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The COVID-19 pandemic reshaped nearly every aspect of public health in the United States, revealing deep discrepancies in health outcomes across demographic and geographic groups. To better understand the different factors that influenced these outcomes, our project analyzed the COVID-19 data from the City of Philadelphia. Using available datasets on death, hospitalizations, and vaccinations (broken down by age, race, sex, and zip code), we study how population characteristics and other components shape the course of the pandemic.

To investigate the impact of COVID-19 on Philadelphia's population, we focused on analyzing hospitalization across different demographic groups: age, race, and sex. Along with analyzing the relationship between vaccination coverage and hospitalizations by zip code. The goal was to understand how different populations alter the experienced hospitalization, death, and vaccination outcomes.

We started by cleaning and organizing the hospitalization datasets. For age, race, and sex, we filtered the data to include only individuals who were hospitalized due to COVID-19. This allowed us to calculate hospitalization counts by demographic group and ensure comparability across groups. For the geographic analysis, we summarized the hospitalization by zip code and merged data with vaccination counts in the code. This enabled us to examine potential correlations between vaccination coverage (partially vaccinated, fully vaccinated, and boosted) and hospitalization rates at the community level. During this process, we encountered a few challenges such as some datasets using inconsistent column names or containing NA values. This required some revision to ensure that everyone's part was flowing nicely into the other, and that NA were not used such as deaths per week. We solved these by standardizing column names, and dropping missing values when appropriate. Another challenge was aligning vaccination counts across the study period to match the hospitalization data.
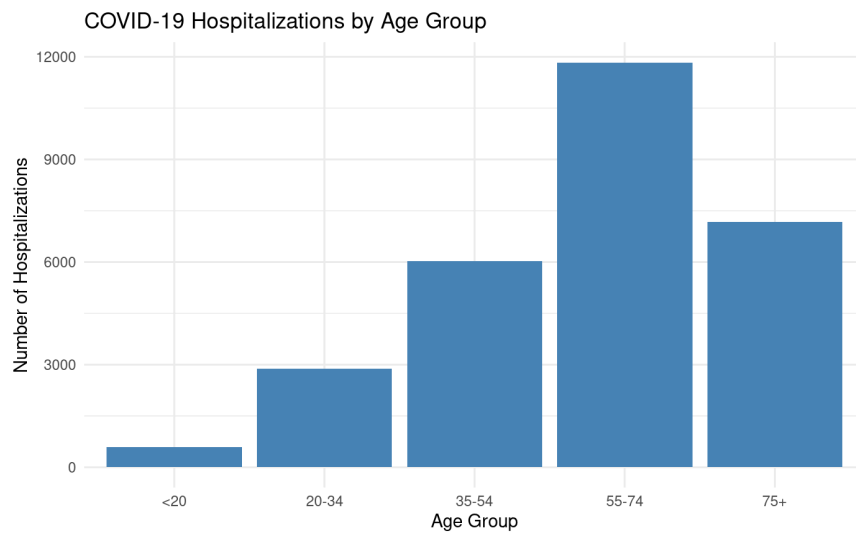
Once the data were cleaned and merged, we generated visualization to illustrate patterns in hospitalizations. These plots include hospitalization or deaths by age, race, sex and borough (ZIPs). As well as a scatterplot comparing hospitalization to vaccination coverage by zip code. These visualizations not only highlight disparities across demographics groups but also show the effects of vaccination during the pandemic. This framework allows the presentation of the results from hospitalization/death trends to analysis of vaccination across Philadelphia.

