COVID-19

One Year Report

March 18, 2021

City of St. Louis Department of Health
1520 Market Street, Suite 4051
St. Louis, MO. 63103

Prepared by:
Neha Sastry, MPH
Binoj Peter, MBBS, MPH
Matt Haslam, MSc

City of St. Louis Department of Health

Vision

St. Louis, an equitable community achieving optimal health for all.

Mission

To assure a healthy St. Louis community through quality public health services and partnerships by providing continuous protection, prevention and promotion for the public's health.

Principles and Values

1. Monitor health status to identify community health problems
2. Diagnose and investigate health problems and health hazards in the community.
3. Inform, educate, and empower people about health issues.
4. Mobilize community partnerships to identify and solve health problems.
5. Develop policies and plans that support individual and community health efforts
6. Enforce laws and regulations that protect health and ensure safety
7. Link people to needed personal health services and assure the provision of health care when otherwise unavailable.
8. Assure a competent public health and personal healthcare workforce.
9. Evaluate effectiveness, accessibility, and quality of personal and population-based health services.
10. Research for new insights and innovative solutions to health problems.

Report Preparation

- This report was prepared by the City of St. Louis Department of Health Bureau of Epidemiology

For additional information, please contact (314) 657-1555 or sastryn@stlouis-mo.gov.

City of St. Louis
COVID-19 One Year Report

Table of Contents

Page

I. Executive Summary

It has been one year to date since the first case of COVID-19 was diagnosed in the City of St. Louis and since then, we have learned, processed, and grieved a great deal. Through this pandemic, we have learned much about the vulnerable populations and regions of our city, and observing well-documented population disparities. As the vaccine roll out begins, it is imperative to examine the trends that got us here, the vulnerable populations most at risk, and how we can use our data to inform our interventions to make them more effective. The aim of this report is to illustrate the trends among COVID-19 cases, testing and fatalities to highlight vulnerable communities and regions of the City to inform further interventions and vaccine dissemination. Data sources include WebSurv, EpiTrax, Hospital Data acquired from SFTP files with local hospital systems (BJC and SSM), and the State of Missouri Secure File Transfer Server.

Case counts have fluctuated throughout the lifetime of the pandemic, gradually increasing for the first three months followed by a decline throughout the month of June. However, towards the end of June, case counts began increasing again and reached its second peak towards the end of July. The third and largest peak of the pandemic, thus far, occurred during November and continued throughout the holiday season. Currently, case counts have decreased to a weekly average of 20 cases per day. Average case counts have not been this low since June of 2020.

Demographic distribution of case counts indicates the most vulnerable populations continue to be African American men and women, and older adults above the age of 50. Case rates among African Americans rose dramatically during the first wave of the pandemic. During the second wave, Asians and African Americans primarily drove the increase in cases. During the third and largest wave, however, Caucasians drove the increase in case counts. While previously those aged 20-39 years old were driving the pandemic, the share of daily cases among these ages had declined, and case rates among those above the age of 50 have recently begun increasing. Fatality data shows the most amount of fatalities among those over the age of 80. Risk ratio analysis shows a clear relationship between age and fatality: as age group increases, fatality secondary to COVID-19 diagnosis increases as well. With rates among those aged 80+ at highest risk of mortality.

Geographic distribution of case counts illustrates that cases have highest distribution among Central West End, South City and Downtown regions. More specifically, during the lifetime of the pandemic, case counts have increased among zip codes 63111, 63118, 63116, and 63109. Case density is highest among neighborhoods Central West End, Carondelet, Bevo Mill, Dutchtown, Holly Hills, and even Downtown. These trends have shifted over time, however currently case density is highest among these specific areas.

Percent positivity has fluctuated in a similar fashion to the pandemic wave trends. As positive case counts increased, percent positivity increased. Since the week of January 2nd, 2021, percent positivity has decreased from a weekly average of 13.2% to 4.8% the week of February 20th, 2021. The last time percent positivity was below 5% was when it reached a low of 4.4% the week of September 12th, 2020. In May 2020, the World Health Organization recommended that percent positivity remain below 5% for at least two weeks before governments consider reopening. While the City as a whole has reopened, a percent positivity below 5% is good indication of decreased disease transmission.

Overall, testing capacity has increased since the beginning of the pandemic. The peak of testing occurred the week of November 14th, 2021 at an average of 1485 tests per day. Since then, testing has decreased. By the last week of February, testing has decreased by 47% to 786 tests per day. The decline in daily tests is tied to the reduction of transmission and low percent positivity. If the percent positivity were to begin increasing once again, testing should likewise increase to ensure sufficient surveillance of disease dynamics. Testing is critical for contact tracing and other public health interventions that interrupt the chain of transmission.

Preliminary vaccination data begins the week of December 14th. Vaccine dose 1 began at 186 vaccine doses and two weeks later, second vaccine doses would also begin, consistent with recommendations for vaccine dissemination. Historically, because of maltreatment, exploitation and lack of access to resources, persons of color have had less faith in institutionalized medicine and this is demonstrated in our vaccination data. Caucasians have higher counts of receiving the vaccine, while African Americans and other races have significantly lower counts. In addition, while older adults are most at risk for fatality following COVID-19 diagnosis, those ages 60-69 and 30-39 are the most vaccinated groups, with greater vaccine adherence among those ages 30-39. Targeted interventions focused on these disparities are crucial to ensure health equity and herd immunity.

Data sources for this report include WebSurv, EpiTrax, Hospital Data is acquired from SFTP files with local hospital systems (BJC and SSM) and much of this data can also be reviewed at www.stlouis-mo.gov/covid-19/.

II. Overall Case Count Trends

a. City of St. Louis COVID-19 Trend Lines

Figure 2.1. COVID-19 Case Incidence in the City of St. Louis,
March 16th, 2020 – March 1st, 2021.

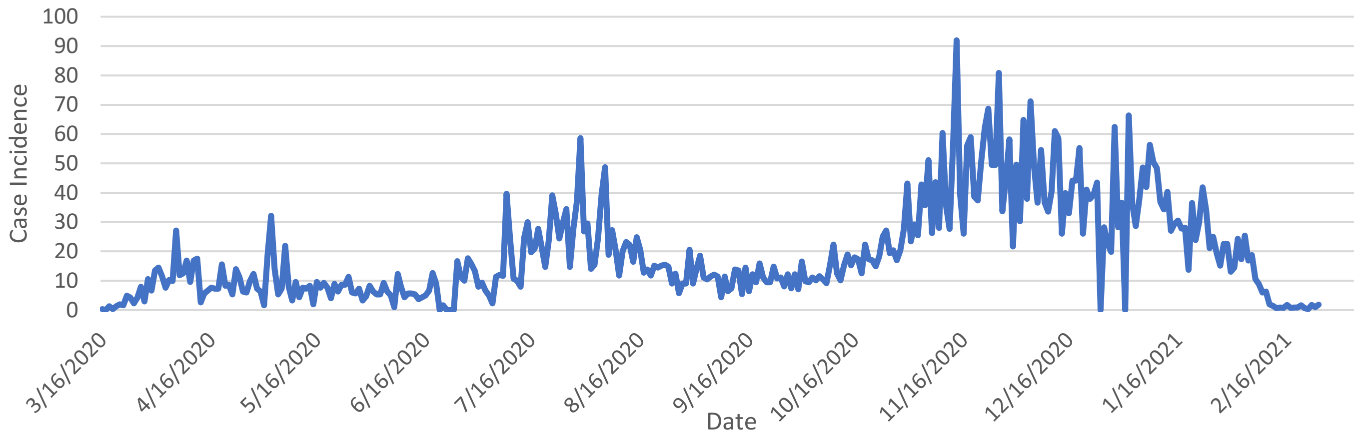
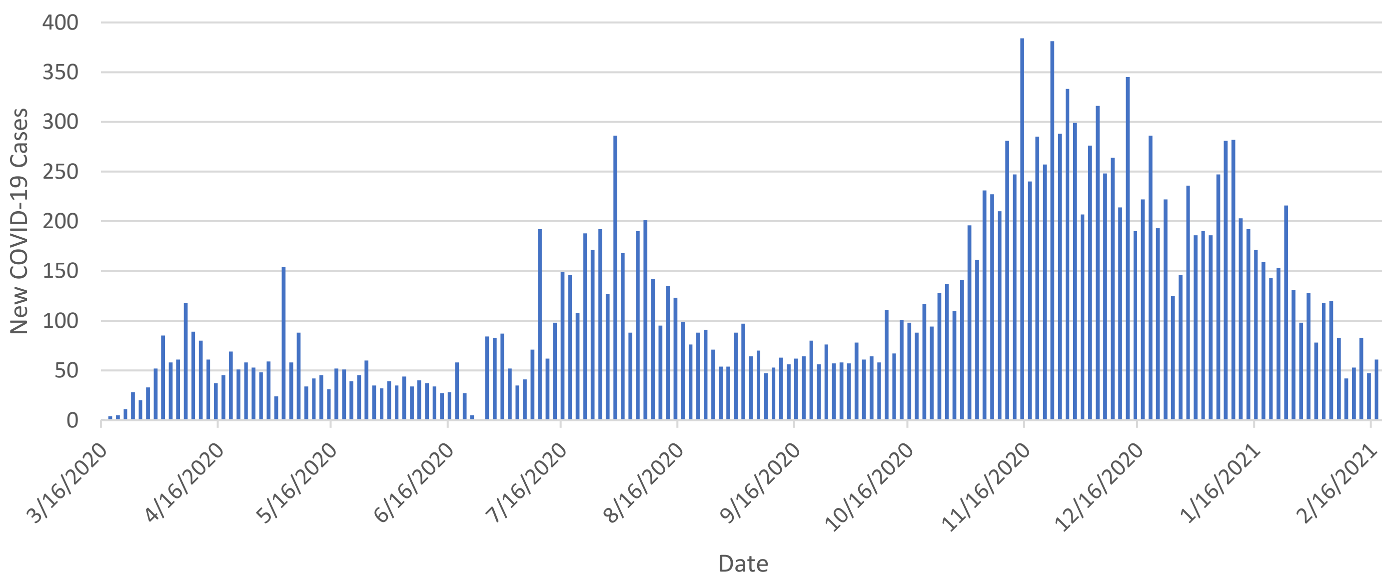


Figure 2.2. COVID-19 Epidemiological Curve of New COVID-19 Cases



The first case of COVID-19 was diagnosed on March 16th, 2020. Since then, case incidence has fluctuated in a similar fashion to the United States overall, with three waves thus far. These three waves are visualized above in Figures 2.1 and 2.2. On March 23rd, the City of St. Louis placed a Stay-at-Home order into place. This would help case counts decline, however when the Stay-at-Home order was lifted June 16th, cases would sharply begin increasing again. This would make up the second wave.

The third wave occurred as schools began opening up and people began traveling for fall and winter holidays. Since then, case counts have decreased, however, with new variants and the improving weather, the risk of transmission is still high. Note: all case data in this report are displayed by specimen collection date, in other words when the individual sought care and was tested for COVID-19. The specimen collection date is the earliest reliable time point available, and is a better reflection of when the person was sick than the date the DOH was notified of the positive test result, which often lags behind by a day or more.

b. Weekly Average Case Trends

Figure 2.3 COVID-19 Seven-Day Average of New Cases,
February 22nd, 2020 – March 1st, 2021

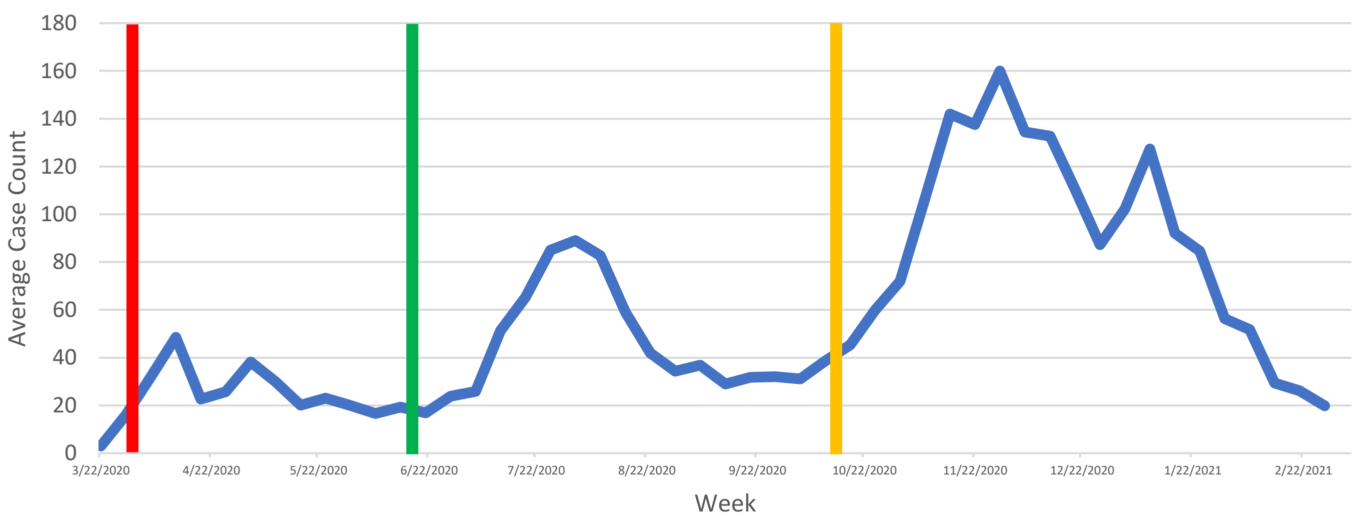


Figure 2.3 tracks weekly average case trends of COVID-19 cases. Examining trends on a weekly basis helps to illustrate overarching trends, as day-to-day is too narrow at times.

On March 23rd, the City of St. Louis put the Stay-at-Home order into place. That following week, the average number of cases per day would reach the first peak of 38 cases and then decline to 17 cases per day the week of June 7th. The following week, June 16th, the Stay-at-Home order was lifted and cases began increasing again. It was following the removal of the Stay-At-Home order, the second wave of COVID-19 cases began. The weekly average of cases per day increased from 17 to a peak of 89 cases per day the week of August 2nd. Cases decreased again, but still stayed above 30 cases per day as schools began reopening. As fall continued, cases remained above an average of 30 cases per day and then began rising again in the beginning of October.

The rise in October would lead to the third wave. By November 29th, average case counts per day would reach the unprecedented peak of 160 cases per day. Average case counts per day would consistently be above 100 until the week of January 10th, 2021. Average case counts per day have decreased since then and have been below 30 since February 14th, 2021.

III. Demographic Distributions

a. By Sex

Figure 3.1. COVID-19 Case Counts by Sex and Case Rate (per 100k)

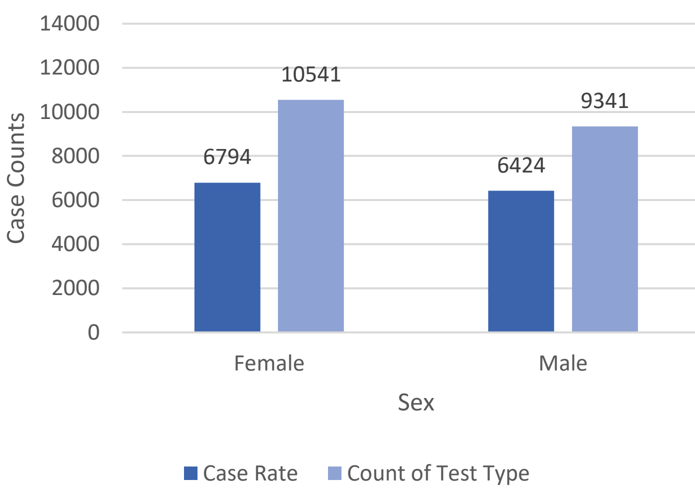
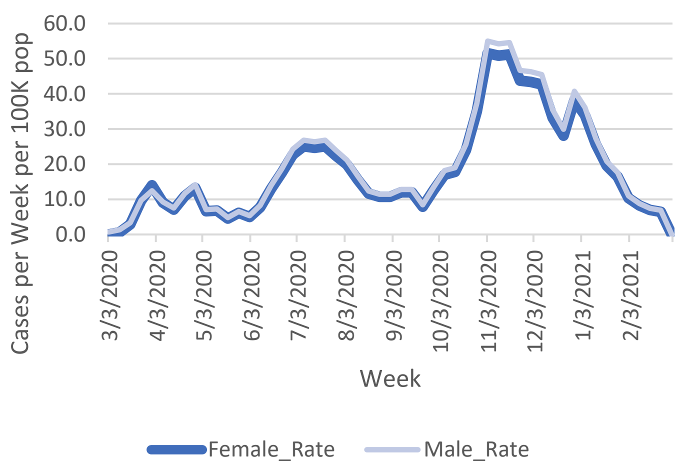


Figure 3.2. Weekly Average Case Rate by Sex (per 100K)



As of March 2021, women make up 53% of COVID-19 cases and men make up 47% of all COVID-19 cases in the City of St. Louis. There are a few reasons that may explain the higher case counts in women; Over 60% of employees entering the healthcare industry are women, and there are simply more women in the City of St. Louis as a whole according to Census estimates.[1].

