Data Analysis Report to the City of Chelsea

COVID positive cases:

March 3, 2020, through August 9, 2020

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Executive Summary and Key Takeaways:

During September of 2020, health equity analysis was conducted on data extracted from the MAVEN database. A total of 3302 positive COVID-19 cases were analyzed to identify trends, frequencies, and correlations between social determinants of health and outcomes.

Analysis of this database revealed significant findings that can help shape public health strategy and policy in Chelsea going forward:

1. **Improving data quality is an essential step in tracking the spread and impact of COVID:**

Actions steps to improve the quality of data collection could include:

   a. Revise current protocols for classifying race/ethnicity/Hispanic and ensure that all Hispanics are consistently classified.
   b. Establish a protocol to ensure there is consistent classification of Hispanics.
   c. Code for Ethnicity according to federal standards, which are Hispanic and Latino or non-Hispanic and Latino.
   d. Establish a protocol to explain the difference in coding for: Unknown, NA, and No.
   e. Propose an additional response- RTA (Refused to answer) and LTF (lost to follow up) to determine pubic behavior and trust in the contact tracing system.
   f. Ensure all variables in the dataset are completed, especially regarding employment.
   g. Check to see if "possible exposure location" is captured on MAVEN. If it is not, discuss the possibility of adding this variable since it is already being collected at a local level.
      i. Establish an exact protocol on how locations will be collected to ensure external researchers can understand location.
   b. Establish monthly monitoring and analysis of the database to provide feedback to contact tracers and city staff on the importance and relevance of data quality.

2. **In Chelsea, those most likely to get COVID are Hispanic essential workers in their 40´s and retired persons.**
3. **Almost 35% of positive cases have no symptoms.**

4. **Patients take about one week between the onset of symptoms to testing, which may lead to increased spreading.**
5. **Retired persons and older people are more likely to be hospitalized and die of COVID.**
6. **While Hispanics are less likely to die of COVID, those with cardiac or pulmonary diseases, hypertension, and diabetes are much more likely to die of COVID.**
7. **While women are less likely than men to be hospitalized, pregnant women are highly likely to be hospitalized.**
8. **Those with asthma, unemployed, and retired persons are much more likely to be hospitalized.**

Action steps in response to trends in COVID outcomes:

1. Public health messaging to inform the public that 35% of COVID cases in Chelsea are asymptomatic.
2. Public health messaging should consider these results and target subgroups specifically to inform them of added risks:
    i. Targeting youth- that younger people are not at risk of being hospitalized and dying, their older family members are. They can keep their elders safe by stopping the spread of COVID to older generations and those with asthma, hypertension, and heart disease.
    1. Targeting seniors- The senior center and other culturally relevant spaces could inform elders with hypertension, pulmonary and cardiac disease, and asthma of their elevated risk of mortality to take extra precautions and get tested for COVID regularly.
    2. Reach out to the Senior Center, and Soldiers home to inform staff and residents about the discrepancies in symptoms among elders who present significantly less fever, chills, and aches than younger adults.
2. Direct messaging efforts at getting tested. Residents should get regularly tested (every two to four weeks) as symptoms vary by age groups and a third of cases do not present symptoms. Waiting to develop symptoms of COVID to get tested is not ideal.
3. Target the unemployed to register for MassHealth to reduce delays in seeking care and access preventative health.
4. Adopt a city-wide strategy to address social determinants of health, including reducing diabetes, asthma, heart, pulmonary diseases, and hypertension.

Introduction:

COVID among Latinos

The epidemic has disproportionately impacted the U.S. Latinx population. According to the CDC, Latinxs represent 34.6% of all COVID positive cases, representing only 14% of the U.S. population (CDC, 2020). In comparison, Black non-Hispanic represent 20.8% of cases, Asians 3.6%, Native Americans 1.4%, and other racial and ethnic groups 4% of cases. It is important to note that half of all cases still lack race and ethnicity data, contributing to the lack of data transparency on COVID cases.

This over-representation in Latinx COVID-19 cases highlights systemic issues related to work and living conditions, access to healthcare, and the perception of risk and access to COVID-19 prevention information and mitigation strategies. In Massachusetts, Chelsea residents have six times the rate of COVID-19 than the rest of the state. Chelsea is a highly vulnerable city, yet the impact of COVID has surpassed predictions of vulnerability and consequence.

Researchers have stated that COVID-19 is occurring against a backdrop of social and economic inequalities in existing health conditions, including NCDs and inequity in the social determinants of health. The high prevalence of pre-existing conditions, including NCDs, may have exacerbated the incidence and severity of COVID-19 in Latinx communities (Bambra et al., 2020).

