



# Spatial distribution of COVID-19 infections and vaccinations in Austin, Texas

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April 12, 2021

The University of Texas at Austin  
COVID-19 Modeling Consortium

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## Overview

In this report, we estimate the spatial distribution of SARS-CoV-2 infections and vaccine administration across Austin, TX. We find marked geographic differences in these outcomes. In particular, ZIP codes on the western side of the city tend to have higher vaccine coverage and lower estimated cumulative infections than ZIP codes on the eastern side of the city. These differences mirror disparities in social vulnerability, as measured by the CDC's social vulnerability index (SVI), which tends to be higher in eastern ZIP codes than in western ZIP codes.

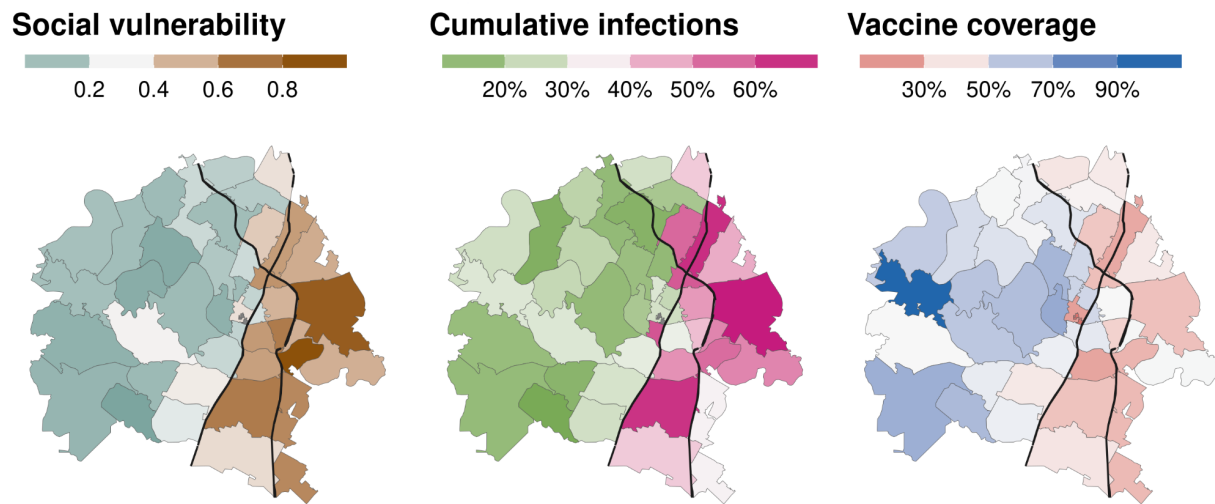
## Estimated SARS-CoV-2 infection rates and vaccine uptake by ZIP code in Austin

Figure 1 maps the spatial distribution of three key estimates across the city of Austin as of early April 2021: (1) social vulnerability, (2) cumulative SARS-CoV-2 infections, and (3) proportion of adults aged 16 and older that have received at least one vaccine dose. There is east-west geographic clustering for each indicator, with ZIP codes on the eastern side generally having a higher social vulnerability index (SVI) [1], higher estimated cumulative infections, and lower estimated rates of vaccine uptake than ZIP codes on the western side of the city.

