries at a uniquely large scale, encompassing the entire adult population of Philadelphia. Although we included over 7,000 times as many participants as typical in past studies of the impact of regret lotteries on health behavior change, we do not find robust benefits *(26-33)*. However, a major difference between our studies and past research was likely the degree to which regret lottery participants were aware of the incentives involved.[8] Further, focusing lottery incentives on only those who had not yet made a vaccination decision might have increased their potency (albeit raising valid fairness concerns).

Our study presents a unique evaluation of the benefits of geographically targeting COVID-19 vaccine lotteries. Our sweepstakes employed an experimental design, which gave us the opportunity to causally evaluate the benefits of concentrating rewards in undervaccinated "treatment" zip codes. To our knowledge, no other vaccine lottery has incorporated experimentation of any kind, and it made a very precise estimate of the null effect of geographic targeting possible. Though we focused on the undervaccinated in selecting our 20 treatment-eligible zip codes, we likely underestimated the reasons many had not been vaccinated and what would genuinely encourage them to be vaccinated. Our results suggest that their reasons required more than a financial reward to be persuaded towards vaccination. Input from trusted leaders in the treatment zip codes may have proven beneficial in informing these communities of the

[8] This might have been alleviated had actual, physical lottery tickets been handed out to all citizens.

sweepstakes, understanding their reluctance around vaccines, as well as increasing vaccination rates, while contributing to efforts to mitigate the impact of the pandemic.

Our study has several other limitations worth noting. First, our sample (Philadelphia residents) is not representative of the broader U.S. population, let alone the global population. Second, we cannot directly compare how well regret lotteries perform relative to other policy tools, nor can our results rule out the possibility that regret lotteries with substantially larger jackpots might have had more robust, positive effects. Similarly, we cannot rule out the possibility that enhanced local marketing or coordination with community health organizations could have improved the results of our regret lotteries. We also cannot compare how well regret lotteries would have worked earlier in the vaccine rollout, when individuals' motivations may have differed; in line with this, recent work by Rabb et al. (2021) *(50)* suggests that text reminders to get a COVID-19 vaccine may have been less potent in later stages of the vaccine rollout than they were at earlier stages *(51)*. Finally, we cannot control for the potential that larger, state-wide jackpots across the nation may have created a reference point that psychologically diminished the impact of our smaller jackpot.

Despite its limitations, this pre-registered analysis of an experimental city-wide lottery helps highlight the limitations of locally-targeted lotteries: giving residents of certain zip codes vastly higher chances than their neighbors of winning did not meaningfully alter their vaccination decisions, and we can estimate a fairly tight 9% upper bound on the benefits of such treatments. We add to a growing literature on vaccine lotteries, with implications for policymakers seeking behavior change at scale whether in the context of COVID-19 or other health-promoting activities. As the COVID-19 pandemic continues to evolve in the U.S. and globally, we hope that demonstrating the limited effectiveness of our three, zip-code targeted vaccine regret lotteries will encourage policymakers to look for other, more impactful ways to encourage vaccination.

DATA AVAILABILITY

All data and analysis scripts have been deposited in the Open Science Framework (https://osf.io/gxsa4/).

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FIGURES

Fig. 1. Daily manual registrations for the Philly Vax Sweepstakes at phillyvaxsweeps.com during the six weeks following its initial announcement (on June 7, 2021) and up until and including the day before the final drawing (on July 19, 2021).