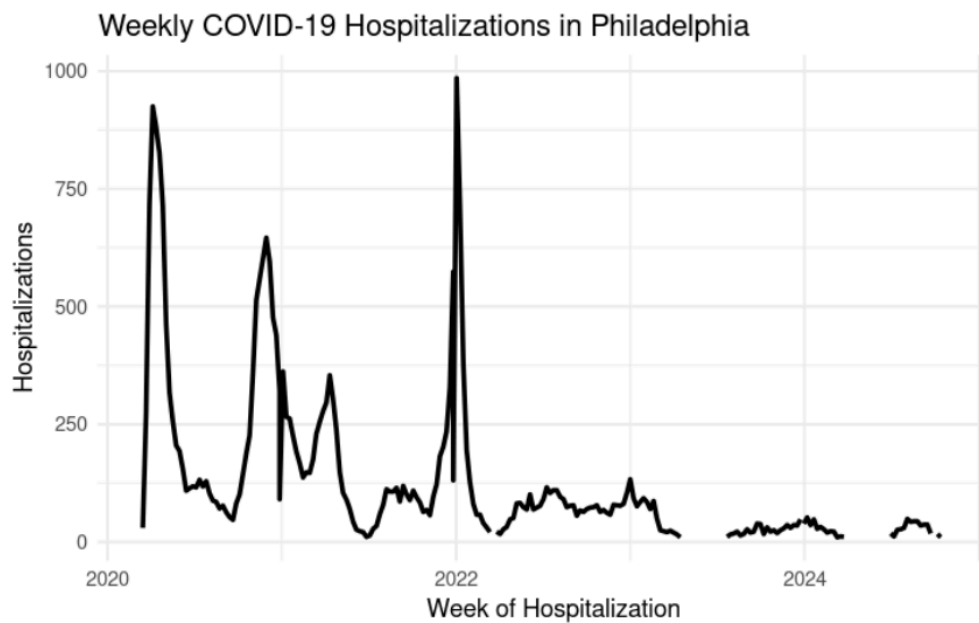| gender <chr>	age <fctr>	count <dbl>	etl_timestamp <S3: POSIXct>	objectid <dbl>
Male	20-34	39	2024-12-09 16:00:01	16650
Male	<20	6	2024-12-09 16:00:01	16651
Male	35-54	303	2024-12-09 16:00:01	16652
Female	20-34	29	2024-12-09 16:00:01	16653
Female	55-74	981	2024-12-09 16:00:01	16654
Female	75+	1514	2024-12-09 16:00:01	16655

This first table shows clear age-related differences in COVID-19 deaths across the male and female populations. Among males, deaths increased sharply with age (35-54 age group showing substantially higher counts). Among females, the pattern is more defined: age groups 55-74 and 75+ account for the largest shares of death. These results align with broader national trends, where severe cases rose significantly with age. The notably high death counts for females also suggest that there are potential differences in longevity, underlying health, or population size in Philadelphia's older female population.

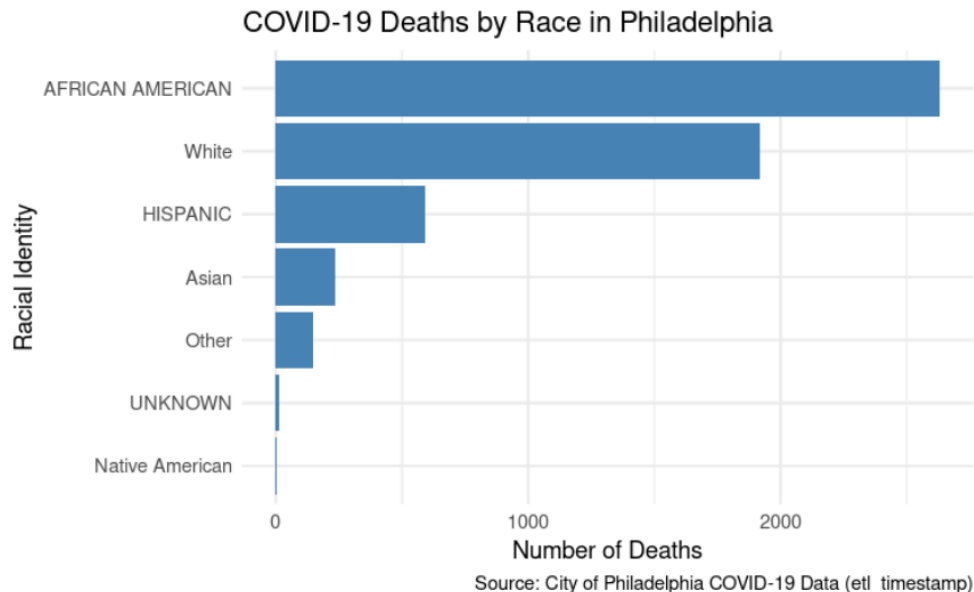| zip_code <chr>	covid_outcome <fctr>	count <dbl>	etl_timestamp <S3: POSIXct>	objectid <dbl>
19107	DIED	29	2024-12-09 16:00:01	26606
19132	DIED	141	2024-12-09 16:00:01	26607
19111	DIED	220	2024-12-09 16:00:01	26608
19115	DIED	297	2024-12-09 16:00:01	26609
19136	DIED	185	2024-12-09 16:00:01	26610
19114	DIED	145	2024-12-09 16:00:01	26611

This table highlights the geographic variation in COVID-19 mortality across Philadelphia zip codes. Several areas (like 19115, 19111, and 19136) show excessive death counts compared to other neighborhoods because they tend to have larger populations of older adults, higher residential density, and/or greater exposure among essential workers (doctors, nurses, caregivers, etc,). The variation among the zip codes also suggest that community-level factors, like housing conditions, access to healthcare, and neighborhood demographics, also play a key role in determining the severity of the pandemic at the local level.