Health among Latinx Communities

Latinxs represent 18.3% of the U.S. population, reaching 59.9 million in 2018 (US Census Bureau, 2020). This number often does not include undocumented Latinx who are not counted in the Census. The Brookings Institute estimates that approximately 10-12 million undocumented people are in the U.S., of which half are from Mexico, and 1.9 million are from Central America (Stenglein, 2019). Latinx workers are much more likely to work in low-wage jobs, and in 2017 one in five Latinx workers were paid poverty wages (Mijente Support Network and the Labor Council for Latin American Advancement, 2020).

Before the COVID pandemic, Latinx populations represented the majority of low-wage workers in the U.S., with only 38.2% having access to health care. Since the pandemic, half of Latinx report they or someone they know has either lost their job or taken a pay cut. Undocumented workers are not counted in unemployment statistics, do not qualify for benefits under the CARES act, and cannot file for unemployment (Mijente Support Network and the Labor Council

for Latin American Advancement, 2020). According to CNN, although all demographic groups have experienced significant unemployment increases, Latinx unemployment has reached nearly 19%, the highest of all demographic groups (CNN, 2020).

Latinx populations are disproportionately affected by NCDs, with Mexican American groups having rates as high as those seen in low and middle-income countries (Reininger et al., 2015). Existing comorbidities including hypertension, diabetes, asthma, chronic obstructive pulmonary disease, heart disease, liver disease, cancer, cardiovascular disease, obesity, and smoking are known to increase the rate and severity of COVID-19 (Bambra et al., 2020).

Latinx communities have significantly less access to healthcare services, affected by their acculturation, language, and immigration status. Undocumented folks delay access to healthcare services out of fear of reporting to ICE. Those who recently arrived in the U.S. or have limited English skills may be unaware of how to access services (Escarce & Kapur, 2006). According to the Office of Minority Health, Latinxs have the highest uninsured rates in the country at 17.8%, compared to 5.9% of the non-Hispanic White population (The Office of Minority Health, HHS, 2019).

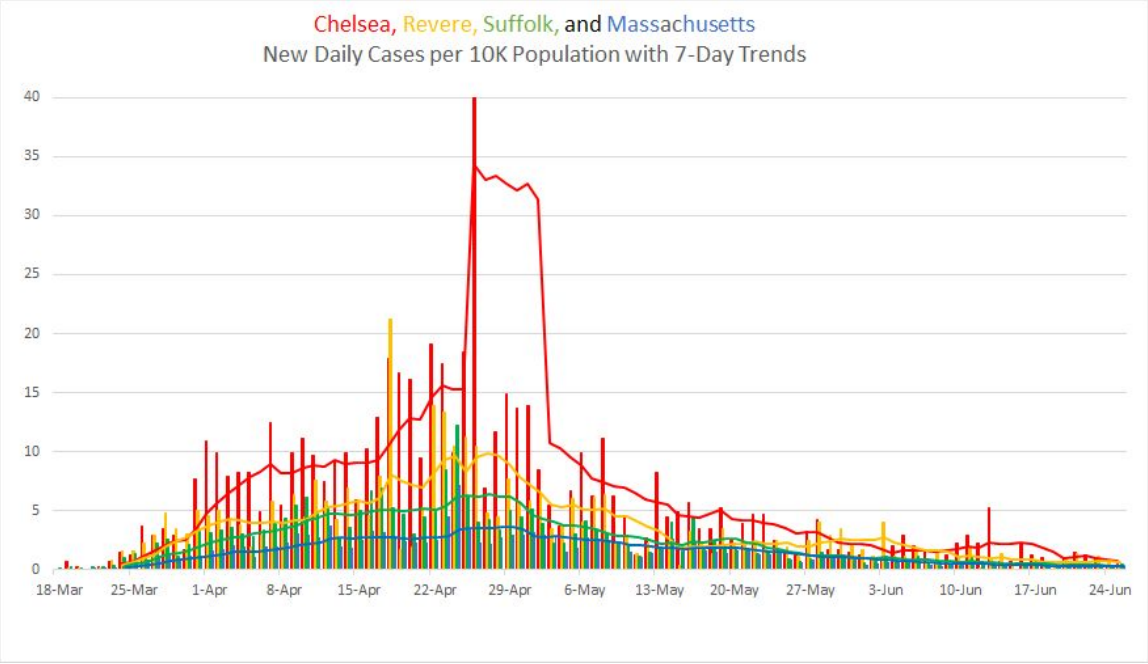
Decades of research on social determinants of health have concluded that marginalized communities are at higher risk of infections, even without underlying health conditions. Chronic stress and psychological determinants of health lead to immunosuppression (Bambra et al., 2020). Constant feelings of exclusion, powerlessness, and collective threat affect the immune system and impact NCDs' risk and may impact individual and collective responses to disease and epidemics. We see this through both delays in accessing care and demanding attention to a devastating outbreak for fear of reprisal.