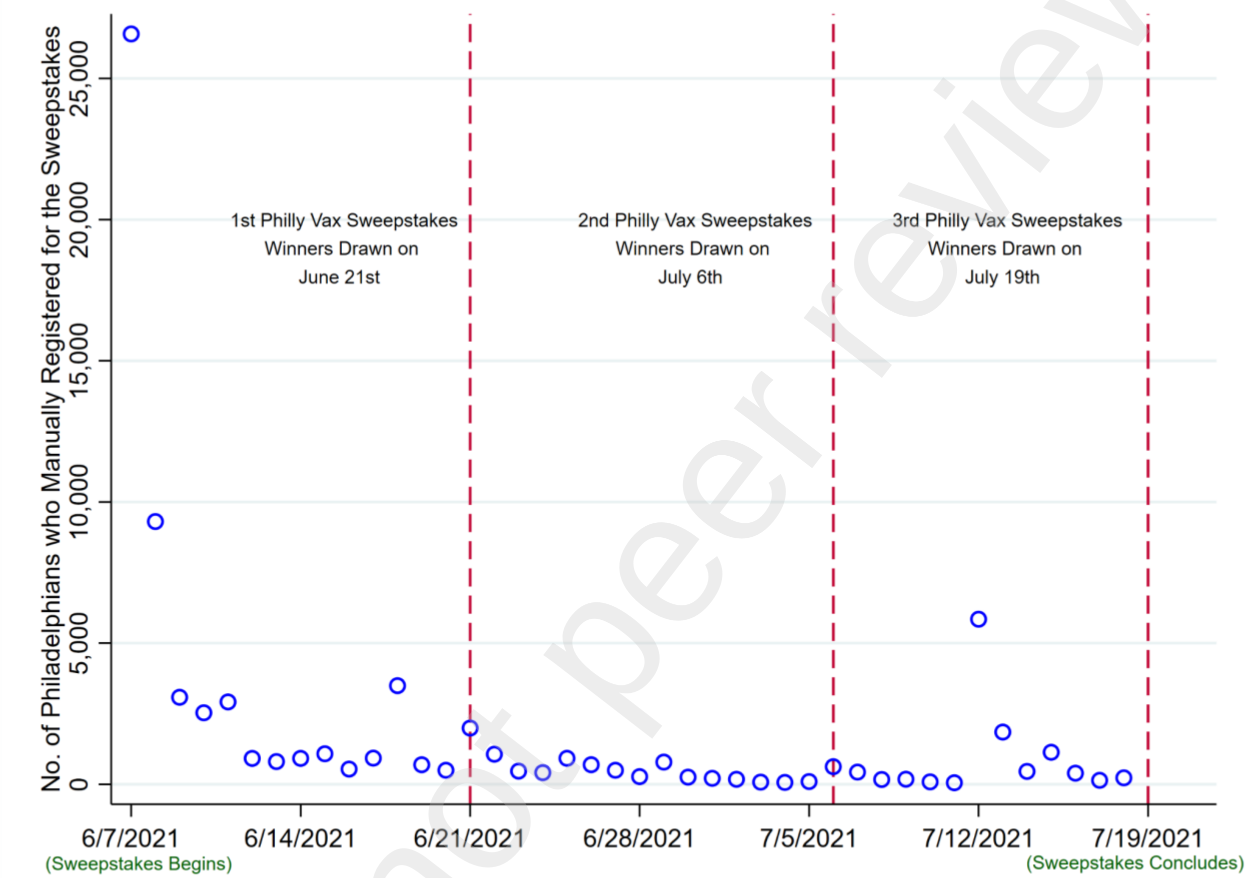


Fig. 2. Map showing Philadelphia County (where the Philly Vax Sweepstakes occurred) in green and border counties in Pennsylvania (Bucks, Delaware, and Montgomery) that were used as controls in our analysis in red. Treatment zip codes within Philadelphia are shown in dark green, control zip codes are shown in medium green, and all other Philadelphia zip codes are shown in light green.