COVID-19 case trends by sex mirror the overall trend lines of the pandemic. While case counts may be higher among women, when controlling for population size, case rates have been higher among men. There was one exception during the week of March 31st, 2020, where case rates were higher among women.

While the rates among men and women are similar, there have been times where the case rate among men has increased dramatically in comparison with case rate of women. During the third wave of the pandemic beginning the week of October 6th, 2020, case rate differences among men rose to an average of 3.5 more cases per week per 10,000 population or 6% more cases than women. During this time, case rates for both men and women increased to more than an average of 50 cases per week per 100K. Since then, case rates have declined and have consistently been below 10 per 10,000 since the beginning of February.

b. By Race

Figure 3.3. COVID-19 Case Rate by Race (per 100K)

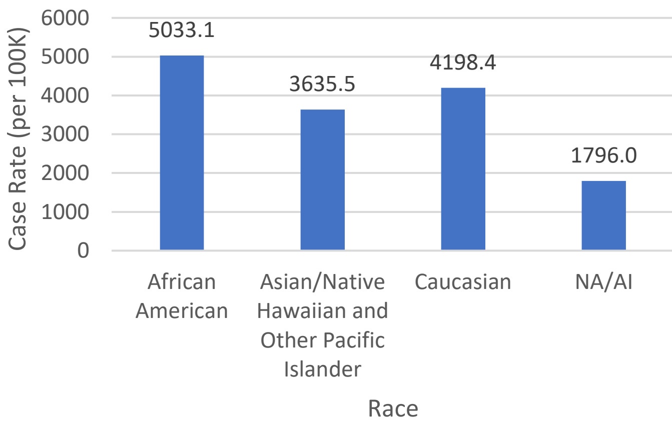


Figure 3.4. COVID-19 Case Rate by Sex and Race

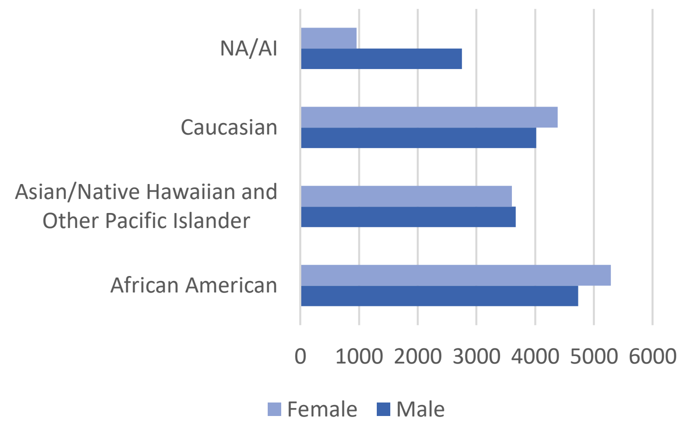
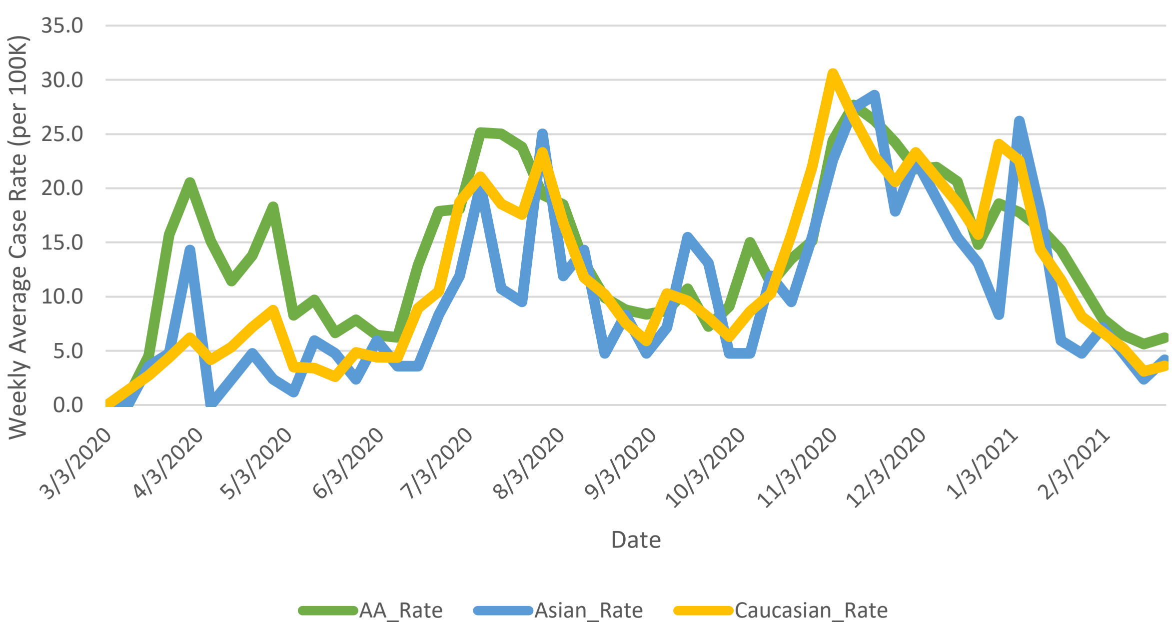


Figure 3.5. COVID-19 Weekly Average Case Rates by Race



Upon initial onset of the pandemic, case rate among African American individuals rose dramatically. Within the first month of the pandemic, the weekly average of daily cases among African Americans increased from 0.7 to 24. Case rates among Asians and Caucasians were not nearly as high. Note: Race and ethnicity data is consistently underreported; the resulting data presented in Figure 3.5 differs slightly from prior reports due to updates for some cases that had previously unknown race or ethnicity.

During the second wave of the pandemic, case rates rose among African Americans, Asians and Caucasians. While data in previous reports showed that case rates among Caucasians rose the most during the second wave, further data collection presents a slightly different picture. Case rates rose among all three races starting from May 26th to a peak during the weeks of July 21st and July 28th. Among African Americans, case rate rose during that time frame from six cases per 100K per day to 25 cases per 100K per day. Among Asians, case rate rose from three cases per 100K per day to a peak of 25 cases per 100K per day. Among Caucasians, case rates rose from four cases per 100K per day to a peak of 23 cases per 100K per day. During this second wave, Asians and African Americans were driving the increase in cases.

During the third wave of the pandemic, cases again rose among all races listed above. While the highest case rates during the third wave were among Caucasians, case rates among African Americans never decreased as low as other races between the second and third wave. Following the second wave, case rates among Asians decreased below five cases per 100K per day and case rates among Caucasians decreased to six cases per 100K per day. Case rates among African Americans decreased only as low as eight cases per 100K per day for the week of September 22nd, 2020, before increasing again. Case rates among Asians began increasing for the third wave during the week of October 6th, 2020 and case rates among Caucasians began increasing during the week of September 29th, 2020. Among African Americans, case rates rose from seven cases per 100K per day to a peak of 28 cases per 100K per day. Among Caucasians, case rates rose from five cases per 100K per day to a peak of 29 cases. Among Asians, case rates rose from seven cases per 100K per day to a peak of 31 cases per 100K per day. During the third wave, Caucasians drove the increase in case counts.

Case Rate by Race and Sex

Figure 3.6. COVID-19 Weekly Average Case Rate by Race (Female) (per 100K)

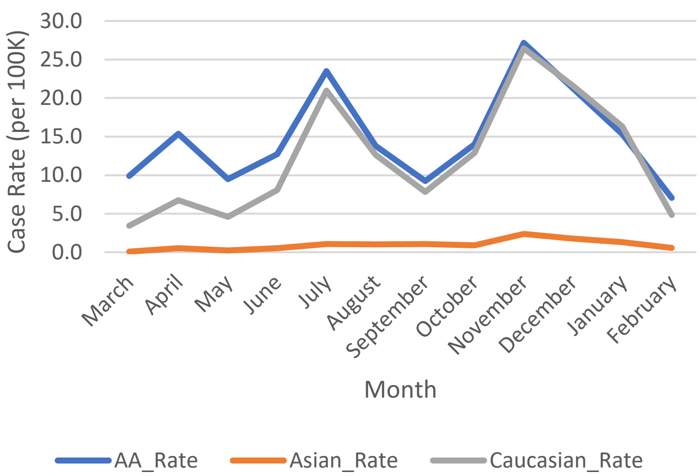
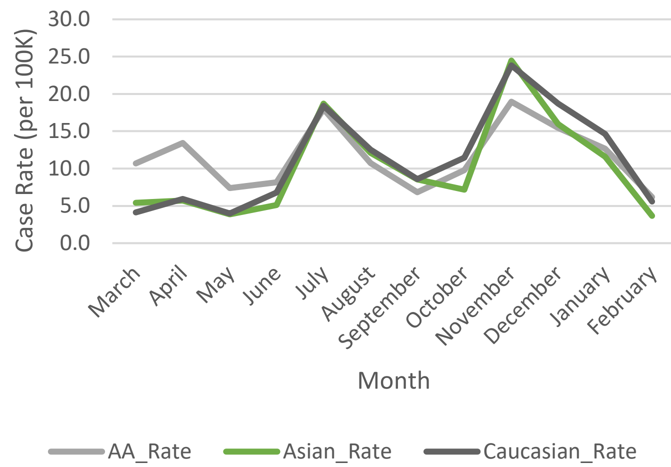


Figure 3.7. COVID-19 Weekly Average Case Rate by Race (Male) (per 100K)



Interestingly, when comparing race by sex case rates, Asian women have the lowest case rate compared to all other race categories among women and among all men. This could be due to a variety of reasons, such as being more adherent to COVID-19 guidelines. Due to their low population counts, less is known about Asian communities in the City of St. Louis and therefore, further examination of health behaviors within the Asian community may be necessary to determine what specific protective factors have impacted the low case rate.

c. By Ethnicity

Figure 3.8. COVID-19 Case Rate per 100k by Ethnicity

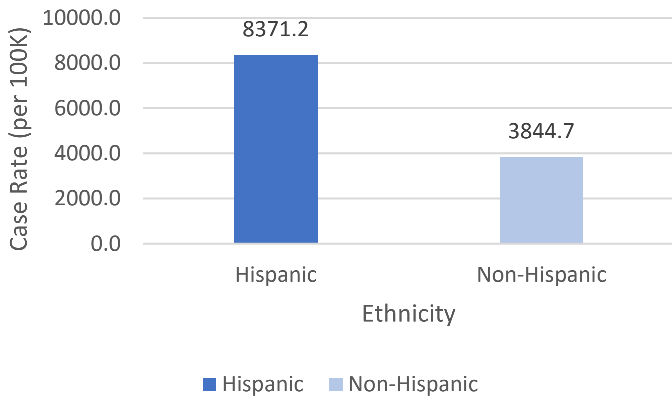
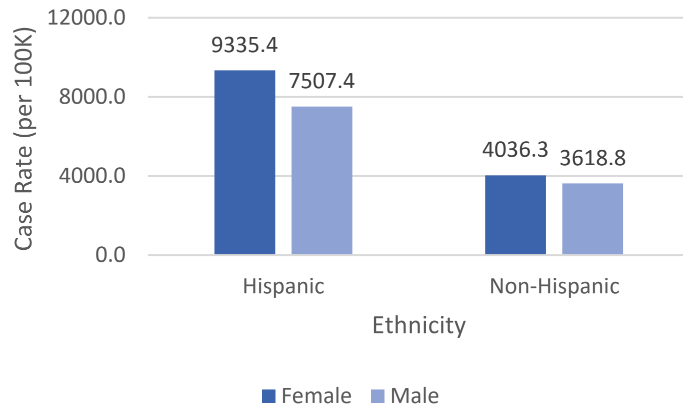
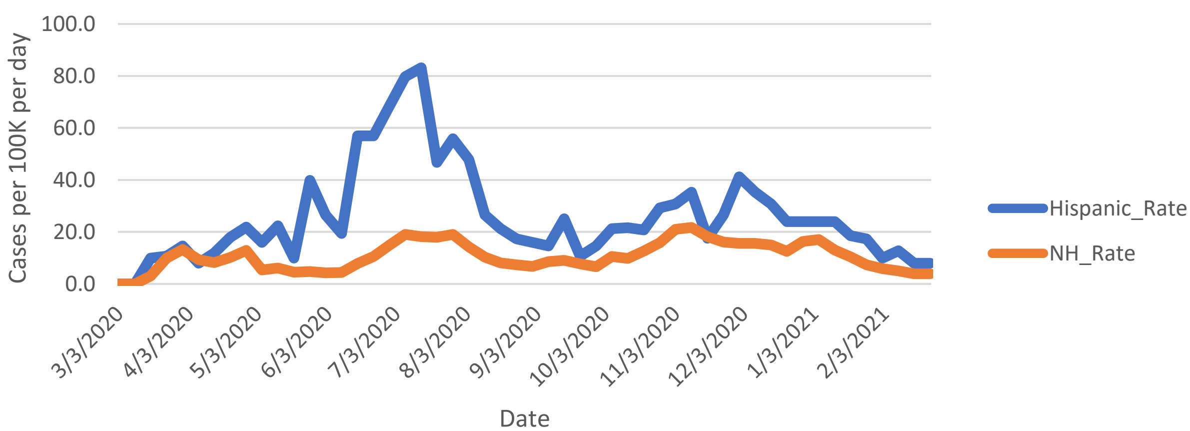


Figure 3.9. COVID-19 Case Rate per 100k by Ethnicity and Sex



Case rate by ethnicity demonstrates that case rate among Hispanic individuals is considerably higher than that of Non-Hispanics. This is likely due to the proportion of cases in comparison to lower Hispanic populations. For both Hispanic and Non-Hispanic populations, case rates are higher among females compared to males.

Figure 3.10. COVID-19 Case Rate per 100k by Ethnicity



The weekly average case rate among Hispanic and Non-Hispanic individuals has fluctuated differently than case rates by race. While there have been three clear peaks by race, there have been two peaks among case rate by ethnicity. These shifts are likely due to low ethnicity data and therefore the counts may not be as accurate as the other race data. Among Hispanic individuals, weekly average case rate rose dramatically the week of March 19th from a weekly average of 10 cases per day to 40 cases per 100K per day during the week of May 26th. Case rates among Hispanic individuals would continue to increase to a weekly average of 83 cases per 100K per day during the week of July 14th. The rate would decrease and reach a low of 15 cases per day the week of September 8th. Case rates would rise again from September 29th to a second peak of 42 cases per 100K per day during the week of December 1st, 2020.

