*Protect Chicago Plus*: Evaluation of a City-wide COVID-19 Vaccine Equity Plan

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**Key Points**

Question

To what extent has the *Protect Chicago Plus* citywide vaccine equity plan improved the uptake of COVID-19 vaccine among high COVID-19 vulnerability index communities compared to all other communities in Chicago?

Findings

Communities that rank highest on the COVID-19 vulnerability index (CCVI) have lower COVID-19 vaccination coverage, compared to all other communities in Chicago. The gap between high CCVI communities and all other communities narrowed after the initial implementation of the vaccine equity plan. However, as vaccine eligibility restrictions were lifted in late March, the gap between communities widened- demonstrating the impact and need for vaccine equity strategies.

Meaning

Vaccine equity plans are essential in increasing and maintaining uptake among populations most impacted by COVID-19.

**Abstract**

Importance: COVID-19 vaccination is one of the most effective strategies to control spread and reduce morbidity and mortality; rapid and equitable dissemination is required.

Objective: To determine the impact of *Protect Chicago Plus* on vaccine uptake in communities with a high COVID-19 vulnerability index compared to all other communities.

Design: A retrospective interrupted time series analysis was conducted for a four-month period from December 29, 2020 through May 1, 2021, using publicly available de-identified data.

Setting: Chicago, Illinois, United States.

Participants: All Chicago residents 16 years of age and older were eligible for the three COVID-19 vaccines (Pfizer BioNTech, Moderna, and Johnson & Johnson)

Main outcomes and measures: Vaccine uptake

Results:

Conclusion and Relevance: City-wide implementation strategies can be effective to improve vaccine equity and address health disparities.

Background/introduction

The illness caused by Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-CoV-2), coronavirus disease (COVID-19), was declared a pandemic by the World Health Organization in March 2020.1 In absence of a cure and natural immunity, by May 2021, more than 500,000 Americans had died of COVID-19 and far more had been impacted by the disease.2The distribution of the disease has not been uniform across the American population; rather, the burden of COVID-19 has disproportionately impacted racial and ethnic minorities, demonstrating the effects of longstanding inequities in social determinants of health, neighborhood traits, and underlying comorbidities.3 Racial/ethnic minority populations in urban settings are often employed in service occupations that prevent work-from-home and physical distancing.4 Further, crowding, multi-generational households, older housing stock, and substandard air quality also contribute to the increased rates of COVID-19 among racial/ethnic minority communities.5 Finally, racial/ethnic minority populations experience a disproportionate burden of comorbidities that impact the severity of COVID-19 (e.g., diabetes, cardiovascular disease, asthma, obesity). Identifying characteristics that are associated with increased COVID-19 risk, even if they are not causally related, can assist in prioritizing communities with high need for testing and vaccination to mitigate the continued impact of COVID-19.

The Chicago COVID-19 Community Health Equity dashboard reports that the city of Chicago recorded 244,230 positive COVID-19 cases from March 13, 2020 through May 1, 2021, resulting in 4,984 deaths.6 Despite representing 28.5% and 28.8% of the city’s total population, Black and Latinx populations represented 38.5% and 33.4% of deaths from COVID-19 respectively.6 Two highly effective COVID-19 vaccines were approved for emergency use in the United States in December 2020 and a third was authorized for use in February 2021.7 As COVID-19 vaccination is one of the most effective strategies to control spread and reduce morbidity and mortality, rapid and equitable dissemination is required to address the disproportionate burden of the disease on Black/Latinx populations. Public health officials must strategically prioritize the allocation of vaccine to those most in need, such as those disproportionately impacted by COVID-19.

The Chicago COVID-19 Community Vulnerability Index (CCVI), adapted and modified from the CDC Social Vulnerability Index8, identifies communities that are uniquely vulnerable to adverse COVID-19 impacts using a ranking of ten components (risk factors and COVID-19 burden) that are synthesized into a single community-level composite score. Chicago community areas that received high CCVI scores had the highest mobility during COVID-19, low socioeconomic status, high rates of COVID-19 hospital admission, and high rates of COVID-19 mortality.8 Fifteen community areas in Chicago comprised the top quintile, 7 of which with predominantly Latinx residents and 8 with predominantly Black residents. To reduce further inequities in COVID-19 related outcomes, public health leaders acknowledged the importance of prioritizing communities with the highest burden of disease for equitable and effective vaccine distribution.