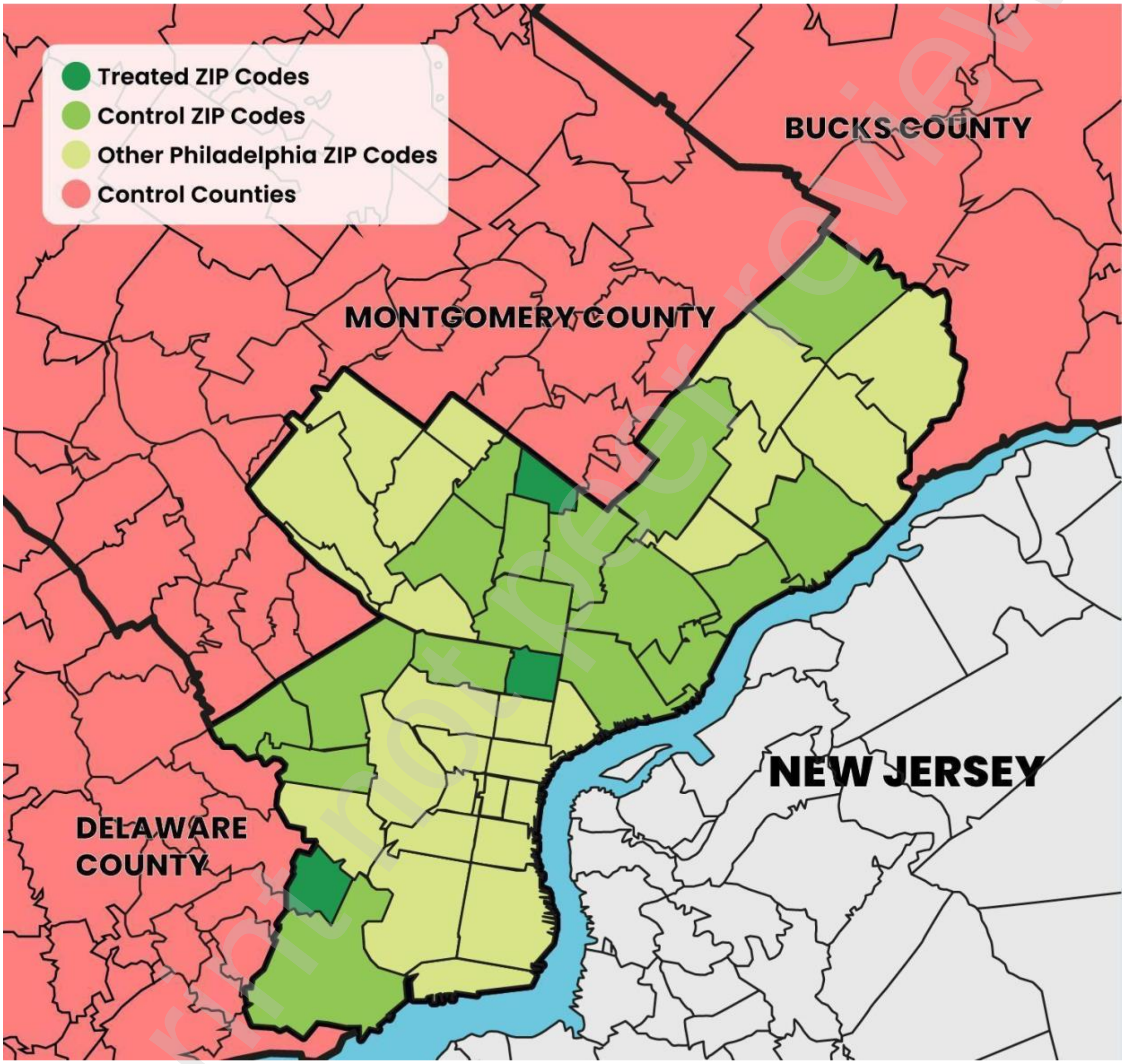
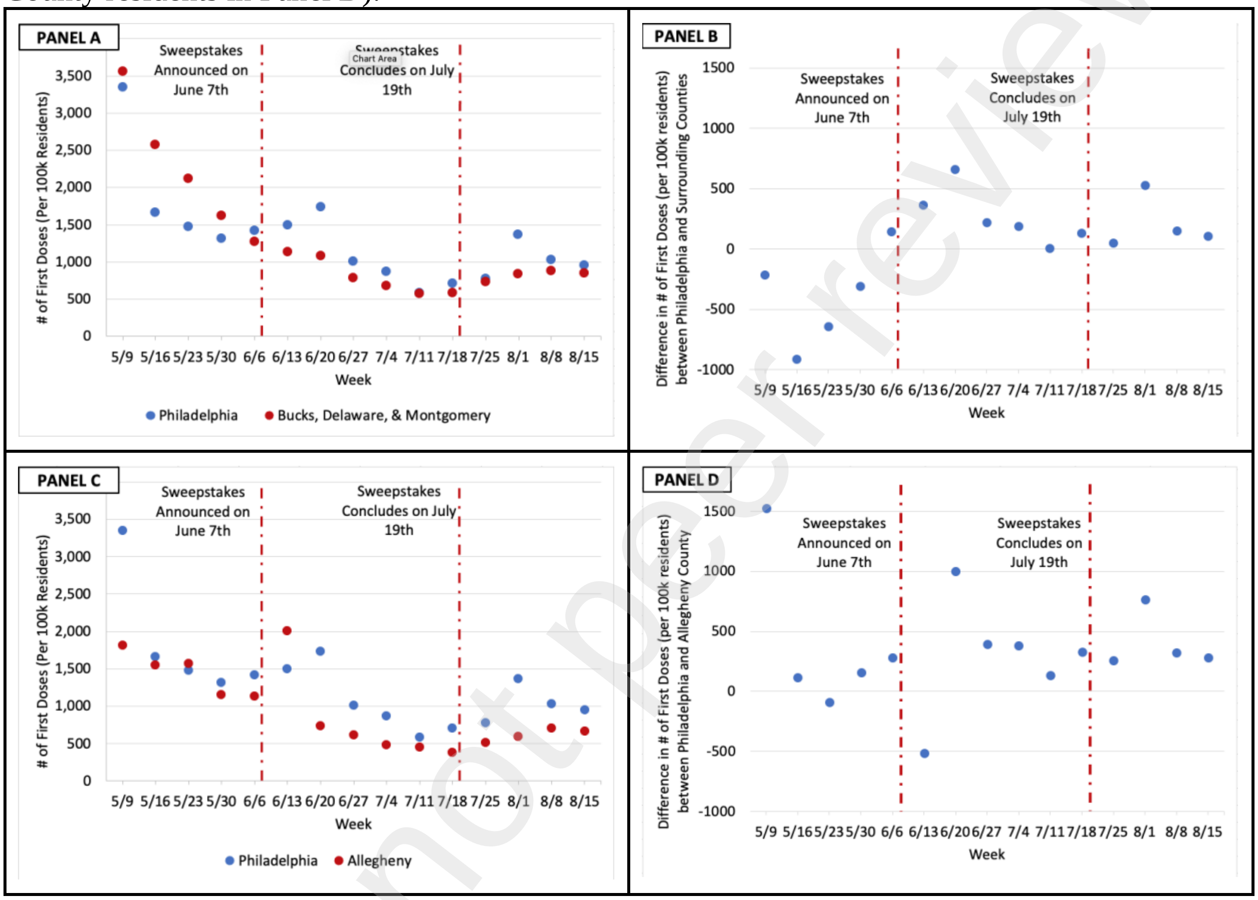