During this same time frame, case rates among Non-Hispanics have also increased. The first peak among Non-Hispanics occurred the week of July 7th, at a weekly average of 19 cases per day. While this is smaller than the peak case rate among Hispanic individuals, the second peak was similar to that among Hispanic individuals. The week of November 10th, the case rate increased to a weekly average of 22 cases per 100K per day. Since then, the case rate among both Hispanic and Non-Hispanic individuals has decreased to below ten cases per 100K per day.

d. By Age Group

Figure 3.11 Case Rate by Age Group, <10

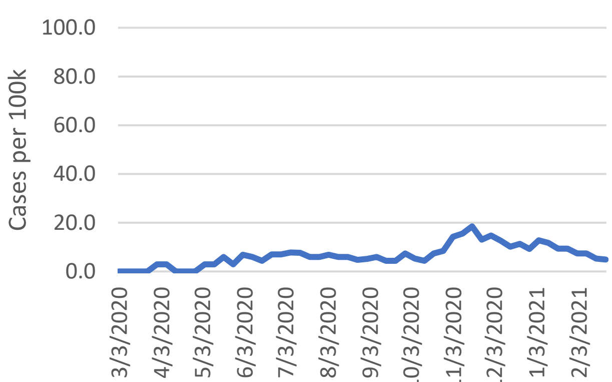


Figure 3.12 Case Rate by Age Group, 10-19

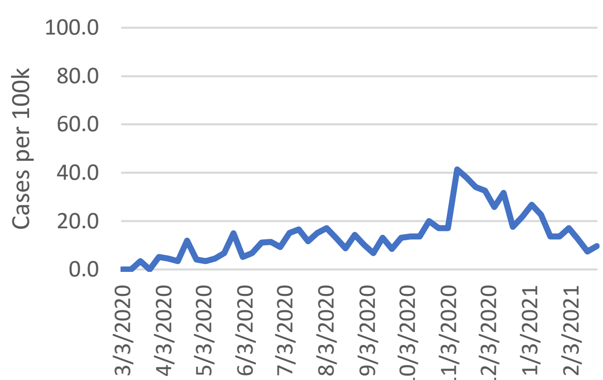


Figure 3.13 Case Rate by
Age Group, 20-29

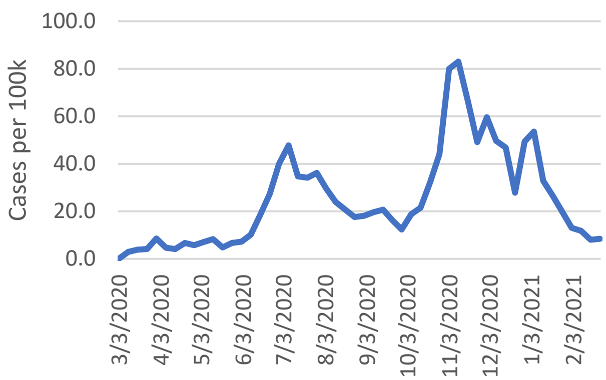


Figure 3.14 Case Rate by
Age Group, 30-39

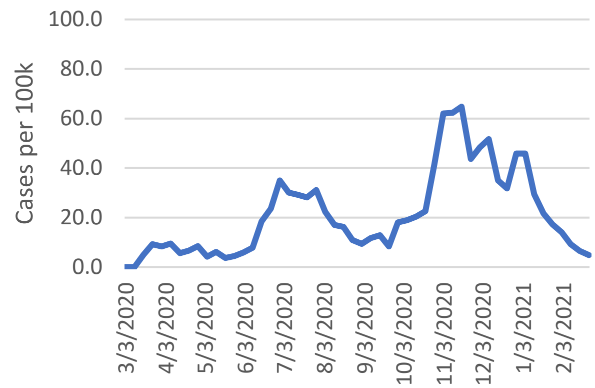


Figure 3.15 Case Rate by
Age Group, 40-49

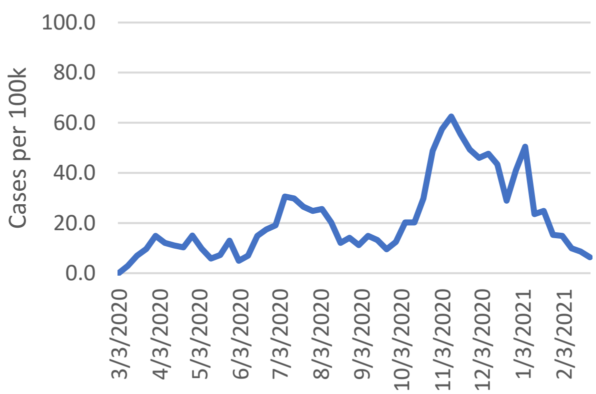


Figure 3.16 Case Rate by
Age Group, 50-59

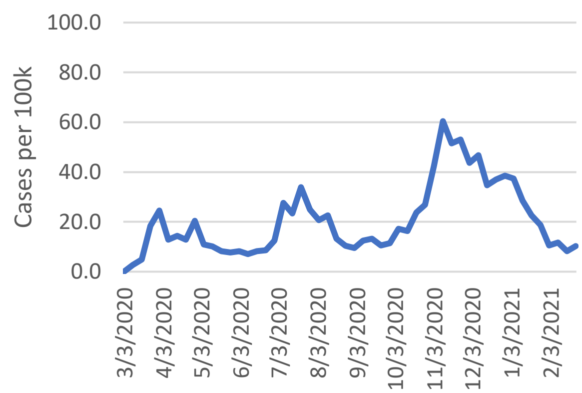


Figure 3.17 Case Rate by Age Group, 60-69

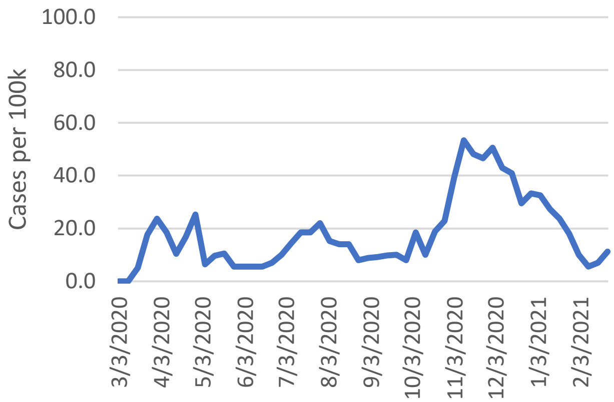


Figure 3.18 Case Rate by Age Group, 70-79

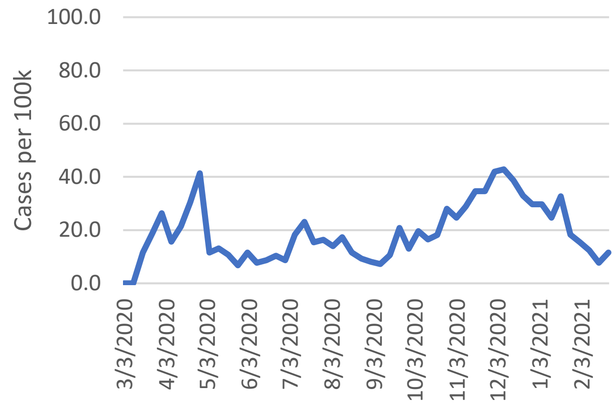
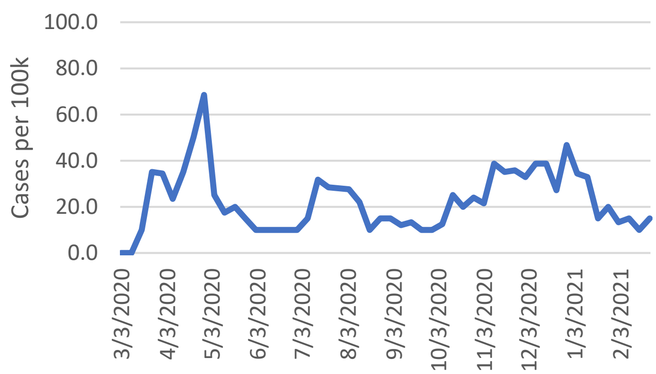


Figure 3.19 Case Rate by Age Group, 80+



Case rate by age group has fluctuated a great deal during the pandemic, reflecting similar trends to that of the overall pandemic trendline. However, case rate among those above the age of 70 had the largest increases in the beginning of the pandemic. This makes sense given that the majority of COVID-19 cases were among older adults. Nursing homes and long-term care facilities were hotbeds of transmission before more stringent public health protocols were established within the facilities, as they are now. Case rates across most age groups increased the most during the same time frame of the third wave of the pandemic, beginning the week of November 13th. The only age group that did not see that increase during the third wave of the pandemic were those above the age of 80.

Those aged 20-29 had the largest case rate increase. From the week of September 29th, case rate among those ages 20-29 increased from 13 cases per 100K per day and reached the highest peak of 83 cases per 100K per day the week of November 10th, 2020. Since then, case rates have decreased, but this was the highest case rate across all age groups.

Currently, case rates are highest among those above the age of 80 and decrease by age group. During the last week of February, the weekly average case rate for those above the age of 80 was 15 cases per 100K per day. Comparatively, the weekly average case rate for those ages 20-29 was nine cases per 100K per day. As case rate begins to increase to among older age groups (specifically those between the ages of 50-59, 60-69, 70-79, and 80+), we must also monitor fatalities for possible increases.

IV. Reproductive Number Estimates

The Reproductive Number (R_0, pronounced "R naught") is an estimation of how many people a COVID-19 positive case will transmit the virus to, on average. The virus that causes COVID-19, SARS-cov-2, has an R_0 that is estimated to be between 2.2-2.7, which explains how the disease was able to spread so quickly across the world.[2]

While the R_0 is an estimate of transmissibility at baseline, the reproductive number can also be calculated at a particular point in time. This is called the instantaneous reproductive number R_e. When R_e is above 1 the epidemic is expected to grow exponentially. For example, if R_e =2 each case is infecting 2 other people on average, and those two will infect 4 more people, who will infect 8 more, then 16, and so forth. When the R_e is equal to 1 the epidemic will maintain itself, neither increasing nor decreasing. And when R_e is less than 1 the epidemic is expected to slow and eventually stop. Effective social distancing, hand washing, and wearing face masks reduces the spread of disease and lowers R_e.

$R_e > 1$ means the pandemic is growing exponentially
(daily case counts expected to increase)

$R_e = 1$ means the pandemic is maintained, growing linearly
(daily case counts expected to stay the same)

$R_e < 1$ means the pandemic is decaying exponentially
(daily case counts expected to decrease)

R_e estimates were calculated using the EpiEstim package in the open source statistical software R.[3,4] There are multiple ways to calculate the reproduction number, and each method requires assumptions to be made. For this calculation, an estimate of the serial interval must be decided upon.

The serial interval is the average amount of time it takes from initial infection to transmission of the virus to another person. From previous studies, the serial interval for SARS-cov-2/COVID-19 is estimated to be roughly 4.7 days with a standard deviation of 2.9 days.[5,6]

The other information needed for the calculation is the number of new cases each day. Daily estimates of R_e by age group were calculated using the 7-day rolling average of confirmed cases in those age groups. Using a 7-day average reduces the effect of normal fluctuations in new case counts, and makes the estimates more stable. Because some 10-year age groups have low daily case counts, larger age group categories were used (20 year age groups until 60+).

Figure 4.1 Reproductive Number (R_e) Ages 0-19

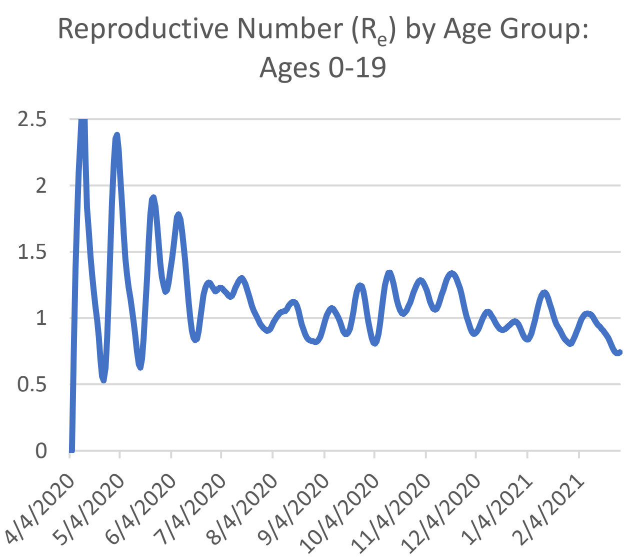


Figure 4.2 Reproductive Number (R_e) Ages 20-39

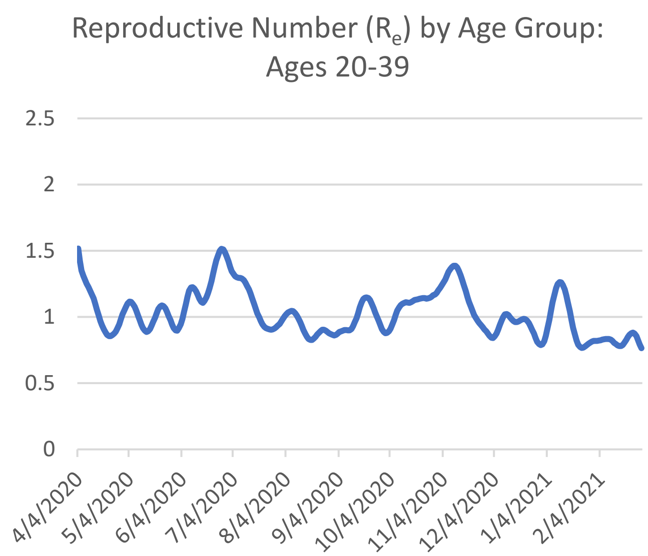


Figure 4.3 Reproductive Number (R_e) Ages 40-59

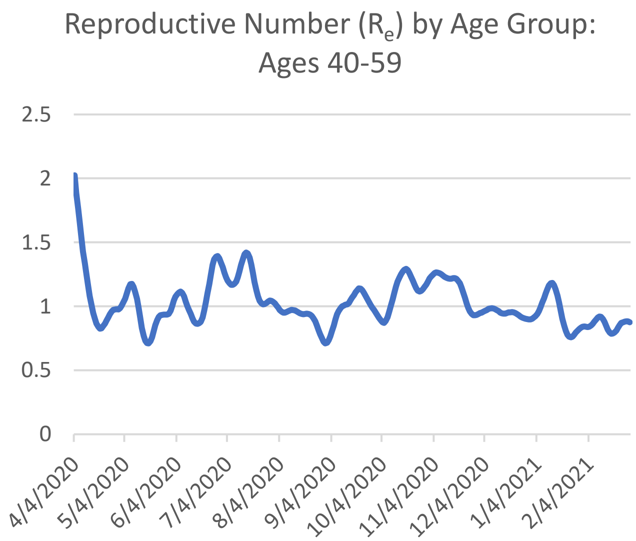
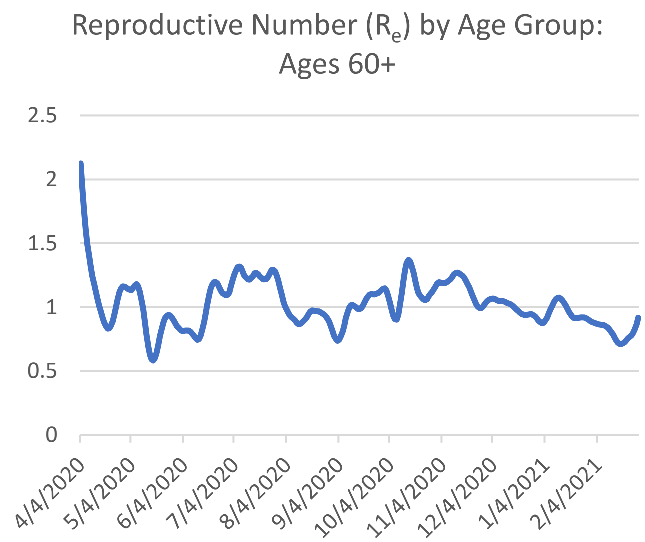


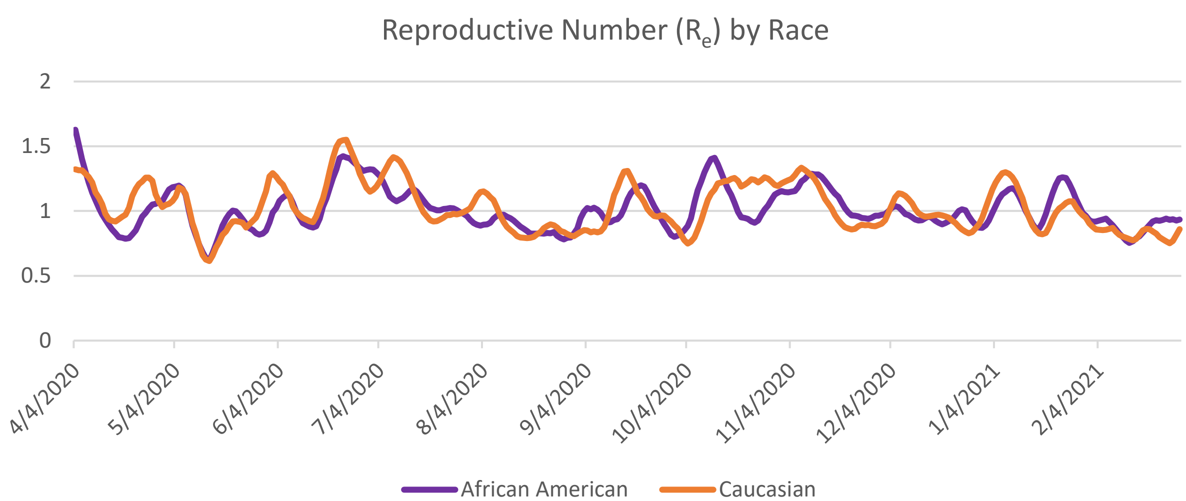
Figure 4.4 Reproductive Number (R_e) Ages 60+



The instantaneous reproductive numbers (R_e) shown above by age group demonstrate the ebbs and flows of transmission throughout the pandemic. R_e estimates for all age groups are above 1 during the upswings of each wave of the pandemic, and drop below 1 as the waves ended.