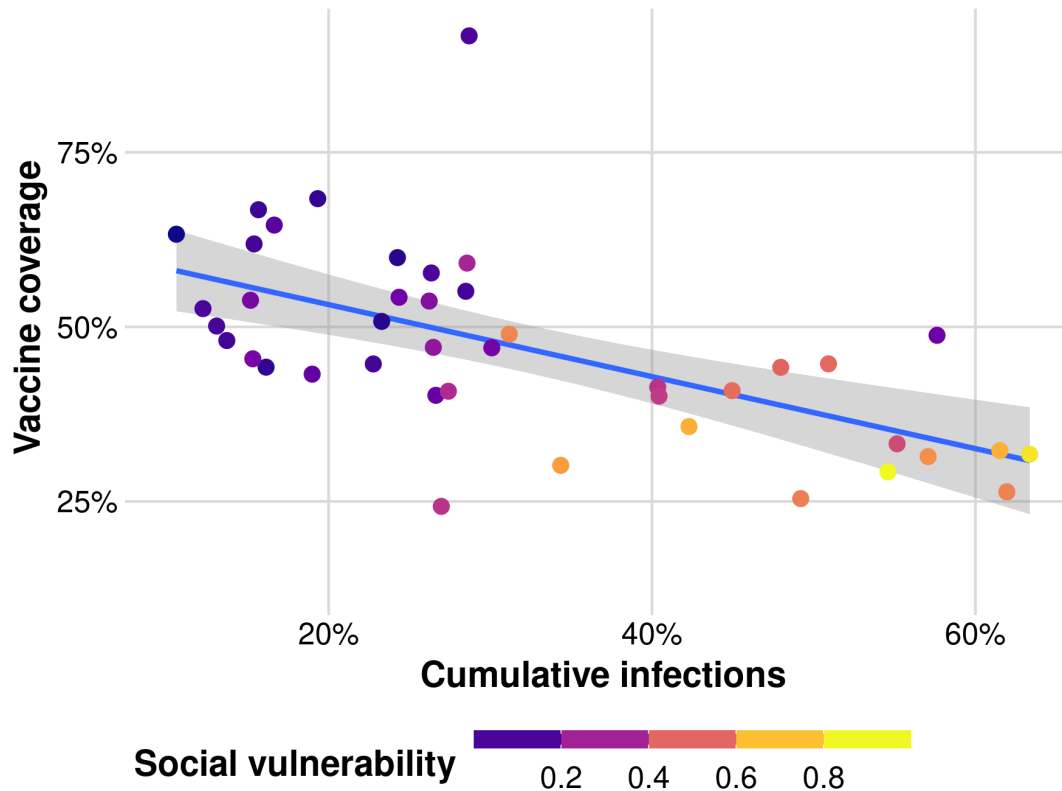
Figure 2 provides a scatter plot showing the correlations between these three variables. Generally, as social vulnerability increases, infection rates increase and vaccination rates decrease. As of the first week of April 2021, a one percent increase in the estimated cumulative infections in a ZIP code is associated with 0.52 percentage point decrease in vaccination coverage in that ZIP code ( $p < 0.001$ ;  $R\text{-sq} = 0.36$ ). Similarly, a

0.01 increase in the SVI a ZIP code is associated with a 0.43 percentage point decrease in vaccination coverage in that ZIP code ( $p < 0.001$ ;  $R\text{-sq} = 0.50$ ).

We also considered the possibility that the estimated disparities in vaccine coverage are simply caused by differences in the proportion of the population over 65 in each ZIP code, rather than general differences in uptake. For this, we conducted a linear regression analysis relating vaccine coverage by ZIP code to three variables: the proportion of the population over 65, the social vulnerability index, and the estimated cumulative infection rate. Even after adjusting for demographics (over 65) and the cumulative infection rate, we found that social vulnerability is significantly associated with lower vaccine coverage. An increase in SVI of 0.01 corresponds to a decrease in vaccine coverage of 0.40 percentage points ( $p = 0.007$ ), compared to 0.43 percentage points when not accounting for demographics.



**Figure 1. Estimated social vulnerability (left), cumulative SARS-CoV-2 infections (middle), and SARS-CoV-2 vaccine coverage (right) for 43 ZIP codes in Austin, Texas.** The CDC's social vulnerability index (SVI) is a measure of poverty, lack of access to transportation, crowded housing and other factors that increase the likelihood of human suffering and economic loss [1]. Cumulative infections is the percentage of the population in each ZIP which has been previously infected by SARS-CoV-2, and is estimated from COVID-19 hospital admissions data through March 29, 2021 [2]. Vaccine coverage is defined as the percentage of the adult population age 16 and older which has received at least one dose of a COVID-19 vaccine as of April 5, 2021 [3]. Black lines represent highways I-35 and US-183. Colors are scaled to reflect values relative to the city average, with white corresponding to the average value across all 43 ZIP codes. There is a marked geographic pattern in all three measures, with eastern ZIP codes tending to have higher social vulnerability, higher infection rates, and lower vaccination coverage.



**Figure 2. Relationship between social vulnerability, cumulative SARS-CoV-2 infections, and vaccine uptake in the 43 ZIP codes of Austin, Texas.** Each point represents a ZIP code. The color of each point indicates the social vulnerability index (SVI; higher is more vulnerable) of the ZIP code, which is a measure of poverty, lack of access to transportation, crowded housing and other factors that increase the likelihood of human suffering and economic loss [1]. Cumulative infections is the percentage of the population in each ZIP which has been previously infected by SARS-CoV-2, and is estimated from COVID-19 hospital admissions data through March 29, 2021 [2]. Vaccine coverage is defined as the percentage of the adult population over age 17 which has received at least one dose of a COVID-19 vaccine as of April 5, 2021 [3]. A one percentage point increase in attack rate is associated with a drop in vaccine coverage of 0.52 percentage points ( $p < 0.001$ ;  $R\text{-sq} = 0.36$ ). Similarly, a 0.01 increase in SVI is associated with a decrease in vaccine coverage of 0.43 percentage points ( $p < 0.001$ ;  $R\text{-sq} = 0.50$ ).