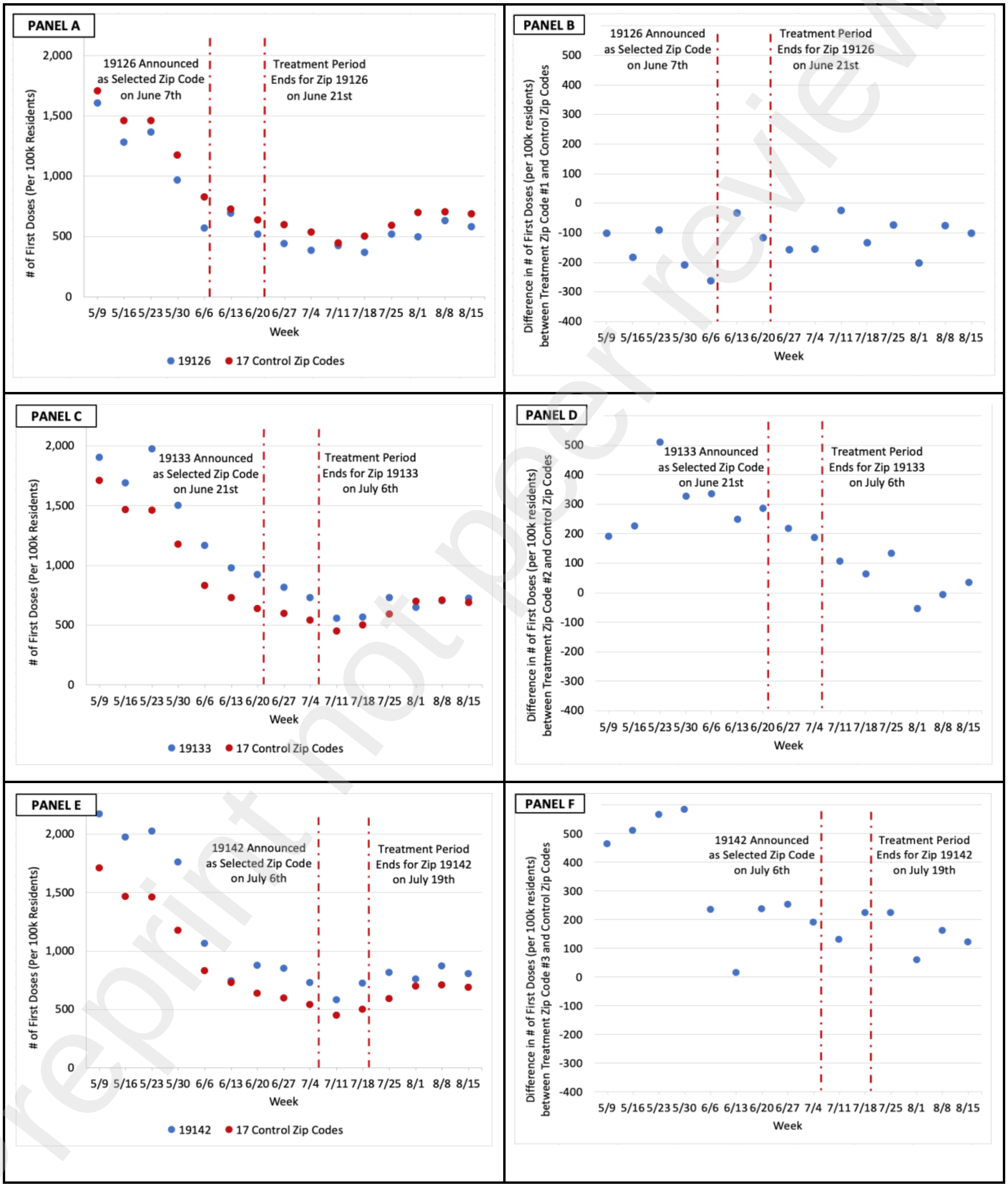