COVID-19 Hospitalizations by Age Group

This graph shows us the number of COVID-19 hospitalizations across different age groups (not to be confused with table 1, the number of deaths in each age group). Hospitalizations appear to have a sharp increase with age, where it starts very low for individuals under 20 and steadily rising. The highest hospitalization count occurs in the 55-74 age group, followed by the 75+ age group. Older age groups tend to have weaker immune systems and preexisting underlying health conditions. This increases the risk of severe COVID-19 illness and requires hospitalization.

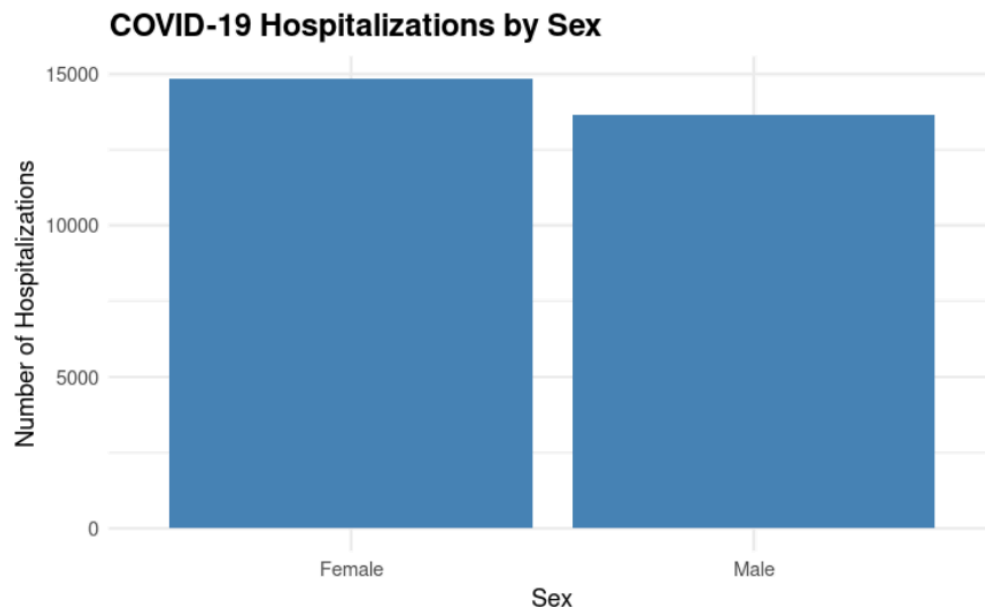Weekly COVID-19 Hospitalizations in Philadelphia