On January 25, 2021, Chicago implemented *Protect Chicago Plus (PCP),* a citywide equity plan for vaccine distribution to ensure equitable access for communities experiencing the highest CCVI.9 The plan focused on increasing vaccine uptake in the 15 community areas in the top CCVI quintile by expanding access through hyperlocal community-led vaccination events. PCP leveraged community stakeholders to reduce barriers to vaccination via call-in lines, strike teams, mobile clinics, homebound distribution, and other strategies (e.g., expanded eligibility to include all residents aged 18+) to improve vaccine uptake.

Our study provides an overview of Chicago’s COVID-19 vaccine uptake over a four-month period, with a focus on evaluating whether or not vaccine uptake improved among the city’s most vulnerable populations after the implementation of PCP. Specifically, this study seeks to answer: To what extent has the *Protect Chicago Plus* citywide vaccine equity plan improved the uptake of COVID-19 vaccine among high COVID-19 vulnerability index communities compared to all other communities in Chicago?

Methods

We used publicly available, de-identified datasets in our analysis, including: (1) age, race, ethnicity, and socioeconomic variables from the US Census Bureau’s American Community Survey (ACS), 2015 to 2019 5-year estimates; (2) daily first dose COVID-19 vaccination counts from the City of Chicago’s data portal; and (3) press releases from the City of Chicago, related media reports, and personal communication with municipal public health personnel concerning the geographic scope, roll-out, and overall implementation of the city’s *Protect Chicago Plus* (PCP) vaccination program.

We used a series of chi-square analyses to understand disparities in vaccination rates across communities categorized by dominant race and ethnic group, poverty status, and PCP program status. We created two-way contingency tables to represent daily cumulative first dose COVID-19 vaccination coverage rates for the resident 18 and older population zip code category from December 29, 2020 (two weeks after the first COVID-19 vaccination dose was administered in the city) to May 1, 2021. We categorized zip codes as “yes” and “no,” based on whether they were prioritized in the city’s PCP program.

We then implemented multiple interrupted time series analyses (ITS)10 to assess the impact of the city’s PCP program on different measures of vaccination coverage and disparity, pre- and post-intervention. ITS was the preferred analytic framework because it requires fewer controls, allowing for general inferences to be made about intervention efficacy with respect to two independent variables - time and program start date.

Results

Our chi-square tests indicate a significant association between PCP participation and vaccine uptake throughout the entire study period (p<0.05, although variations in the magnitude of these associations changed over time. In Figure 1, we plotted the standardized residuals from the chi-square tests for PCP and non-PCP zip codes. Values positioned above the horizontal axis (i.e., greater than 0) indicate vaccination rates that are significantly greater than would be expected if the null hypothesis were true, whereas values positioned below the horizontal axis indicate rates that are significantly lower than would be expected. When evaluated collectively, communities that rank highest with respect to CCVI (e.g., PCP zip codes)underperform with respect to COVID-19 vaccination coverage when compared to non-PCP zip codes. This gap narrowed in early February (indicated with dashed black vertical line) – after the initial roll-out of the PCP vaccination program – before widening again in late March, as vaccine eligibility expanded to additional population subgroups.

The ITS results (Figure 2) also suggest that Chicago’s PCP vaccination program effectively reduced disparities between low and high CCVI communities over time. Prior to program implementation, cumulative vaccination rates were climbing over twice as fast among low-CCVI burden communities (0.25 percent per day) compared to high-burden community communities (0.12 percent per day). Whereas after program implementation, residents of both PCP and non-PCP zip codes were vaccinating at similar rates; 0.84 percent and 0.76 percent per day, respectively (p <= 0.01).