Fig. 3. Panels on the left present the weekly average first-dose vaccinations per 100,000 people for adult Philadelphia County residents versus adult residents of comparison counties (Bucks, Delaware and Montgomery County residents pooled in Panel A, and Allegheny County residents in Panel C). Panels on the right present the difference in weekly first-dose adult vaccinations per 100,000 people between adult Philadelphia County residents and adult residents of comparison counties (Bucks, Delaware and Montgomery County residents pooled in Panel B, and Allegheny County residents in Panel D).



Note. Weekly data is plotted on the last day of a given week (e.g., data for the week 5/31-6/6 is plotted on 6/6).

Fig. 4. Panels on the left present the weekly number of first-dose vaccinations per 100,000 adult Philadelphians in each of the treated zip codes (19126 in Panel A, 19133 in Panel C, and 19142 in Panel E) versus the pooled 17 control zip codes. Panels on the right present the difference in the number of weekly first-dose vaccinations per 100,000 adult Philadelphians between treated and control zip codes (19126 in Panel B, 19133 in Panel D, and 19142 in Panel F).



Note. Weekly data is plotted on the last day of a given week (e.g., data for the week 5/31-6/6 is plotted on 6/6).

TABLES

Table 1. Population Summary Statistics for Counties and Zip Codes of Interest.

	(1) First Doses per 100k People Week of 5/31-6/6/2021	(2) Percent with At Least One Dose as of 6/6/2021	(3) No. of 18+ Residents	(4) % White	(5) % Black	(6) % Asian	(7) % Hispanic	(8) % Over Age 65	(9) Median Household Income
Counties									
Philadelphia County	1,419	64%	1,241,810	34%	40%	8%	15%	14%	$47,474
Allegheny County	1,134	72%	989,647	78%	13%	4%	2%	19%	$64,871
Bucks County	1,272	74%	501,425	83%	4%	5%	6%	19%	$93,767
Delaware County	1,376	76%	442,201	66%	22%	6%	4%	17%	$77,339
Montgomery County	1,185	89%	652,573	75%	9%	8%	5%	18%	$92,302
Bucks, Delaware, & Montgomery	1,265	81%	1,596,199	75%	11%	6%	5%	18%	$87,803
Zip Codes									
Treatment Zip Code #1 (19126)	569	40%	12,485	6%	81%	3%	5%	18%	$44,006
Treatment Zip Code #2 (19133)	1,165	30%	19,824	3%	35%	1%	58%	9%	$20,353
Treatment Zip Code #3 (19142)	1,065	30%	20,565	6%	82%	8%	2%	9%	$33,265
All 3 Treatment Zip Codes	985	33%	52,874	5%	64%	4%	24%	11%	$32,541
All 17 Control Zip Codes	877	34%	534,634	21%	51%	5%	20%	13%	$39,913
All 20 Zip Codes Eligible for Treatment	886	33%	587,508	20%	52%	5%	20%	12%	$38,808