# Limitations

## Vaccination coverage estimates

Vaccination data from Texas DSHS [3] are subject to reporting delays and thus may not be up to date in all ZIP codes. Furthermore, the ZIP code of the vaccine recipient is reported by the vaccine provider to ImmTrac2 and may be inaccurate if the recipient's ZIP code:

- is not provided accurately or at all by the vaccine recipient
- no longer reflects the recipient's residence
- is not entered accurately or at all into ImmTrac2 by the provider

Of the 8.2 million vaccine recipients in the data set, approximately 0.9% have an invalid or unknown ZIP code and approximately 0.6% are outside of Texas. Therefore, our estimates may not fully or accurately represent vaccination coverage throughout the city.

## Cumulative infection estimates

We note several assumptions of our analysis. First, the population composition of each ZIP code is based on 2015-2019 ACS data, which does not account for annual fluctuations in ZIP codes. Fluctuations may occur due to large numbers of university student residents migrating seasonally (78705 for UT Austin) or those who may have relocated permanently during 2020, both influx of new residents and outflux of those displaced. Estimates for ZIP codes have additional uncertainty and should be considered with caution. Second, our estimates for age groups and ZIP codes with small numbers of hospitalizations have a high level of uncertainty. Finally, the case and hospitalization data does not include individuals who were tested or required hospitalization for COVID-19 while traveling outside of Austin or whose addresses were not correctly recorded. For example, people experiencing homelessness or undocumented residents may be less likely to provide addresses. Such omissions would lead to underestimation of the cumulative infections and overestimation of the reporting rates.

# Data and Methods

The CDC social vulnerability index (SVI) was calculated for Texas at the census tract level using the 2014-2018 American Community Survey (ACS) [1]. SVI is a composite of a number of factors which may make a community vulnerable to natural or

human-made disasters, and includes measures of poverty and crowded housing. SVI values are percentile ranks of census tracts within Texas. For example, a census tract with an SVI of 0.6 is more vulnerable than 60% of the census tracts in Texas. SVI was converted to ZIP code level using the percent of residential addresses in each census tract from the 3rd quarter 2020 crosswalk provided by the U.S. Department of Housing and Urban Development (HUD) [4].

For each ZIP code, total infections were estimated from reported age-stratified COVID-19 hospitalizations in the Austin area through March 29, 2021 and the estimated infection hospitalization ratio (IHR) for each age group and ZIP code. To transform these estimates into percents, we divided each by the population size of the ZIP code, according to the 2015-2019 ACS [5]. Children under one year of age were excluded from the analysis. Children ages 1-19 were grouped together, adults 20 or over were grouped into 10 year bins up to age 70. IHRs for each age group were based on estimates from France [6] and then transformed for each ZIP code based on the ratio between the high risk proportion in the ZIP code versus France. Individuals with conditions listed as high risk for severe illness by the CDC were separated into high risk subgroups [7]. For Austin, we estimated the high risk proportion of each ZIP code based on the CDC PLACES dataset [8] and calculated pregnancy rates by following the methodology in the CDC reproductive health report [9]. For France, we used a similar methodology to estimate high risk proportions based on comorbidity data for France [10–13]. The high risk group was assumed to be six times more likely to be hospitalized than the low risk group [14]. A prior report on the spatial burden of COVID-19 infections in the Austin-Round Rock Metropolitan area [2] provides a detailed description of the methods for estimating cumulative infections. However, in this analysis, we grouped age groups across ZIP codes with zero reported hospitalizations to avoid overestimation.

Vaccine administration data are provided daily by the Texas Department of State Health Services, aggregated by residential ZIP code of the vaccine recipient [3]. As of April 2021, the FDA has authorized SARS-CoV-2 vaccines to be used in person at least 18 years old (Moderna; Janssen) or 16 years old (Pfizer). Therefore, we combine vaccine administration data and ZIP code population estimates from the 2015-2019 ACS to estimate adult vaccine coverage, that is, the percentage of the adult population aged 16 and older that has received at least one dose of a SARS-CoV-2 vaccine. Our estimates for vaccine coverage reflect data collected through the end of April 5, 2021.

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