High rates in NCDs reflect inequalities in social determinants of health. Latinx populations chronically suffer from stressful living and working conditions, insecure housing and food, and potential harassment from employers, landlords, and authorities, including ICE. Latinx groups are more likely to work in low-wage jobs where they are exposed to adverse working conditions and lack of workers' protections and rights. It cannot be ignored that Latinx groups migrate from countries where these conditions are rampant and endemic. The transgenerational effect of food and economic insecurity, political conflict, low-intensity conflicts, revolution and war, and the recent Narco and gang realities in Mexico and Central America must be included in any understanding of the health and wellbeing of Latinx populations.

The impact of COVID in Chelsea

The city of Chelsea occupies about two square miles north of Boston. It has an estimated formal population of 40,000 residents, but informal estimates claim there may be up to 75,000 residents (Editorial Board, Boston Globe, 2020). For the week of June 10, 2020, right after the peak in cases, Chelsea had recorded 2839 cumulative cases of COVID, at a rate of 7537 per 100,000. 7444 individuals had been tested with a positive rate of 38.14%. The state had reported 100,158 cases with a rate of 1437 per 100,000 and a positive testing rate of 15% (Massachusetts Department of Public Health, 2020). During this time, Chelsea had a COVID-19 rate almost six times higher than the state average, and many of those tested were positive, indicating low access to testing (Barry, 2020). In short, the community of Chelsea was the hardest hit in Massachusetts.

By the week of September 30, Chelsea had registered a cumulative total of 3596 cases, with 99 cases reported in the second half of September. The positivity rate had reduced to 2.75%, indicating that both the absolute number of cases had decreased while the number of people being tested has significantly increased in the last few months (Massachusetts Department of Public Health, 2020).



(Source: Department of Planning and Development Chelsea, 2020)

Chelsea holds many of the reasons mentioned above why the COVID epidemic spread so rapidly and had such a severe impact. Many Chelsea residents are immigrants from Central America,

are undocumented, and are low-wage or essential workers. Chelsea residents live in overcrowded housing and lack access to health care and social services (The Boston Globe, 2020). The Governor's Command Center established a hotel for isolation and quarantine of positive patients, yet it was closed down in early June due to lack of use (Chelsea Record, 2020).

It was essential to conduct data analysis of data collected in Chelsea through contact tracing of positive cases to understand the impact of COVID-19 on Chelsea. Therefore, the Chelsea Local Board of Health requested the dataset from the Massachusetts Department of Health in August 2020. Data analysis was carried out during September and October 2020.

Goal: To conduct health equity analysis to understand the impact of COVID-19 in Chelsea.

Methods:

The lead researcher received the dataset from MDPH through a secure and private email server to protect privacy. The first step involved cleaning and recoding the dataset for consistency, relevance, and efficiency in the data analysis.

After cleaning the data set and recoding certain variables, the following issues and trends were identified in the data collection:

1. Incomplete data: a number of cases had incomplete data, for example, hospital admit data but no discharge date, although the person was marked as recovered.
2. Race-ethnicity data: There seems to be confusion over how to code race and ethnicity. Other/unknown/NA are used almost interchangeably. If a person was marked as Hispanic, they are often labeled as "other" in race, although not always. While some Hispanics were marked as "white" and others marked as "unknown." Where "unknown" was marked, it was re-coded to "other."
3. Addresses: Some address data was incomplete. Some Zip Codes were marked as NA when the address was clearly in Chelsea.
4. Symptoms: A number of symptoms were marked as "unknown." Again, it is unclear whether "unknown" is used interchangeably with "No" or "NA." In some instances, "loss of sense of smell and taste" was in the notes section but not checked off in the symptoms box.
5. Gender: Some contacts were marked as NA. There seems to be no option for non-binary or anything other than male-female.
6. Overall missing data: Most of the missing data is on employment, race, and ethnicity. These variables are key to understanding the epidemic and are not being collected consistently.
7. Variables not captured: There is no information on how many people live in a household and no variable for "possible exposure location." These are key variables that can help stop the spread and are collected during the contact tracing conversation.
8. Unclear responses: It is unclear what the difference is between NA and UNKNOWN. There is no option for "refused to answer," which is different from Lost to Follow-up or that the person does not know. Adding this response option would help understand people's trust in the contact tracing process.

Recoding the Dataset

To prepare the data for analysis, it was necessary to recode certain variables for clarity and consistency.

1. Lab facilities included the name and address of the lab. These were recoded for simplicity, and a codebook was created for reference (See appendix A). We identified 34

labs where Chelsea residents are getting tested for COVID. Mass General Hospital was most frequently used.