Note. This table reports summary statistics from several data sources. In columns 1 and 2, county-level vaccination data comes from the Centers for Disease Control and Prevention *(45)*; ZIP code-level first dose data was provided by the Philadelphia Department of Public Health as of June 6, 2021 *(44)*; and ZIP code-level "at least one dose" data was downloaded from OpenDataPhilly on May 27, 2021 *(36)*. All county-level vaccination data and the ZIP code-level first dose vaccination data pertains to the 18 and over population. The ZIP code level "at least one dose" vaccination data reflects the total population. Columns 3-9 and all population data come from the 2019 American Community Survey *(52)*. Columns 4-8 reflect the percentages of each respective variable relative to the total population. Column 9 presents the median household income for each unique geography, and the average of those medians where geographies are pooled.

Table 2. Impact of the Philly Vax Sweepstakes on Weekly First-Dose COVID-19 Vaccinations per 100,000 People in Philadelphia County (Compared with Surrounding Counties and Allegheny County).

	Model 1 Week Cluster	**Model 2** Week Cluster
Philly During Treatment Period vs Surrounding Counties	383^{+} (203)	
Philly During Treatment Period vs Allegheny		-116 (365)
Observations	60	30
R-squared	0.94	0.87
No. of clusters	15	15
Weeks Absorbed	15	15

Note. This table reports difference-in-differences models relying on an ordinary least squares regression to predict a county's weekly first-dose COVID-19 vaccinations per 100,000 adult residents. The predictor variables include county fixed effects, week fixed effects, and an indicator that takes on a value of 1 after the Philly Vax Sweepstakes was announced on June 7, 2021, until the Philly Vax Sweepstakes concluded on July 19, 2021, and 0 otherwise. To be conservative, standard errors have been clustered by week (rather than by zip code or robustly estimated without clustering) since this yields the highest standard errors of the three methods. All standard errors are reported in parentheses. +p<0.10; *p<0.05; **p<0.01; ***p<0.001.

Table 3. Impact of Being Selected as a Treatment Zip Code in the Philly Vax Sweepstakes on Weekly First-Dose COVID-19 Vaccinations per 100,000 People.

	Model 1	**Model 2**	**Model 3**	**Model 4**
Treatment Zip Code #1 During Treatment (19126)	61			
	(39)			
Treatment Zip Code #2 During Treatment (19133)		19		
		(48)		
Treatment Zip Code #3 During Treatment (19142)			-102	
			(66)	
Treatment Zip Codes During Treatment (Pooled)				-4
				(45)
Treatment Zip Evaluated	19126	19133	19142	3 Zips Pooled
Observations	270	270	270	300
R-squared	0.93	0.93	0.93	0.93
No. of clusters	0	15	15	15
Weeks Absorbed	15	15	15	15

Note. This table reports a series of difference-in-differences models relying on ordinary least squares regressions to predict a zip code's weekly first-dose COVID-19 vaccinations per 100,000 for adult residents. The predictor variables in each regression include zip code fixed effects, week fixed effects, an indicator that takes on a value of 1 when a treatment zip code of interest was eligible for rewards and 0 otherwise, and an indicator that takes on a value of 1 in the weeks after a treatment zip code of interest was eligible for rewards and 0 otherwise. To be conservative, standard errors have been clustered by week (rather than by zip code or robustly estimated without clustering) for Models 2,3 and 4 since this yields the highest standard errors of the three methods. For Model 1, robust standard errors are reported since this yields the highest standard errors. All standard errors are reported in parentheses. +p<0.10; *p<0.05; **p<0.01; ***p<0.001.

Link to Supplementary Materials: https://bcfg.wharton.upenn.edu/phillyvaxsupplement/