The graph of weekly COVID-19 hospitalizations in Philadelphia helps situate the demographic and geographic findings within the broader timeline of the pandemic. It shows several distinct waves of hospitalizations, with very high peaks in 2020 and early 2021 and an especially large surge in early 2022. After this point, hospitalization numbers decline and remain relatively low through 2023 and 2024, reflecting the combined effects of increased immunity, widespread vaccination, and changes in circulating variants. Viewing these fluctuations over time clarifies how the demographic patterns observed in age, race, and sex, as well as the differences between zip codes, played out during periods of intense transmission. The groups and neighborhoods with higher hospitalization or death counts were likely those most affected during the major waves shown in the graph. By connecting these citywide trends with the more detailed analyses in the report, the visualization highlights how both individual characteristics and community factors shaped the impact of the pandemic across Philadelphia.
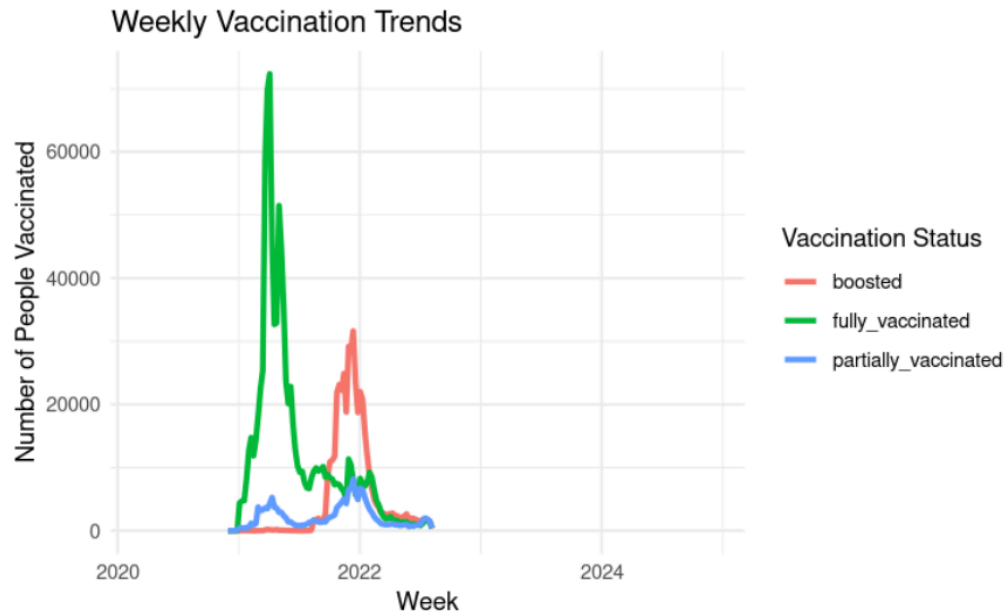

The bar chart displaying COVID-19 deaths by race in Philadelphia highlights clear disparities in how different racial groups experienced the most severe outcomes of the pandemic. African American residents represent the highest number of reported deaths, followed closely by White residents, with Hispanic, Asian, and other racial groups showing considerably lower totals. These differences reflect longstanding inequities in health conditions, access to care, occupational exposure, and housing environments that placed some communities at greater risk. The especially high death count among African American residents aligns with national patterns in which communities of color faced disproportionate vulnerability due to structural barriers and higher rates of chronic health issues. By comparing these racial patterns with the age-, sex-, and zip-code-based findings in the larger analysis, the graph reinforces how COVID-19 outcomes

were shaped not only by individual factors but also by broader social and economic inequalities across Philadelphia.

COVID-19 Hospitalizations by Sex

The graph showcasing COVID-19 hospitalizations by sex in Philadelphia indicates that the number of hospitalizations is almost equal between males and females, with females experiencing slightly higher rates. However, when looking at the data for COVID-19 deaths, a different pattern emerges. National and local data indicate that males tend to have higher death rates than females. This trend may be attributed to a variety of factors, including biological differences, differences in underlying health conditions, and the impact of social determinants of health. Despite the higher hospitalization rates among females, males appear to be more susceptible to the severe effects of the virus, reflecting the complex relationship between gender and COVID-19 outcomes.

Weekly Vaccination Trends

Number of People Vaccinated (y-axis): 0, 20000, 40000, 60000

Week (x-axis): 2020, 2022, 2024

Vaccination Status:
- boosted
- fully_vaccinated
- partially_vaccinated

The graph displaying weekly vaccination trends in Philadelphia reveals significant fluctuations in vaccination efforts throughout the pandemic. The sharp rise in fully vaccinated individuals, represented by the green line, peaked around mid-2021 as the availability of vaccines expanded, followed by a gradual decline as the initial vaccination surge slowed down. The red line, representing booster shots, shows a clear increase starting in late 2021, reflecting the ongoing need for additional doses as immunity waned. Meanwhile, the blue line for partially vaccinated individuals demonstrates a steady rise early on, but this number remained consistently lower than the fully vaccinated and boosted groups, indicating that many individuals who began the vaccination process did not complete it.

In conclusion, the analysis of COVID-19 hospitalizations, deaths, and vaccination trends in Philadelphia reveals a complex and dynamic picture of how different factors, such as age, sex, and vaccination status, influenced the severity and spread of the pandemic. Hospitalizations were relatively evenly distributed between males and females, but males experienced higher death rates, likely due to a combination of biological and social factors. Vaccination efforts, particularly the uptake of booster shots, saw a sharp increase during key points in the pandemic, but disparities in vaccination completion remained. These findings highlight the importance of continued public health efforts to address these inequalities and promote vaccination to prevent further severe outcomes in the future.