Initially, case counts among youth were very low, so the estimates for R_e oscillate wildly above and below 1, before leveling out with more stable estimates when cases among ages 0-19 became more commonplace. Importantly, this age group was not a focus for testing early in the pandemic because the risk for severe illness is very low among children.

Figure 4.5 Reproductive Number (R_e) by Race



The instantaneous reproductive numbers for the two predominant races in the City, African American and Caucasian, are shown in Figure 4.5. Other races had too few daily cases to reliably calculate Re. The R_e for both African Americans and Caucasians largely follow the same trends, but do diverge in some places. For example, between 10/4 and 11/21 both races had an R_e well above 1, corresponding to the large spike in cases of the most recent 3rd wave. However, the R_e for African Americans dropped back below 1 during that time period before climbing again, whereas the R_e for Caucasians remained elevated over the entire duration, meaning Caucasians experienced disproportionately high rates of transmission during this time.

Figure 4.6 Reproductive Number (R_e) by Ethnicity

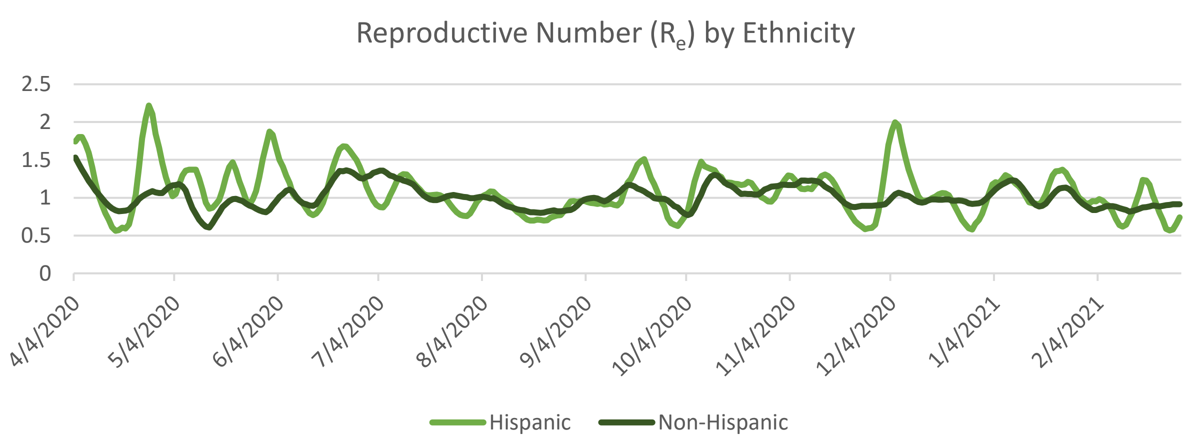


Figure 4.6 shows the reproductive numbers by ethnicity. Hispanic cases represent a far lower proportion of overall cases than Non-Hispanics, so the estimates oscillate more drastically due to the variability in daily cases. As was shown in the case rates in Figure 10, Hispanics experienced greater transmission than Non-Hispanics early on in the pandemic, particularly between the months of May and August. After this period the R_e for Hispanic and Non-Hispanic populations converge, with the exception of a spike in transmission in Hispanics in late November/early December.

V. Geographic COVID-19 Case Distribution

Figure 5.1 Cumulative case counts by ZIP Code

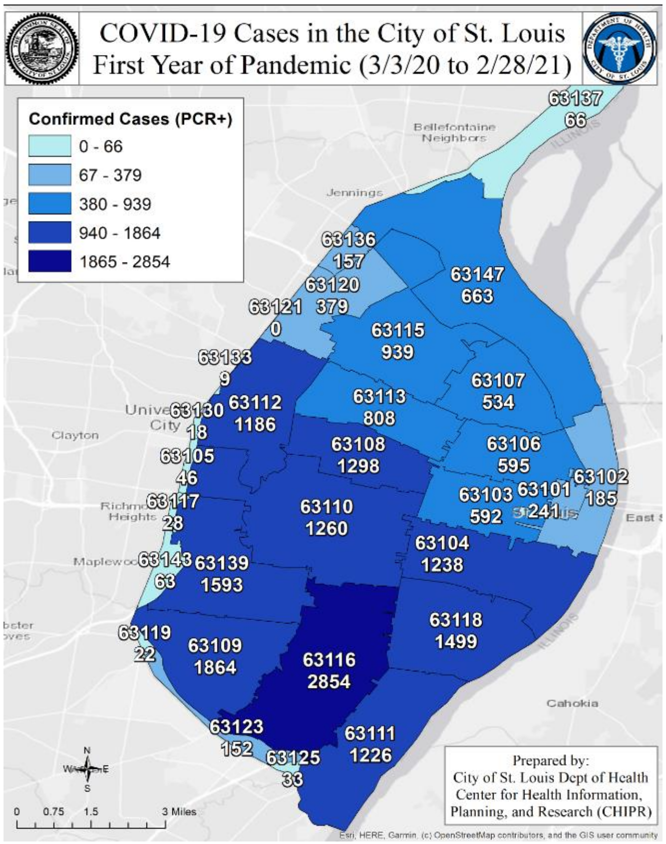
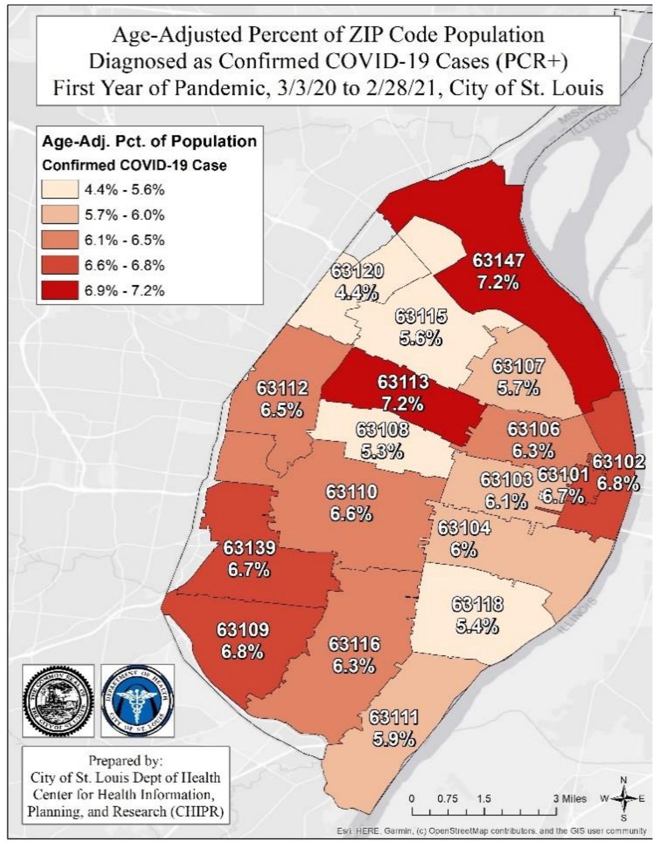


Figure 5.2 Age-Adjusted Rate per 100 by ZIP Code



Geographic distribution of cases in the City of St. Louis demonstrated in Figure 5.1 indicates that the majority of case counts are localized in South City. South City is more densely populated than other parts of the City and for this reason, there is greater risk of

case transmission and positive tests. In addition, during the beginning of the pandemic when northern, predominantly African American regions of the city had a higher case rates, resources were devoted to educational interventions in North City. The reduction in disease burden in North City may be partially attributable to these outreach efforts and increased compliance with COVID-19 guidelines.

Figure 5.2 adjusts the case counts by population size and age distribution. This age-adjusted rate per 100 tells a different story compared to the cumulative case map in Figure 5.1. Rates remain disproportionately elevated in some North City ZIP codes like 63147 and 63113, which have the highest adjusted case rates in the City – 7.2% of the population in these ZIP codes have been diagnosed with COVID-19 by PCR test. The true figure for how many individuals have been infected is a factor greater, considering many infections go undetected. The extent of undercounting is unknown, but may be 2-5x as high as the confirmed case count shown here. Downtown and South City ZIP codes, particularly in the southwest follow with the next highest rates.

Figure 5.3 Cumulative Case Density Heat Map

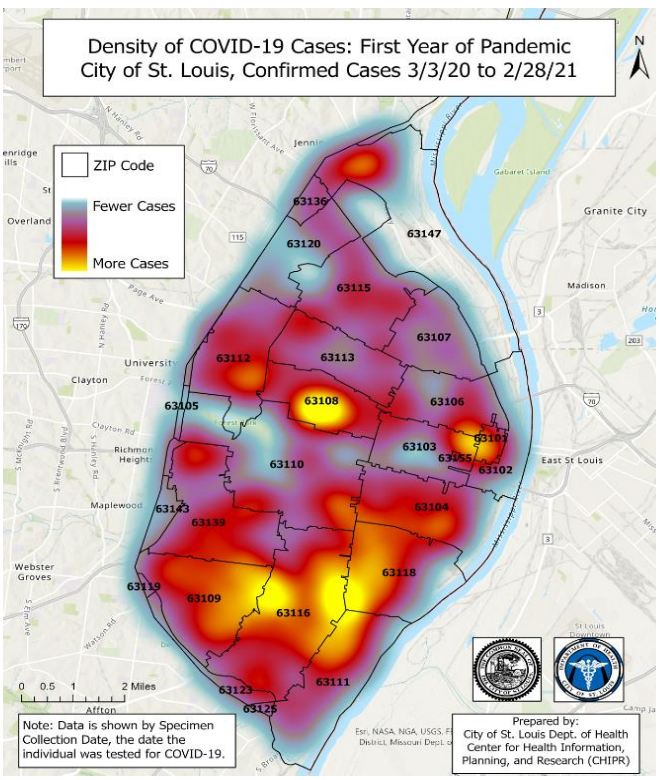
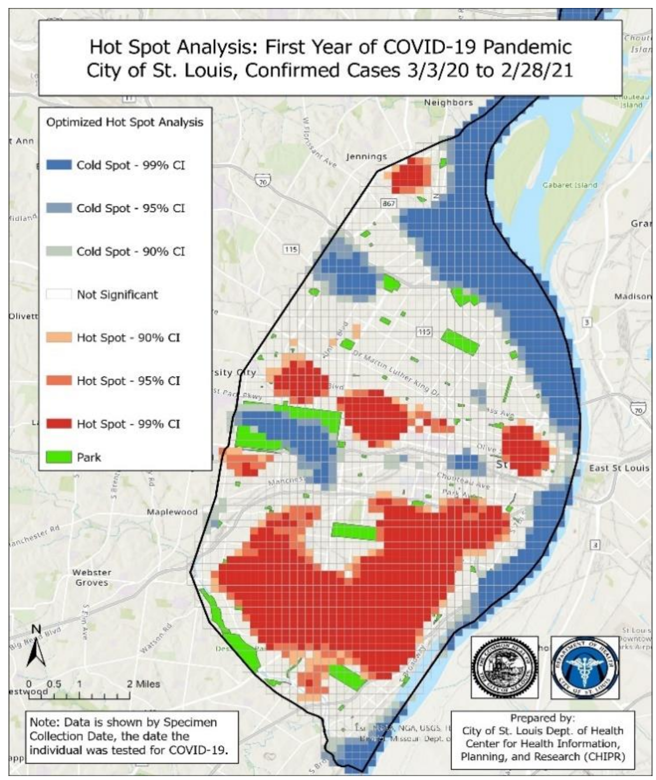


Figure 5.4 Hot Spot Analysis of Cumulative Cases



Figures 5.3 and 5.4 identify specific areas of the City that generate more COVID-19 cases than others. Figure 5.3 is a heat map of the density of cumulative cases. The more cases there are concentrated in one geographic location, the brighter the location will be on the map, with yellow and orange indicating high case density and community transmission, and blue and purple hues representing low case density. Figure 5.4 shows a hot spot analysis performed in ESRI's GIS software ArcPro. The hot spot analysis uses what is called the Getis-Ord G* statistic to highlight areas of case clustering.[7,8] Areas with

statistically significant clustering compared to other areas are shown in red, with the hue corresponding to the statistical significance (pink = 90% confidence, light red = 95% confidence, and dark red = 99% confidence). Similarly, blue regions are areas with low case clustering, i.e. cold spots.

Specific areas that show a high density of cases include South City, Downtown, and the Central West End. South City likely generates more COVID-19 cases because of greater residential population distribution in that area. The Central West End is where BJC Hospital System is located. Generally, people who work for the hospital live in or near that area as well, therefore it makes sense that risk of SARS CoV-2 transmission would be higher in those areas.

Figure 5.5 COVID-19 Case Density Heat Map over Time

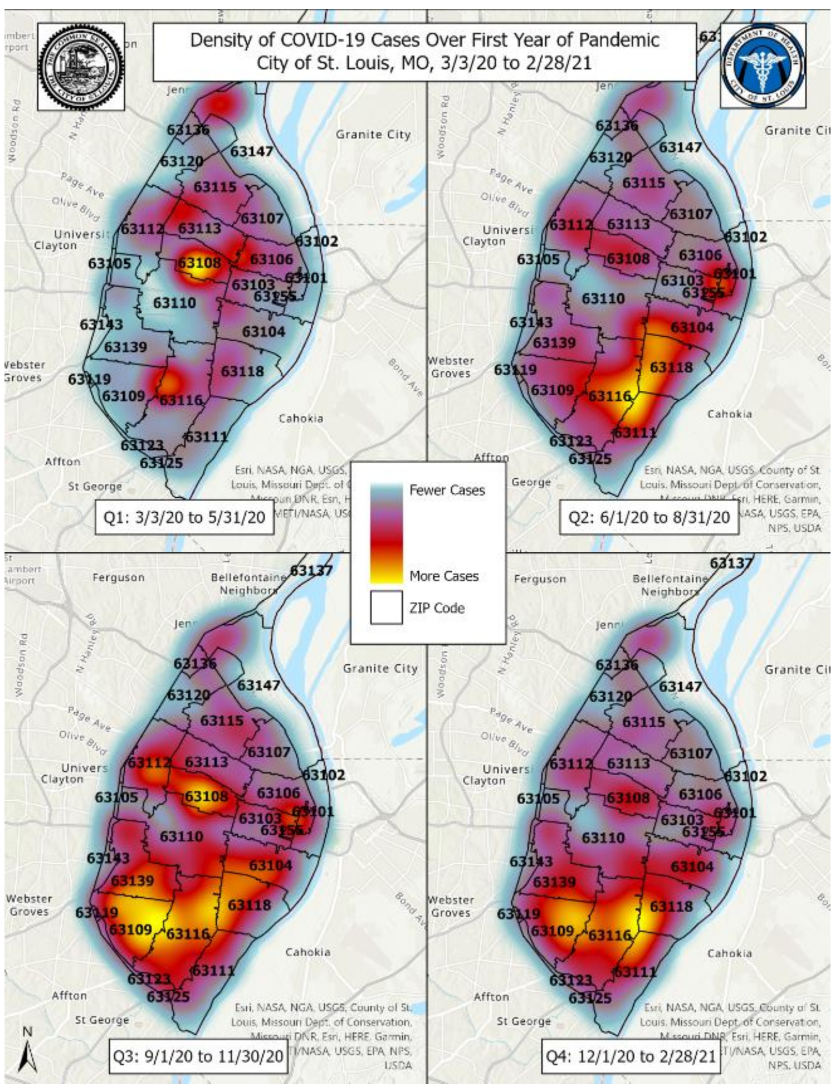
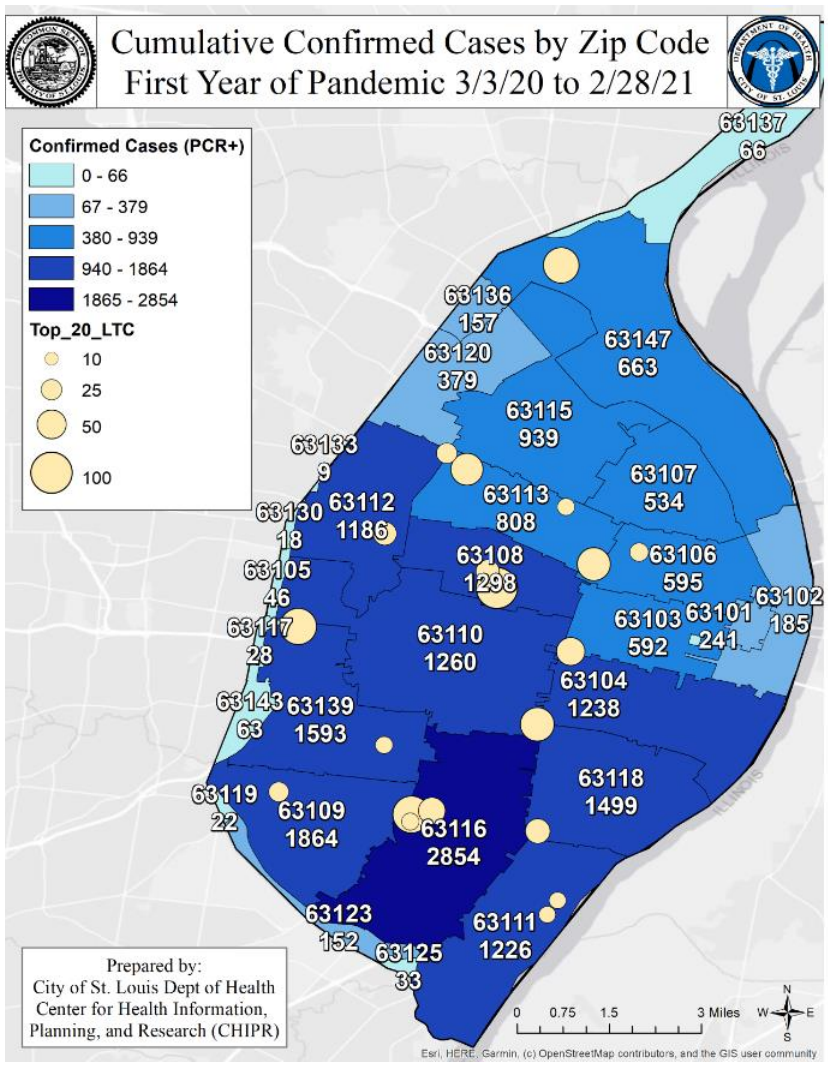


Figure 5.5 is a density heat map of COVID-19 cases through the four quarters of the pandemic. During Quarter 1 (Q1), case counts rose most densely in zip code 63108, in a combination of neighborhoods Central West End, Vandeventer, and Lewis Place. During Quarter 2-4, however, case density rose among South City regions.