Discussion

* *PCP can serve as a national model to improve equity in vaccine distribution, particularly as it relates to government and healthcare systems’ support of community-led efforts*
* *Impact of PCP may be conservative as eligibility/access changed throughout the time period; VEI may be better measure of overall impact*
* *Study period may be too short and variable (e.g., all the eligibility changes + overall expanded access w vaccine supply) to see impact; need to repeat*
* *Lessons learned & Implications for future vaccination roll-out*
* *Barriers exist that are not mitigated by equitable vaccine access:*
  + *Hesitancy, online scheduling systems (vs. walk-ins), centralized locations (vs. community based), language or citizenship barriers, parental consent*

Results should be interpreted in light of the following limitations. First, due to limitations in data availability and accuracy, this study used first dose as an indicator of vaccine status, yet those who do not return for a second dose are not considered fully vaccinated. Therefore, future analyses should consider using fully vaccinated cases. Second limitation... Finally, our analysis focused only on the Chicago, while mirroring demographic characteristics of other large urban jurisdictions, findings may not be generalizable to other settings.

Conclusion

City-wide implementation strategies can be effective to improve vaccine equity and address health disparities. It is important to monitor the impact of vaccine equity strategies to rapidly identify and address any needed modifications as well as to inform future scale up.

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Table 1. Characteristics of Population, COVID-19 Outcomes and Vaccination Activity by Protect Chicago Plus (PCP) Priority, 3/14/2020 through 5/1/2021

|  |  |  |  |
| --- | --- | --- | --- |
|  | Protect Chicago Plus Priority Zip Codes | |  |
|  | **No** | **Yes** | **City of Chicago** |
| *Total zip codes* | 47 | 13 |  |
|  |  |  |  |
| **Population characteristicsa** |  |  |  |
| *Total population* | 1,955,851 | 808,387 | 2,764,238 |
| *18 and older* | 1,589,133 (81.3%) | 596,254 (73.8%) | 2,185,387 (79.1%) |
| *65 and older* | 240,686 (12.3%) | 103,991 (12.9%) | 344,677 (12.5%) |
| *Essential workers* | 381,144 (36.1%) | 193,836 (59.7%) | 574,980 (41.7%) |
|  |  |  |  |
| *Asian, not Latinx* | 164,040 (8.39%) | 14,241 (1.76%) | 178,281 (6.45%) |
| *Black, not Latinx* | 455,820 (23.3%) | 356,834 (44.1%) | 812,654 (29.4%) |
| *White, not Latinx* | 856,503 (43.8%) | 63,723 (7.88%) | 920,226 (33.3%) |
| *Latinx* | 427,528 (21.9%) | 365,082 (45.2%) | 792,610 (28.7%) |
|  |  |  |  |
| *Earning below poverty-level income* | 300,723 (15.8%) | 195,271 (24.3%) | 495,994 (18.3%) |
| *No health insurance* | 156,004 (8.1%) | 108,182 (13.4%) | 264,186 (9.7%) |
|  |  |  |  |
| **COVID-19 burden and vaccinationsb** |  |  |  |
| *COVID-19 cases (per 100K)* | 175,903 (89.9) | 95,462 (118.1) | 271,365 (98.2) |
| *COVID-19 deaths (per 100K)* | 3,308 (1.7) | 1,945 (2.4) | 5,253 (1.9) |
| *COVID-19 tests (per 100K)* | 2,925,814 (149.6) | 861,002 (106.5) | 3,786,816 (137.0) |
| *Positivity rate* | 6.0% | 11.1% | 7.2% |
| *Mean CCVI* | 28.8 | 52.6 | 35.7 |
|  |  |  |  |
| *First COVID-19 vaccine dose* | 924,146 (58.2) | 286,275 (48.0) | 1,210,421 (55.4) |
| *Completed COVID-19 vaccine series* | 650,283 (40.9) | 199,258 (33.4) | 849,541 (38.9) |

*Data sources: (a) US Census Bureau American Community Survey 5-year estimates, 2015-2019; (b) City of Chicago Open Data Portal*

Figure 1. Standardized Residuals of Chi-Square Analyses Comparing Daily Cumulative First Dose COVID-19 Vaccination Counts for Communities Inside (YES) and Outside (NO) PCP Target Area

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Figure 2. Interrupted Time Series (ITS) Analysis of Cumulative First-Dose COVID-19 Vaccination Rates, Pre- and Post-Rollout of the Protect Chicago Plus Program by Community CategoryChart, line chart

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