In Quarter 2, cases rose in zip code 63116, 63118, and 63111, in the neighborhoods Carondelet, Holly Hills and Dutchtown. Quarter 3 demonstrated similar trends, however cases appear to spread out past the South City and Central West End regions previously mentioned, to zip codes 63109, 63116, and 63118 or neighborhoods Lindenwood Park, St. Louis Hills, Southampton, and Bevo Mill. During Quarter 4, case rates have decreased in intensity, as illustrated by the bottom right map. Overall, the regions with higher case density continue to be South City regions, specifically zip codes 63109, 63116, 63118, and 63111 or neighborhoods Bevo Mill, Lindenwood Park, Southampton, and Tower Grover South. With initial investment of educational resources in North City, case counts are more concentrated in other areas of the City.

As case counts rise among those above the age of 50 and fatality risk increases by age group, a concern since the beginning of the pandemic is the increase in COVID-19 cases and fatalities in long-term care facilities (LTCs). Disease can quickly spread in LTCs, affecting not only the vulnerable older adults living there, but also the healthcare providers who work there and then go home. For this reason, monitoring case growth in reference of these facilities is critical.

Figure 5.6 Cumulative Case Map by ZIP, with Top 20 Long Term Care Facilities (LTC)



In Figure 5.6 above, cumulative case counts are again shown by ZIP code like in Figure 5.1, except this map has Long Term Care Facilities (LTC) with the top 20 highest case counts overlaid. ZIP code 63116 has the highest overall case counts, wherein there are at least three facilities high case counts related to outbreaks within the facilities. As we examine the rest of the map more clearly, case counts appear to be highest in the South side of the City, extending all the way to Midtown and even Central West End. Population counts are highest in these areas, and more people living and working in certain areas increases the risk of SARS CoV-2 being passed from person to person, making its way to individuals in LTCs. This vulnerable population was affected heavily at the start of the pandemic, but as control measures were adopted in the facilities, case counts and significant outbreaks declined.

VI. Percent Positivity by Testing

a. By Overall Testing

Figure 6.1 Percent Positivity, February 22nd, 2020 – March 1st, 2021

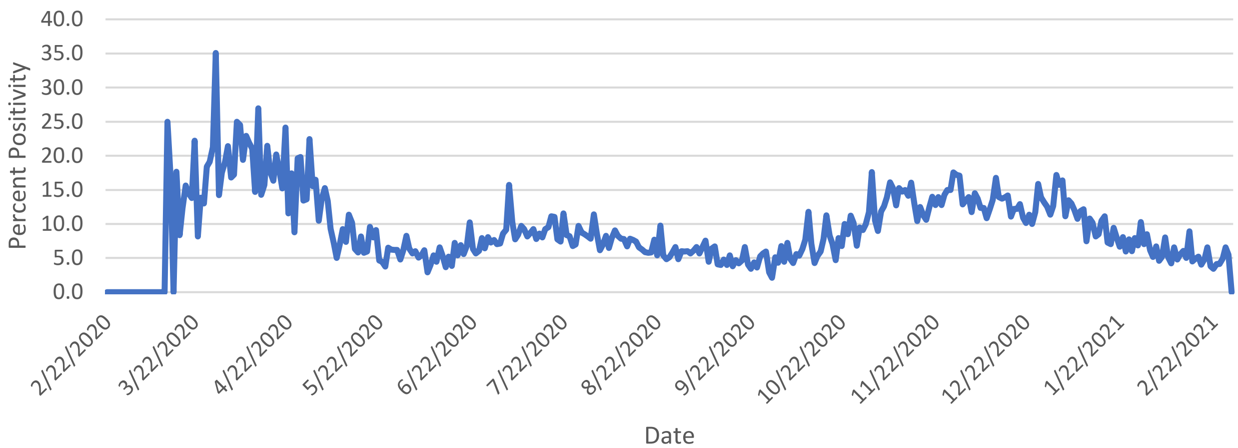


Figure 6.2 One-Week Average Percent Positivity, February 22, 2020 – March 1, 2021

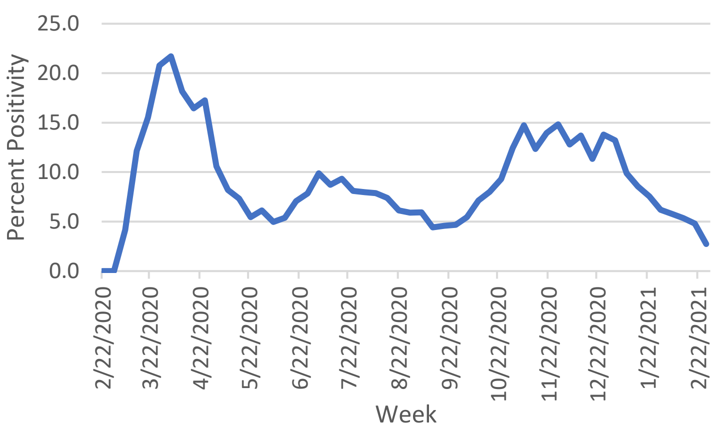


Figure 6.3 One Week Testing Average February 22nd, 2020 – March 1st, 2021

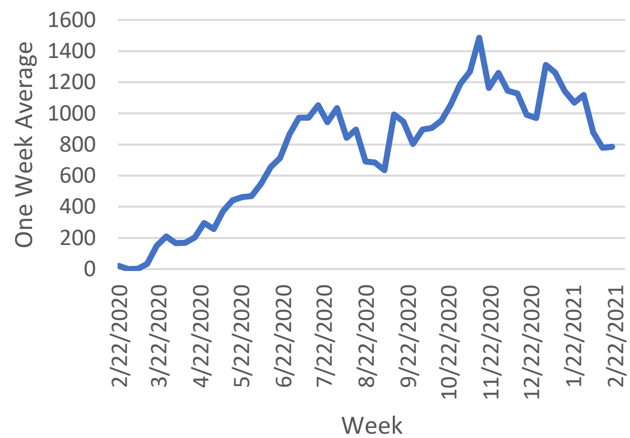


Figure 6.1 demonstrates percent positivity throughout the lifetime of the pandemic. The trend rises and falls consistent with the overall case trends. As case counts increased, percent positivity increased. Examining one-week averages helps us determine overall trends, as day-to-day counts fluctuate too much to discern overall trends.

As visualized in Figure 6.2, since the week of January 2nd, percent positivity has decreased from a weekly average of 13.2% to 4.8% the week of February 20th. The last time percent positivity was below 5% was during the month of September when percent positivity reached a low of 4.4% the week of September 12th. In May 2020, the World Health Organization recommended that percent positivity remain below 5% for at least two weeks before governments consider reopening. While the City of St. Louis has "re-opened", percent positivity below 5% is a good indicator for decreased disease transmission.

Daily testing averages in conjunction with percent positivity helps to determine if testing is the most efficacious it can be to detect positive cases (Figure 6.3). High testing rates and low percent positivity are preferable. If percent positivity gets too high, it suggests insufficient testing compared to disease transmission in the community. While case counts have fluctuated, testing averages have increased since the beginning of the pandemic. The peak of testing occurred the week of November 14th, 2021 at an average of 1485 tests per day. Since then, testing has decreased. By the last week of February, testing has decreased by 47% to 786 tests per day.

If percent positivity was trending upwards, this would indicate that there would need to be an increase in testing to meet the need.

b. Testing Type Trends

Figure 6.4 Serology Test One Week Average Percent Positivity

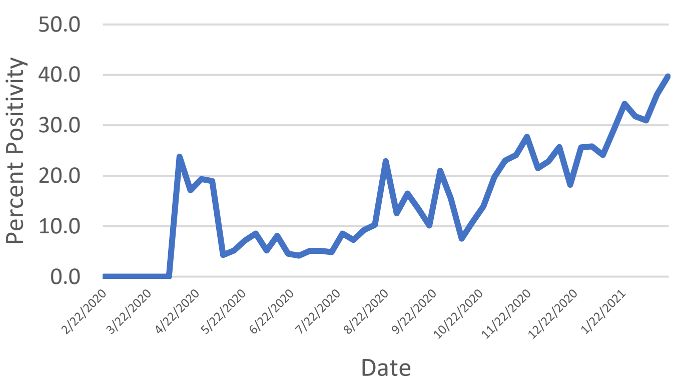


Figure 6.5 One Week Average of Serology Test Counts

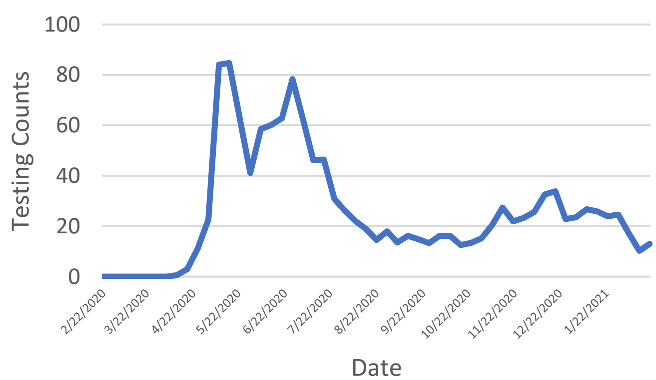


Figure 6.6 PCR Test One Week Average Percent Positivity

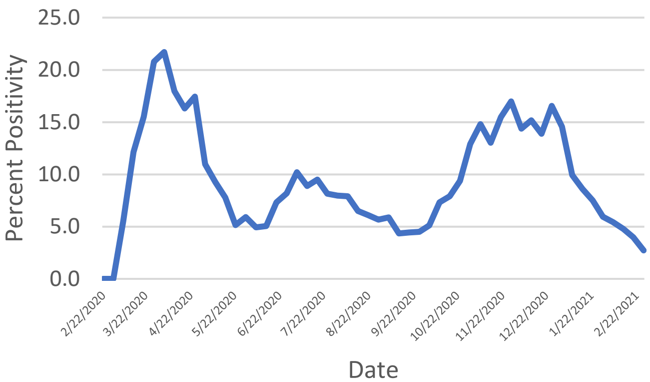


Figure 6.7 One Week Average of PCR Test Counts

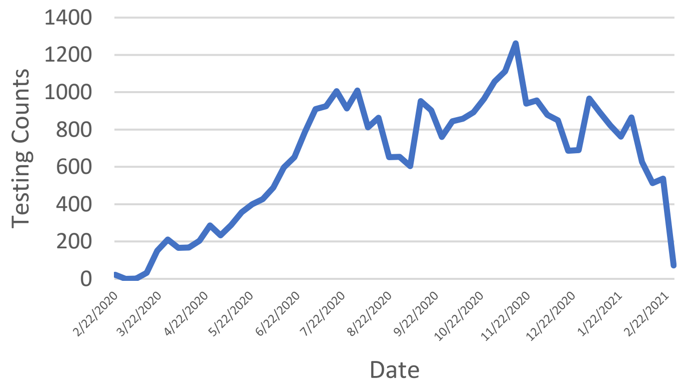


Figure 6.6 PCR Test One Week Average Percent Positivity

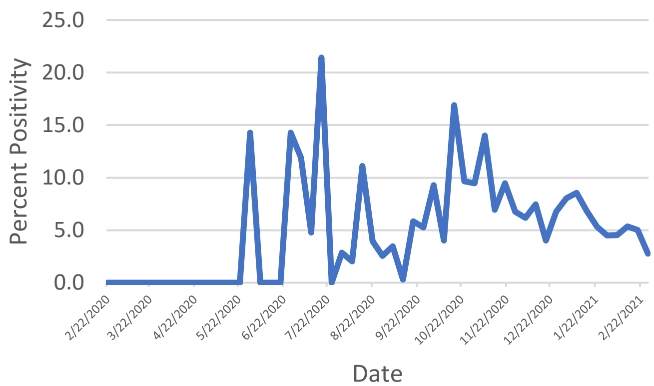
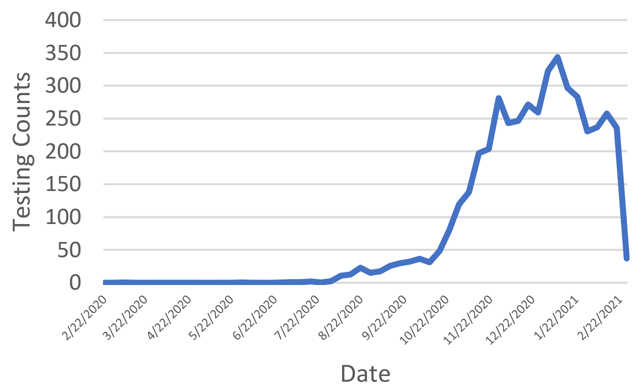


Figure 6.7 One Week Average of PCR Test Counts



PCR tests are the most common and accurate test, and demonstrates a trend line with a percent positivity most similar to the pandemic. Interestingly, serology percent positivity has increased since October 2020 from a weekly average of 7.6% to a peak of 39.7% in the last week of February. This is likely related to a decreased amount of serology tests being performed, which is consistent with what is seen in Figure 6.5, wherein the average number of tests decreased from 34 tests per day in the week of December 19th, 2020 to 13 tests per day in the last week of February 2021.

VII. Hospitalization Trends

The following is data provided by BJC and SSM Healthcare systems. The data below demonstrates positive tests done by the hospitals, their percent positivity, hospital admissions, ICU admissions, and Ventilator usage among City residents who went to these hospital systems. The trends visualized below reflect the three waves of the pandemic in the City.

Figure 7.1 Hospital COVID-19 Test 7-day Average Percent Positivity: BJC and SSM

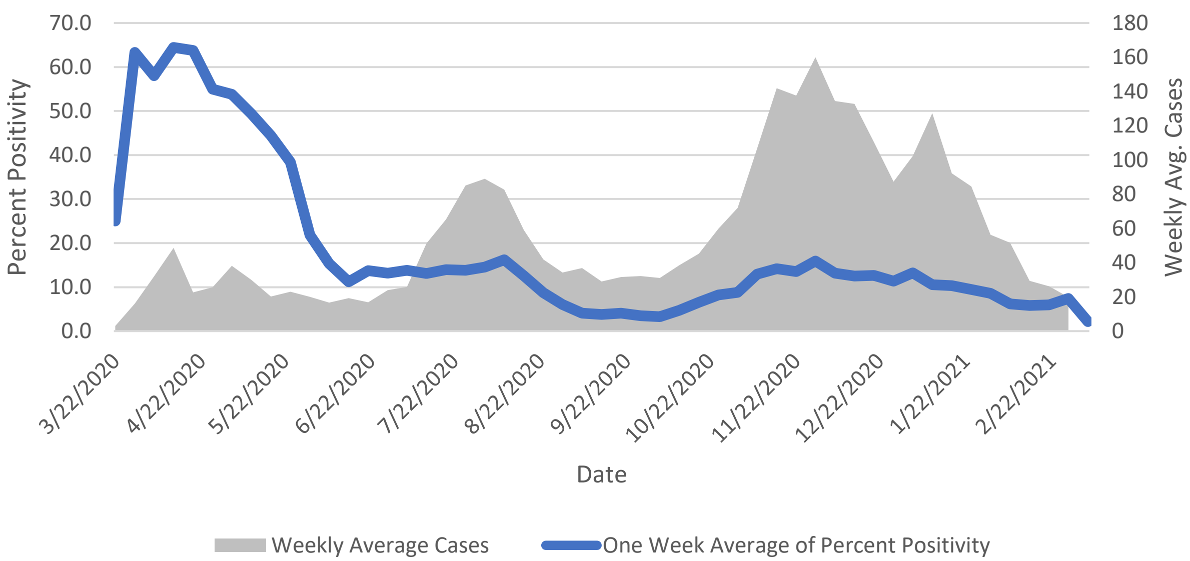


Figure 7.1 illustrates the weekly average of hospital tests' percent positivity (blue), with the weekly average cases per day shown underneath for comparison (grey). Following the beginning of the pandemic in March, there was a significant uptick in percent positivity. The peak was during the week of April 5th, where the weekly average percent positivity was 65%. Since then, there has been a significant decline and percent positivity has remained low. The extremely high positivity rate was related to the global lack of testing availability. Stringent testing criteria meant that only those who were hospitalized or otherwise symptomatic and at significant risk for morbidity/mortality were tested. As the supply of testing equipment and capacity grew, the percent positivity fell from a peak of 65% in April to 11% by June, when tests were more abundant.

However, where there was an increase in cases, percent positivity of testing in hospitals would begin increasing as well. The second wave began approximately halfway through the summer after the July 4th holiday. From July 5th, 2020 to August 2nd, 2020, the weekly average of new cases per day increased from 26 to 89. Percent positivity of testing in hospitals would also subsequently increase from 13% to 16% during that same time period. When cases during the second wave began decreasing, the percent positivity began decreasing as well. The week of September 13th, the weekly average was 29 cases per day. Percent positivity that week was at 4%.

During the third wave of the pandemic, cases increased in the City. However, Figure 7.1 above does not seem to depict any subsequent increase in percent positivity of hospital tests. Figure 7.2 below compares the weekly average of percent positivity of Hospital tests and the number of hospital positive tests. The weekly average of positive hospital tests increased in a manner that reflects the increase in cases noted during the third wave. However, the percent positivity does not seem to reflect this. This is likely due to an increase in testing at the examined hospital systems to accommodate testing. It could also be attributable to greater testing at local Federally Qualified Healthcare Centers and therefore lesser testing at hospitals.

Figure 7.3 COVID-19 Seven Day Average of New Cases and Hospital Admissions

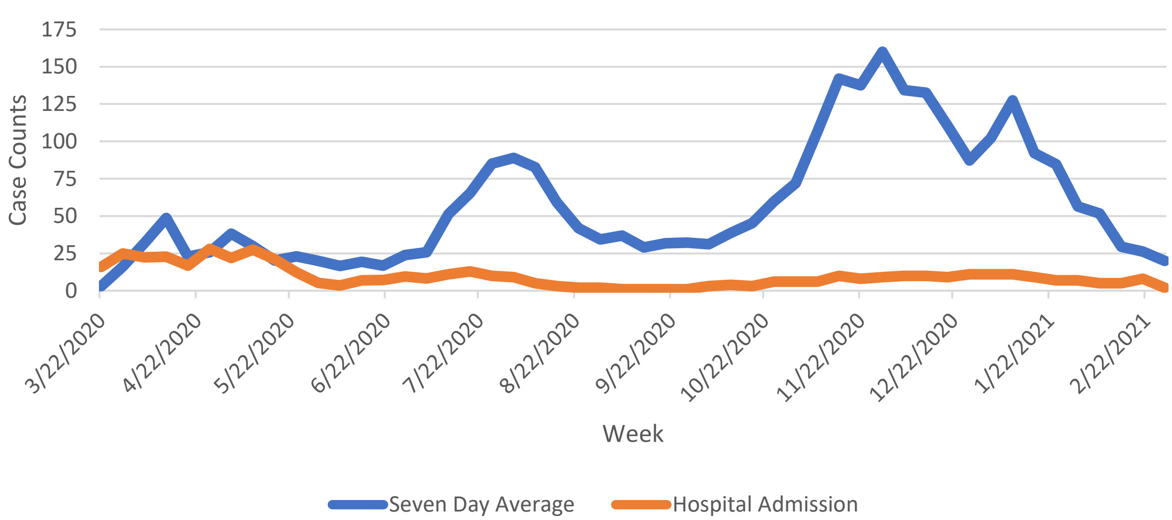
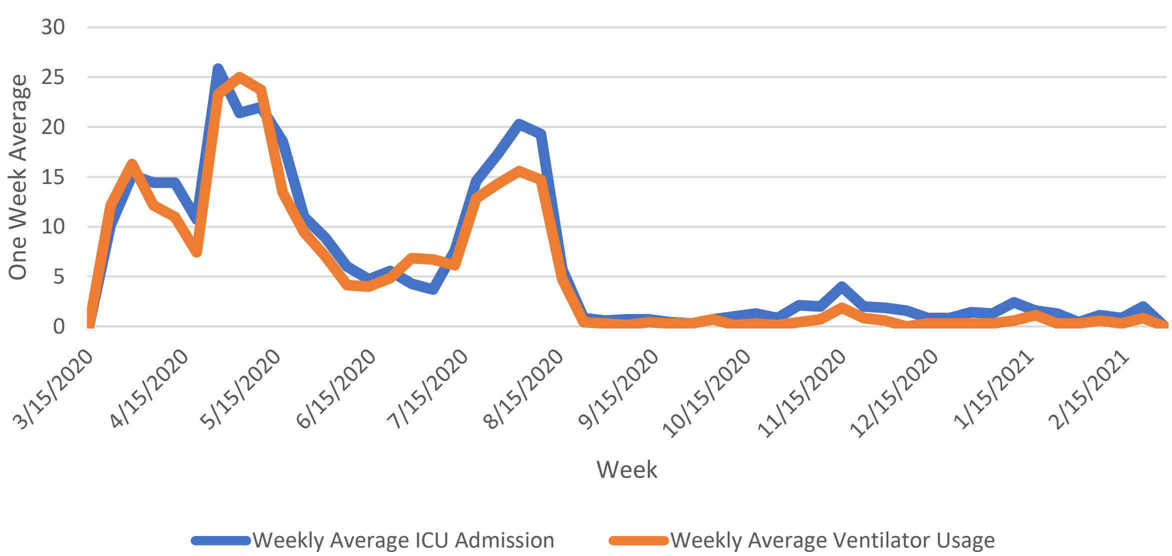


Figure 7.3 refers to Hospital Admissions during the lifetime of the pandemic. This figure also is similar to that of the pandemic trendline, with three peaks. However, these three peaks occur at a slight delay as cases increase.

The second peak of the pandemic began in the beginning of June, when cases increased from 17 cases per day during the week of June 7th to a peak of 89 cases per day the week of August 2nd. Hospitalizations during that second peak began rising the week of June 14th at seven hospitalizations per to a peak of 13 hospitalizations per day the week of July 19th. Hospitalizations would consistently be above ten as cases reached their peak the week of August 2nd.

During the third quarter of the pandemic, cases began increasing the week of September 13th and increased to its peak the week of November 29th from a weekly average of 29 cases per day to 160 cases per day. However, hospital admissions did not begin increasing until two weeks following. Hospital admissions increased from one hospitalization per day during the week of September 20th to ten hospitalizations per day the week of December 6th. This was one week after case counts reached their peak in the City. In addition, when comparing to the weekly average of case counts per day, the hospital admissions appear low in comparison to case counts. This could be due to more patients being sent home to quarantine than being hospitalized. These low hospitalization counts also coincide with later on in the year, when interventions and treatments were more developed and more patients could be sent home to recover.

Figure 7.4. Hospital COVID-19 One Week Average ICU Admissions and Ventilator Use



ICU admission and ventilator use trends reflect similar trends seen among the hospital admission data and some of the COVID-19 case count data. Consistent with the two waves seen early on COVID-19 case counts, ICU admissions and ventilator use trends

also reflect that. However, there is no third wave among ICU admissions and ventilator use and even the second wave is smaller than that of the first wave. This is different from prior trends, as the second wave of the pandemic was obviously bigger than that of the first. This could be due to the better development of treatments and decreased intensity of symptoms requiring hospitalization. The decrease in hospital and ICU admissions and ventilator use could also be due to increased testing which allows for individuals to be diagnosed, treated and recover sooner.

VIII. Fatality Trends

a.Trendline Overview

Case fatality is represented by the number of fatalities over the total number of cases. Following the initial increase from the beginning of the pandemic to its peak at June 20th, there was a slow decline from July 2020 to November 2020. The week of July 16th, case fatality rate was at approximately six deaths per 100 cases. This has since decreased reaching two deaths per 100 cases.

Figure 8.1 Case Fatality Rate in the City of St. Louis (per 100 cases)
March 16th, 2020 – March 1st, 2021

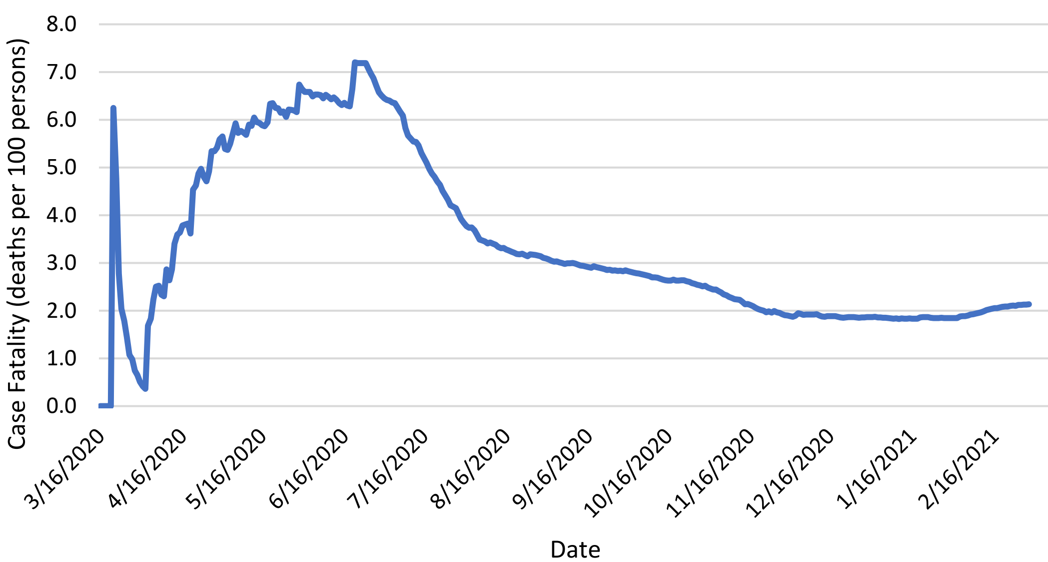


Figure 8.2 One Week Fatality Average (Adjusted)

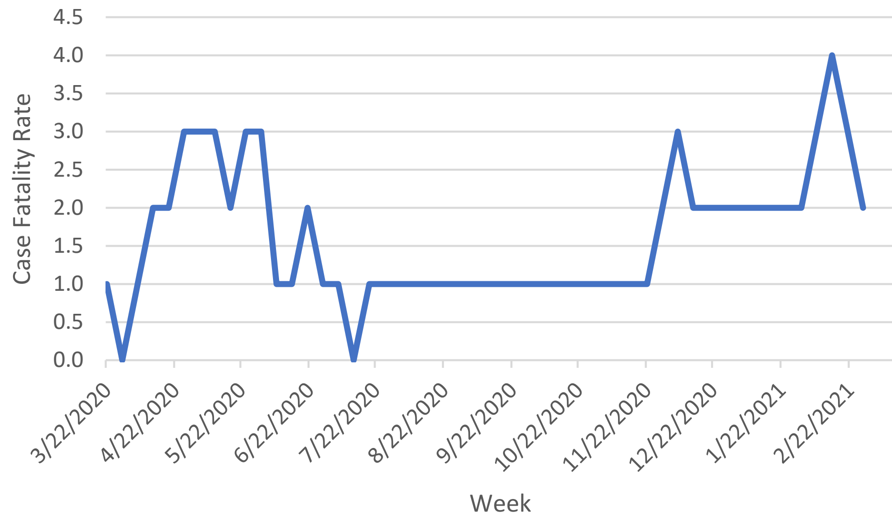


Figure 8.2 depicts the weekly average of fatalities per day, adjusted by rounding to the next whole number. From the week of December 13th to January 31st, fatality counts were approximately two deaths per day. However, in the beginning of February, this began increasing again to unprecedented counts. The week of February 7th, there was an average of three fatalities per day and this increased again to four per day the week of February 14th. Fatalities have since decreased to two. It is possible that the recent increase in fatalities is due to a backlog of deaths, however this still translates to high fatality counts.

b. COVID-19 Case Fatalities by Demographic Distribution

Figure 8.3 COVID-19 Fatalities by Sex (n=431)

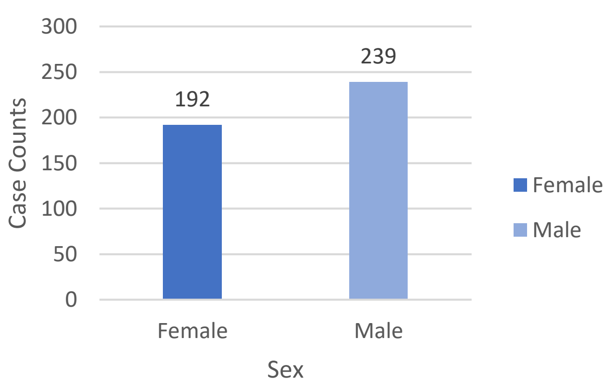
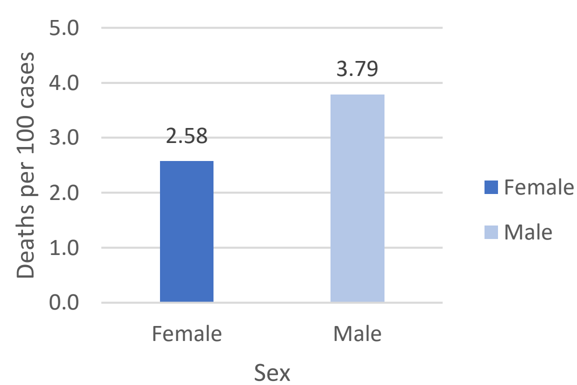


Figure 8.4 Case Fatality Rate by Sex (per 100 cases)



Case fatality rate by sex in Figure 8.3 demonstrates that despite women making up 53% of all COVID-19 cases, men have higher mortality secondary to COVID-19. This is a shift from the very beginning of the pandemic, when African American women made up the majority of fatalities, however it also consistent with other health outcomes, such as heart disease, stroke, and cancer. Odds ratio analysis reveals that women have a 33% decrease in fatality risk secondary to COVID-19 diagnosis compared to men [OR = 0.67, 95% CI (0.55, 0.81)].

Figure 8.5 COVID-19 Fatalities by Race (n=438)

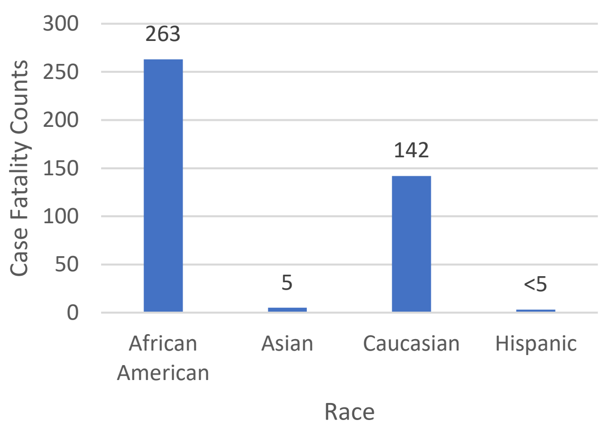
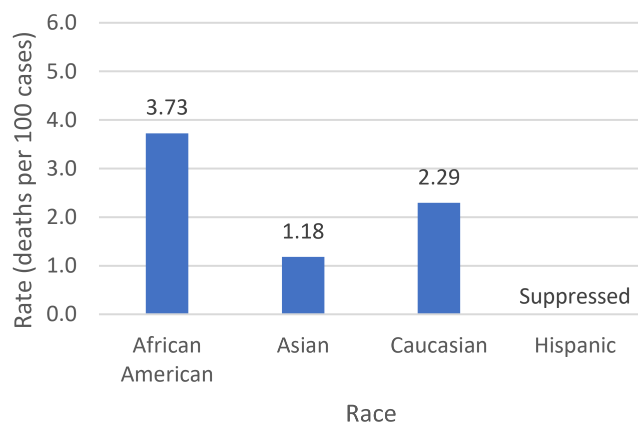


Figure 8.6 COVID-19 Fatality Rates by Race (per 100 cases)



Figures 8.5 and 8.6 depict fatalities and fatality rate by race and subsequently highlights the racial disparities noted among cases. African Americans have the highest case counts and fatality counts, and thereby have the highest case fatality rate, followed by Caucasians. African Americans make up 63.7% of all fatalities. This is a decrease from prior trends where African Americans initially made up all of the fatalities, which then decreased to 67% in June through August 2020. This is a point of concern because African Americans and Caucasians have practically even populations here in the City. The reason for the racial disparities in COVID-19 case counts and outcomes are still concerning and warrant further investigation.

Risk ratio comparison indicates that compared to African Americans, Caucasians have a 38.5% decrease in fatality risk following COVID-19 diagnosis and Asians have a 68% decrease in fatality risk following COVID-19 exposure [OR = 0.624, 95% CI (0.5101, 0.7630), OR = 0.325, 95% CI (0.1349, 0.7834)]*. Risk ratios were not calculated for Hispanic fatalities as the fatality counts are below five and rates could therefore be considered unstable.

*Confidence intervals overlap with each other, demonstrating that the difference between categories are not statistically significant ($p > 0.05$)

Figure 8.7 COVID-19 Fatalities by Race and Sex (n=438)

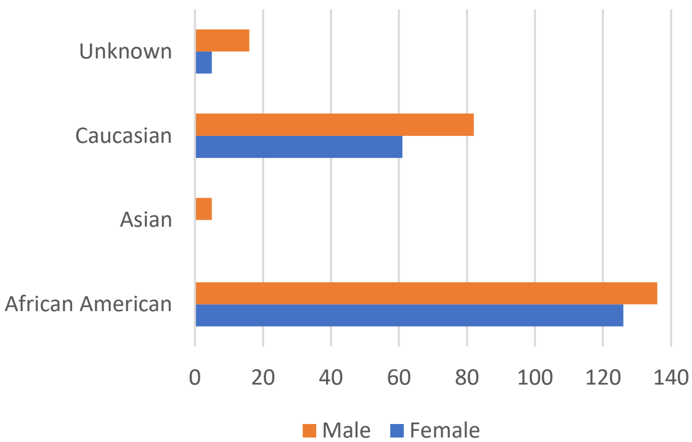
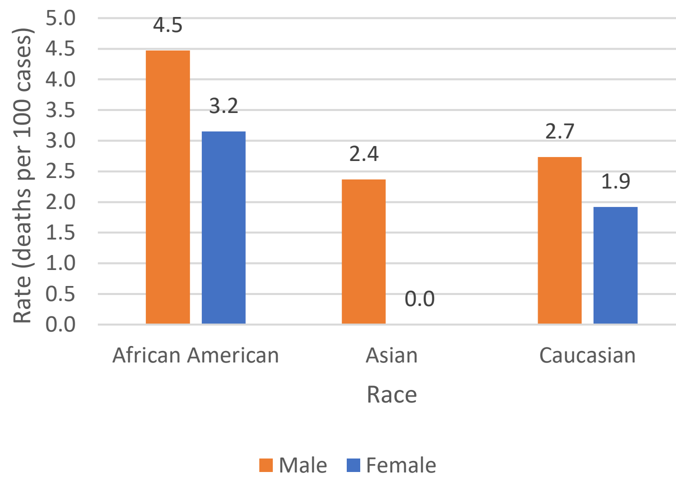


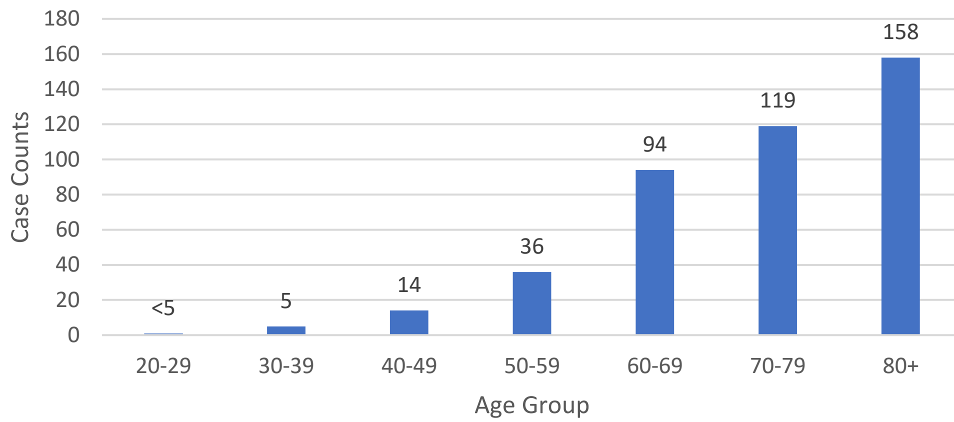
Figure 8.8 Case Fatality Rate by Race and Sex (per 100 cases)



In the beginning of the pandemic, African American women had higher case fatality counts and rates than any other group. This has since shifted. While African Americans still face higher burden of mortality, African American men now have a higher case fatality rate than women.

Risk ratio calculations show that African American women have a 67% increase in fatality risk following COVID-19 diagnosis compared to all other women. African American men have a 44% increase in fatality risk compared to all other men following COVID-19 (OR = 0.616, 95% CI [0.4553, 0.8334]). Odds ratio comparing African American men and women found that African American men also had a 42% increase in fatality risk compared to African American women (OR = 1.42, 95% CI [1.1191, 1.8003]). This analysis identifies African American men at greater risk of fatality than all other demographic groups, consistent with their higher case fatality rate. In the beginning of the pandemic, African American women made up almost all of the fatalities. This trend has since changed, but the risk COVID-19 poses to the African American community remains one of great concern and interventions that works within those communities to identify vulnerable individuals is critical.

Figure 8.9 COVID-19 Case Fatalities by Age Group (n = 427)



As Figure 8.9 illustrates above, fatality counts in the City of St. Louis have increased as age group increases. Risk ratios calculated also illustrate younger age groups have decreased risk of fatality following COVID-19 diagnosis in comparison with those above the age of 80.** Given the noted increase in case rate among those above the age of 80, the high counts of fatalities among those above the age of 80 is concerning. Perhaps safety measures among older adults need greater security, but mask wearing and social distancing guidelines should also be further reinforced to ensure that older adults are protected from disease transmission.

**Appendix B for Risk Ratios and Confidence Intervals

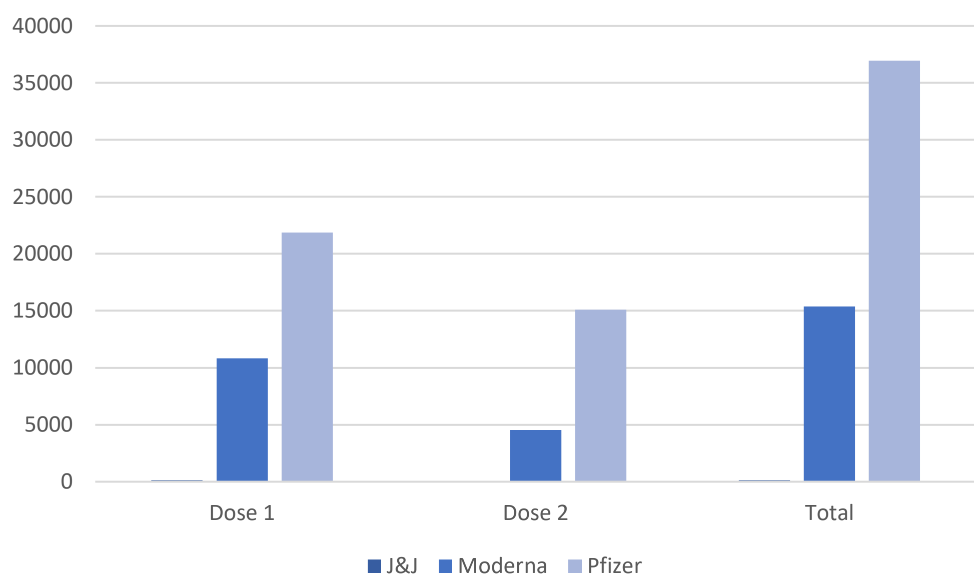
IX. Vaccination Data

a. Demographic Distribution

Vaccinations in the City of St. Louis began on December 14th, 2021 among City residents. There have been some other mass vaccination clinics since then and the following analysis is of the vaccinations that have been disseminated thus far.

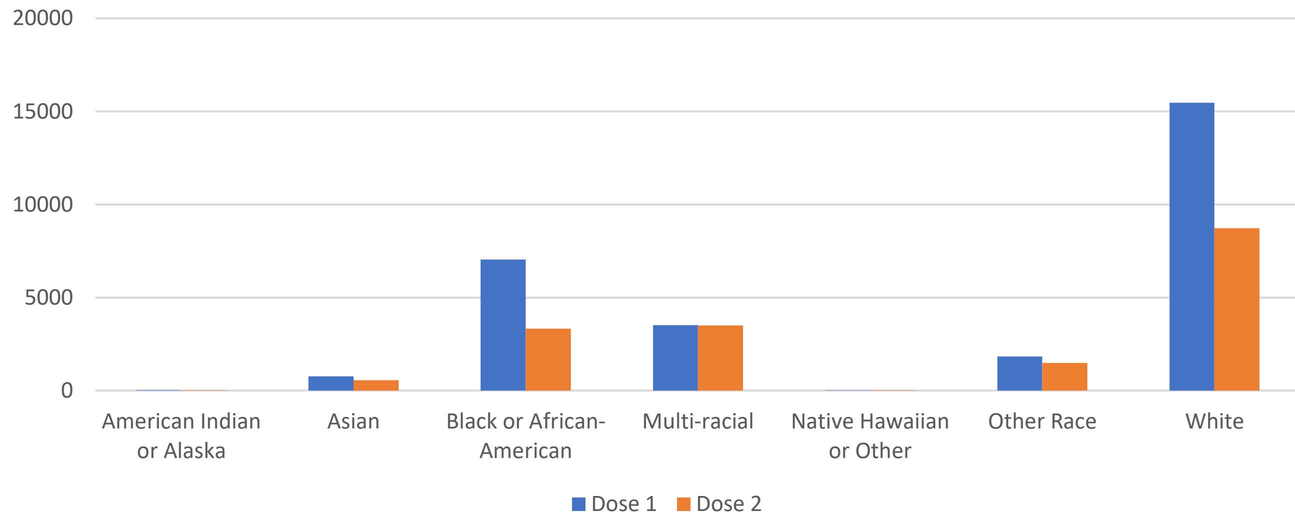
Thus far, the Pfizer vaccine has been the most readily disseminated vaccine.

Figure 9.1 Vaccine Counts by Vaccine Type



Historically, minority populations have had more reason to be suspicious regarding vaccinations. Distribution of race counts demonstrate that, as Caucasian individuals make up 47% of the first COVID-19 vaccine dose disseminated.

Figure 9.2 Vaccine Dissemination by Vaccine Dose Count and Race



African American individuals make up 21.5% of the first vaccine dose. This is a large disparity considering that African Americans and Caucasians individuals have nearly even populations in the City. Greater resources must be devoted to dismantle the interpersonal reasonings for the lack of vaccine adherence. Figure 9.2 also depicts lesser adherence to the second dose of the vaccine, however that could be a delay in reporting. There also appears to be lesser vaccine adherence among other races, such as those who identify as Asian, American Indian or Alaskan Native, or Native Hawaiian. This could be due to low population counts, but could also require more conversations within the communities to understand lack of adherence.

Figure 9.3 One Week Average of Vaccine Dose Dissemination

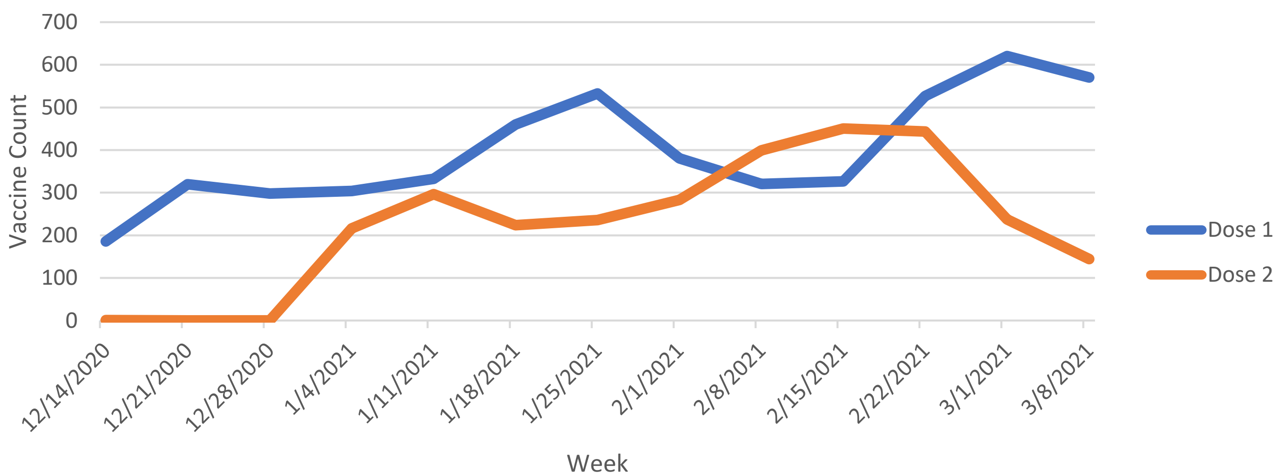


Figure 9.3 depicts the average count of vaccine dissemination by dose count over time. While Vaccine Dose 1 dissemination began at 186 vaccines the week of December 14th, 2020, Vaccine Dose 2 began picking up two weeks following the beginning of vaccination dissemination during the week of January 4th, 2021. The week of February 1st to February 15th, there was a dip in the first vaccine dose disseminated as the second vaccine dose dissemination increased. Most recently, there has been a decrease in the second vaccine dose, while the first vaccine dose began increasing again.

Figure 9.4 Vaccination Rates by ZIP:
First dose

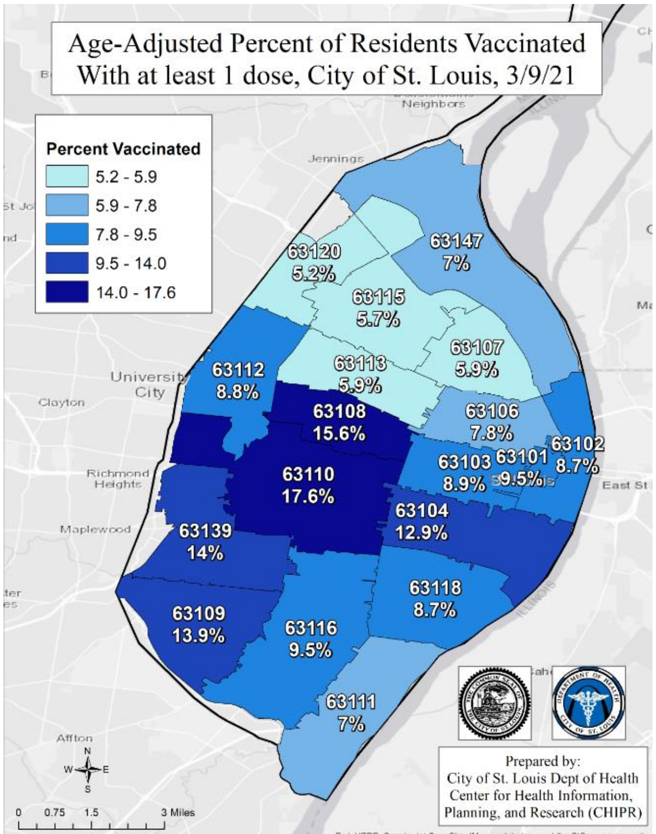
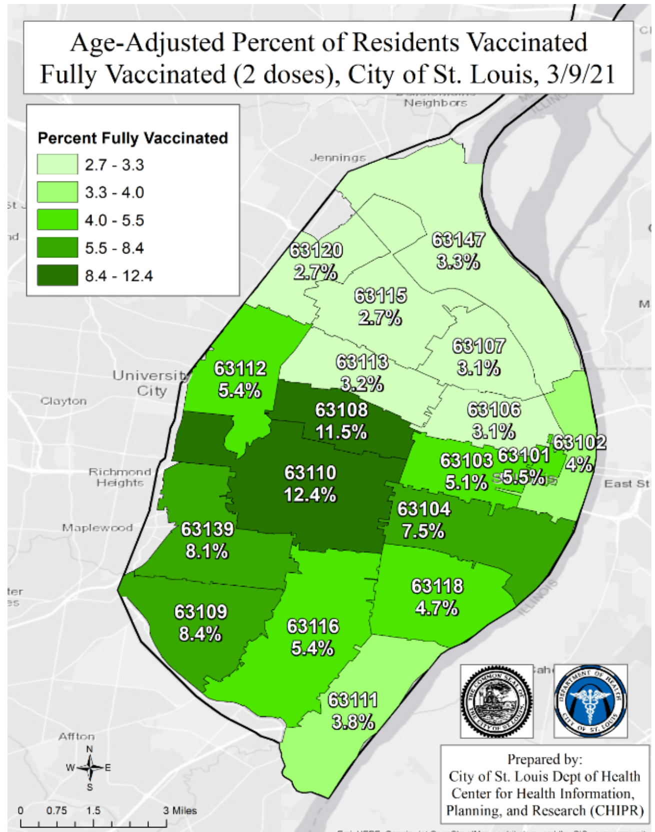


Figure 9.5 Vaccination Rates by ZIP:
Fully vaccinated



Figures 9.4 and 9.5 show the age-adjusted proportion of the ZIP code population that has been vaccinated with 1 or 2 doses as of March 9, 2021. Rates of at least one dose received range from 5.2% in 63120 to 17.6% in 63110. And rates of fully vaccinated populations range from 2.7% in 63115 to 12.4% in 63110. These maps show the disproportionate geographical distribution of vaccine across the City. The highest rates are among ZIP codes that include the major hospital systems BJC and SSM, so it is logical that these areas have higher rates due to the number of Phase 1A healthcare workers that reside close to where they work. But the gap between North and South City vaccination rates is substantial.

The Department of Health uses an online pre-registration survey to collect residents' information to help determine eligibility for the vaccine and extend invitations to mass vaccination events held by the DOH. The proportion of survey responses resembles the geographic distribution in the above maps, with far higher response rates in the southern ZIP codes than in northern ZIP codes. Longstanding systemic inequities may leave northern residents at a disadvantage when attempting to register, due to lack of computer access, fluency of internet navigation, advanced age, disability, or knowledge of how and where to register. Some of the discrepancy in vaccination and registration may also be due to vaccine hesitancy. To help address these inequities the DOH has held several mass vaccination events specifically for residents of North City, and has made efforts to secure vaccines for vulnerable populations through the Dept. of Health and Human Services Functional Needs Registry.

Figures 9.6 and 9.7 demonstrate vaccinations by age group. We would expect for vaccinations to increase by age group, in an effort to protect older adult populations. Figure 9.6 illustrates that those ages 30-39 and 60-69 are the most vaccinated groups in the City. Figure 9.7 illustrates that those ages 30-39 have greater vaccine adherence, having received the most amounts of the second dose. This could simply be due to a delay in vaccine delivery, but it may be an issue with vaccine adherence. Stressing the importance of both doses for protective efficacy is critical to ensure that the City is able to work towards herd immunity.

Figure 9.6 Vaccinations by Age Group

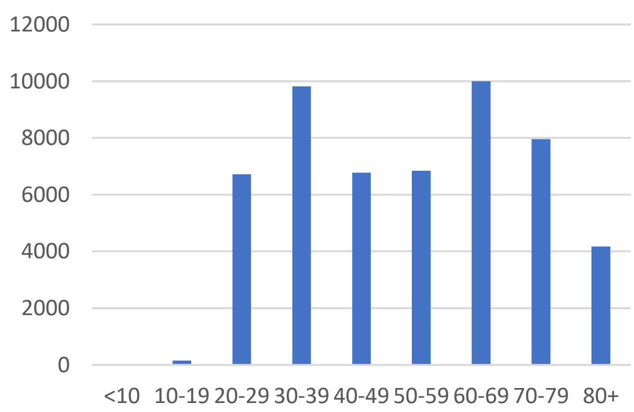
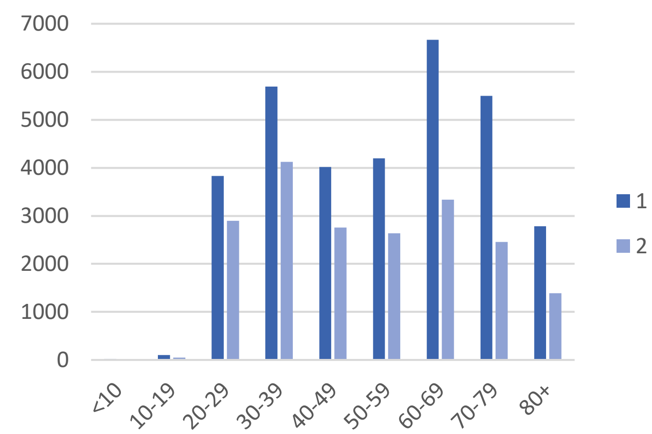


Figure 9.7 Vaccinations by Age Group and Dose



X. Modeling

a. St. Louis Regional Comparative Modeling Network

The City of St. Louis has been engaged with academic and health systems partners to model the pandemic since June, 2020. DOH epidemiologists participate and help lead modeling projects as part of the St. Louis Regional Comparative Modeling Network (STL CMN), which is a collaborative effort bringing together a wide array of experts in the field, from health care systems like BJC, SSM, and Mercy, academic institutions like Washington University, St. Louis University, University of Missouri St. Louis, and local and state public health associations from Missouri, and recently Illinois. The Network has 4 key topic areas that projects focus on including 1) testing, tracing and transmission, 2) prevention and behavior, 3) syndromic surveillance, and 4) vaccination and immunity. Projects include modeling state-wide school attendance policies in relation to case rates by school district in MO, comparing trends of influenza-like illness symptoms to COVID-like symptoms in the State's syndromic surveillance system ESSENCE, and creating projections of hospitalization and ventilator use. Additionally, the Network is engaging systems science experts to create causal loop diagrams, which highlight the virtuous and vicious cycles that affect COVID-19 transmission. This Network is a unique and unprecedented workgroup that works in tandem with the Pandemic Task Force to provide evidence to support data-driven decision making.

b. TRACE-STL

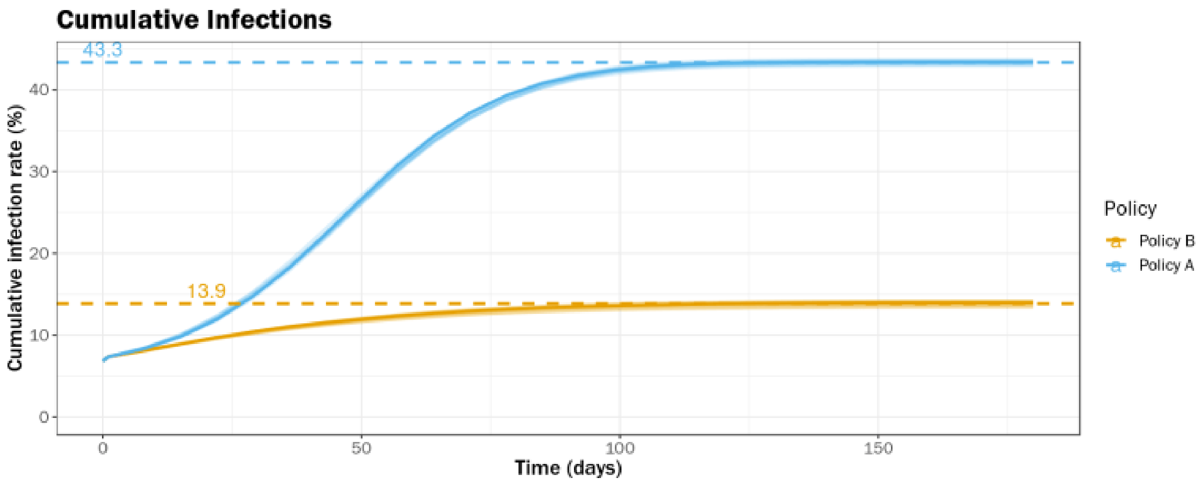
The City of St. Louis Department of Health worked with a team from the Brookings Institution Center on Social Dynamics and Policy and Washington University in St. Louis on a computational simulation model to help determine how the COVID-19 pandemic can be effectively contained in St. Louis over the coming six months. The project is called "TRACE-STL" (Testing Responses through Agent-based Computational Epidemiology in St. Louis). Read a more detailed summary on the Brookings Institution website www.brookings.edu/trace-stl.

The spread of new highly contagious SARS-Cov-2 variants, the pace of the roll-out of effective vaccines, and available resources for other, simultaneous control efforts like adherence to public health mitigation measures (e.g. mask mandates, social distancing and avoiding big crowds) are important factors that will determine how quickly the pandemic will end. The aim of the modeling project was to adapt and extend an existing nationally-representative simulation to the City of St. Louis and St Louis metro area to rapidly answer questions about how policies and practices implemented by the City of St. Louis Department of Health and neighboring jurisdictions can minimize cases of COVID-19 in the coming months. The project developed a highly realistic simulation model that uses a "synthetic" population representing the entire St. Louis metro region, including the consideration of individual attributes (e.g. age) and where residents live or work. It also includes all the latest science and data on the properties of the SARS-Cov-2 virus and how it spreads.

The project conducted approximately 50,000 simulations that exhaustively explored a wide range of policy choices and potential epidemiological conditions. Overall, analysis using the model found that current control measures already in place in St. Louis were effective. It also projected the mitigation efforts would continue to be effective unless underlying conditions change (for example, if a new and more infectious variant of SARS-Cov2 becomes widespread in St. Louis or via prematurely relaxed testing and social distancing measures). The analysis found that if new variants become widespread, additional control measures will likely be needed—and the model identified multiple specific policy options for the Department of Health that would be expected to be effective in this circumstance.

One of the most important findings from the simulation model was the continued importance of widespread use of well-fitted facemasks by the general public in the coming months. The simulations showed if a high percentage of the population wears a facial covering properly and routinely when outside their homes, the impact of any newly contagious variants would be largely contained.

Figure 10.1 TRACE-STL projections of cumulative infection with current PCR testing (A) vs increased PCR testing (B)



An interactive dashboard was created for the project (https://brookings-csdp.shinyapps.io/trace-stl-dash/), where users can experiment themselves with the various policy options and underlying epidemiological assumptions. Two different sets of parameters can be compared side by side to show the effect of differences in policy.

For example, Figure 10.1 shows that increasing the rate of PCR testing in the region would substantially cut the spread of infection. This is true even with all other policies held constant, but is especially effective in combination with increased contact tracing [see policy B vs policy A].

XI. Conclusions

The aim of this report was to make specific conclusions about vulnerable populations in the City and vaccine dissemination. Through this report, we can report that African American men and women continue to be at greatest risk of fatality following COVID-19 diagnosis and have the highest counts among all COVID-19 cases in general. Case counts are increasing among those above the age of 50 and those above the age of 80 have the greatest fatality risk. Fatality risk increases with age group. Early interventions for resources, testing, and safety information invested in North City have resulted in decreased case counts in North City, with greater case counts among South City, downtown and Central West End.

As vaccinations are disseminated, data informs us that most vaccines are being distributed in central parts and some South parts of the City. Historical mistrust of institutionalized medicine has resulted in the majority of vaccines being disseminated to Caucasians, with decreased counts among African Americans and other races. Vaccine dissemination was expected to increase as age did, ensuring that older adults most vulnerable would be receiving the vaccine, however, vaccination record data shows that those ages 30-39, 60-69 and 70-79 have received the most vaccines. In fact, those ages 30-39 are the most vaccinated in the City across the board. Increasing vaccinations among older adults through clinics may be critical to protect the older adult population in the City of St. Louis. Working to engage with older adults and people of color to ensure they are vaccinated is critical as we move forward through the pandemic.

a. Conclusion: Moving Forward

As COVID-19 has progressed throughout the country, we have learned several things. The most vulnerable populations susceptible to COVID-19 has fluctuated throughout the pandemic, but it is critical that we not lose sight of the lessons of the pandemic as we progress to the “new normal” with vaccination roll-out. Having a solid data infrastructure for management and collection is critical to ensure that reliable data is available for analysis, visualization, and communication. While there is a great deal of data to work with, there are gaps since the beginning of the pandemic. Knowing the accurate percentage of cases among health care workers would help determine the risk.

Scientific understanding of the virus and its transmission changed over time and as a result, interventions changed as well. Stay-At-Home orders were initially effective but difficult to continue at risk of economic shutdown. Masks were initially in short supply; therefore, the public was discouraged to purchase them. As it became clear that COVID-19 was an airborne virus, masks became and are still critical to ensure the safety of everyone. Further use of masks and social distancing measures are critical to ensure that the safety of the general public. Solidifying and encouraging these safety precautions can help minimize disease transmission and help develop faith and trust in the City of St. Louis Department of Health.

The Department of Health is expanding its data management and infrastructure team to continue improving the data-driven response to the COVID-19 pandemic and other diseases that affect the City of St. Louis. Reliable and accurate data collection with consistent data definitions are critical for data analysis and communication across stakeholders and community partners.

We also hope to strengthen the collaborative relationships between City departments and agencies, and with health partners, such as FQHCs, the major regional health systems, and academic partners. The cooperation and coordination between the Department of Health and partners have greatly improved as a result of the common goals shared across all sectors to end the pandemic and protect the community. Continuing to foster these collaborative efforts will assist in ensuring that reliable data further informs the data-driven efforts to curb disease transmission.

As we expand to vaccination dissemination, use of geographic distribution is also important to ensure that vaccination clinics target those are eligible as soon as possible. However, in the face of historical mistrust of institutionalized medicine among people of color, ensuring that individuals develop trust in our Department of Health and information through reliable and accurate data.

XII. Appendices

Appendix A: References

1. Berlin G, Darino L, Greenfield, M, Starikova I. (June 7, 2019) Women in the healthcare industry. McKinsey & Company: Healthcare Systems & Services. Retrieved from https://www.mckinsey.com/industries/healthcare-systems-and-services/our-insights/women-in-the-healthcare-industry#.
2. Sanche S, Lin YT, Xu C, Romero-Severson E, Hengartner N, Ke R. (July 2020). High contagiousness and rapid spread of severe acute respiratory syndrome coronavirus 2. Research: Emerging Infectious Diseases,26 (7), 1470-1477.
3. Cori A, Ferguson NM, Fraser C, Cauchemez S. A New Framework and Software to Estimate Time-Varying Reproduction Numbers During Epidemics. American Journal of Epidemiology, Nov 2013, 178 (9): 1505-1512. https://doi.org/10.1093/aje/kwt133
4. Thompson RN, Stockwin JE, van Gaalen RD, et al. Improved inference of time-varying reproduction numbers during infectious disease outbreaks, Epidemics, Dec 2019, 29 (100356): 1755-4365. https://doi.org/10.1016/j.epidem.2019.100356
5. Nishiura H, Linton NM, & Akhmetzhanov AR. Serial interval of novel coronavirus (COVID-19) infections. International Journal for Infectious Diseases. April 2020, 93: 284-286. https://doi.org/10.1016/j.ijid.2020.02.060
6. Du Z, Xu X, Wu Y, et al. Serial Interval of COVID-19 among Publicly Reported Confirmed Cases. Emerging Infectious Diseases. 2020;26(6):1341-1343. doi:10.3201/eid2606.200357
7. Getis A & Ord JK. The analysis of spatial association by use of distance statistics. Geographical Analysis 24, no. 3. 1992.
8. Mitchell A. The ESRI Guide to GIS Analysis, Volume 2. ESRI Press, 2005.

Appendix B: Confidence Intervals

Table 12.1 Confidence Intervals for Risk Ratios by Age Group, Fatality Report

Age Group	Odds Ratio	95% Confidence Interval
20-29	0.0011	0.0002, 0.0077
30-39	0.0064	0.0026, 0.0156
40-49	0.0263	0.0153, 0.0452
50-59	0.0674	0.0473, 0.0959***
60-69	0.1981	0.1555, 0.2525***
70-79	0.5009	0.4018, 0.6244***

***Statistically significant ($p < 0.05$)

The confidence intervals for those 50-59, 60-69, and 70-79 do not overlap with each other, indicating that in comparison to those above the age of 80, the risk ratios are statistically significant.