2. Comorbidities were registered in nine columns under the title "underlying_illness." The columns were fused, which resulted in one column with Yes/no/NA and four columns listing comorbidities, which was the maximum amount that any case listed. All types of cancers were recoded as "cancer."
3. "Other symptoms" were recoded to capture patterns. All body aches were recoded as "bodyache" and symptoms that had their own columns were corrected. Notes about the course of care were deleted.
4. All variables marked as "unknown" were recoded as NA.
5. "Case_Hospialized" included three columns and were merged into one that notes either Yes/No/NA.
6. All cases who were hospitalized and coded as UNKNOWN outcome were recoded as LTF (Loss of Follow up).
7. All data related to occupation were merged into one row.

Data was analyzed using R statistical programming. Frequency tables and histograms were used for frequency data, and logistic regression and odds ratios were determined for questions related to social determinants of health.

Four research questions were answered by the dataset that relate to the impact of COVID-19 on individuals according to gender, race/ethnicity, employment status and comorbidities. These four questions include:

•Are symptoms related to gender, race, or comorbidities?

•Are outcomes related to gender, race, employment, or comorbidities?

•Is there any variable that can explain a higher risk of hospitalization or death?

•Do jobs, gender, race, or comorbidities affect the type of symptoms reported?

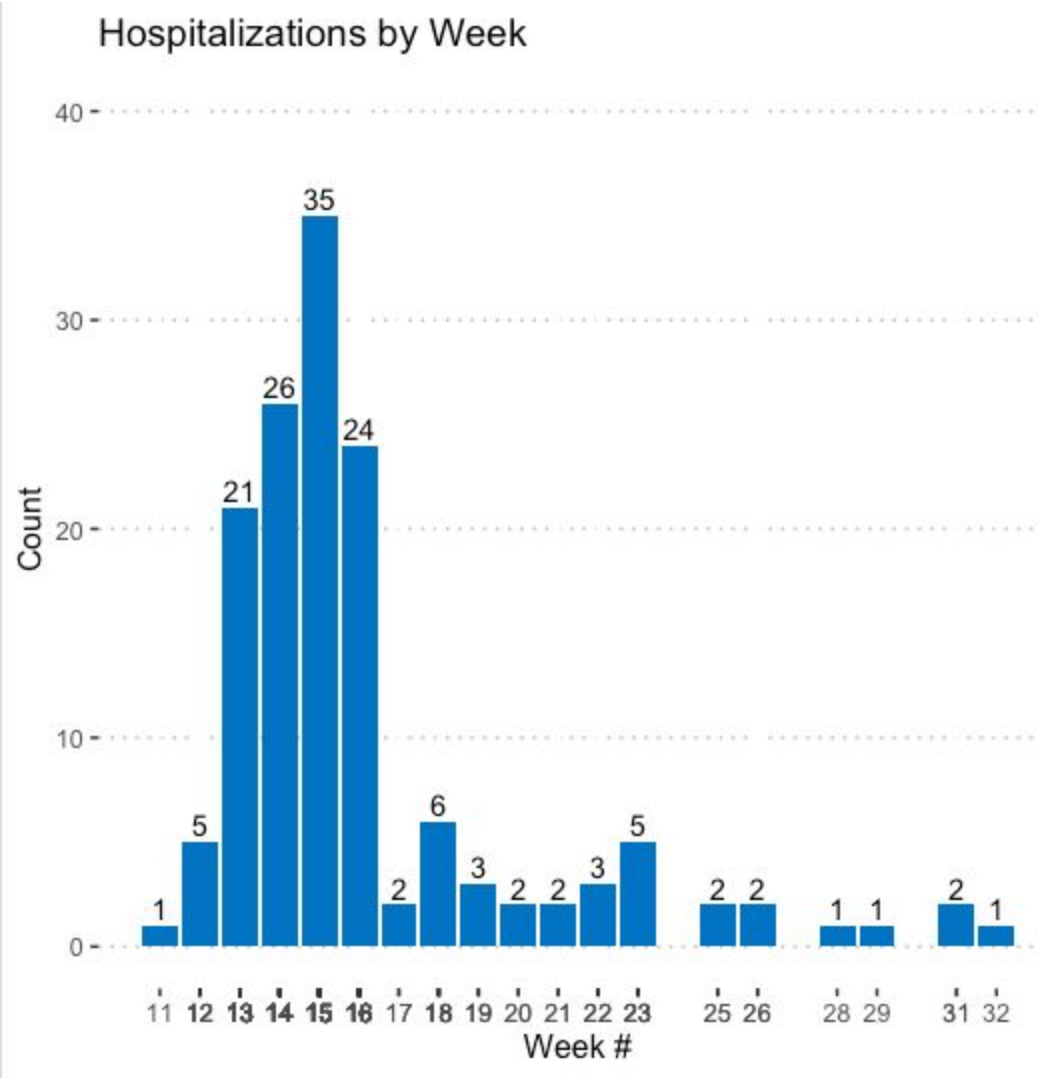
Results:

1. **Total number of cases: 3302**

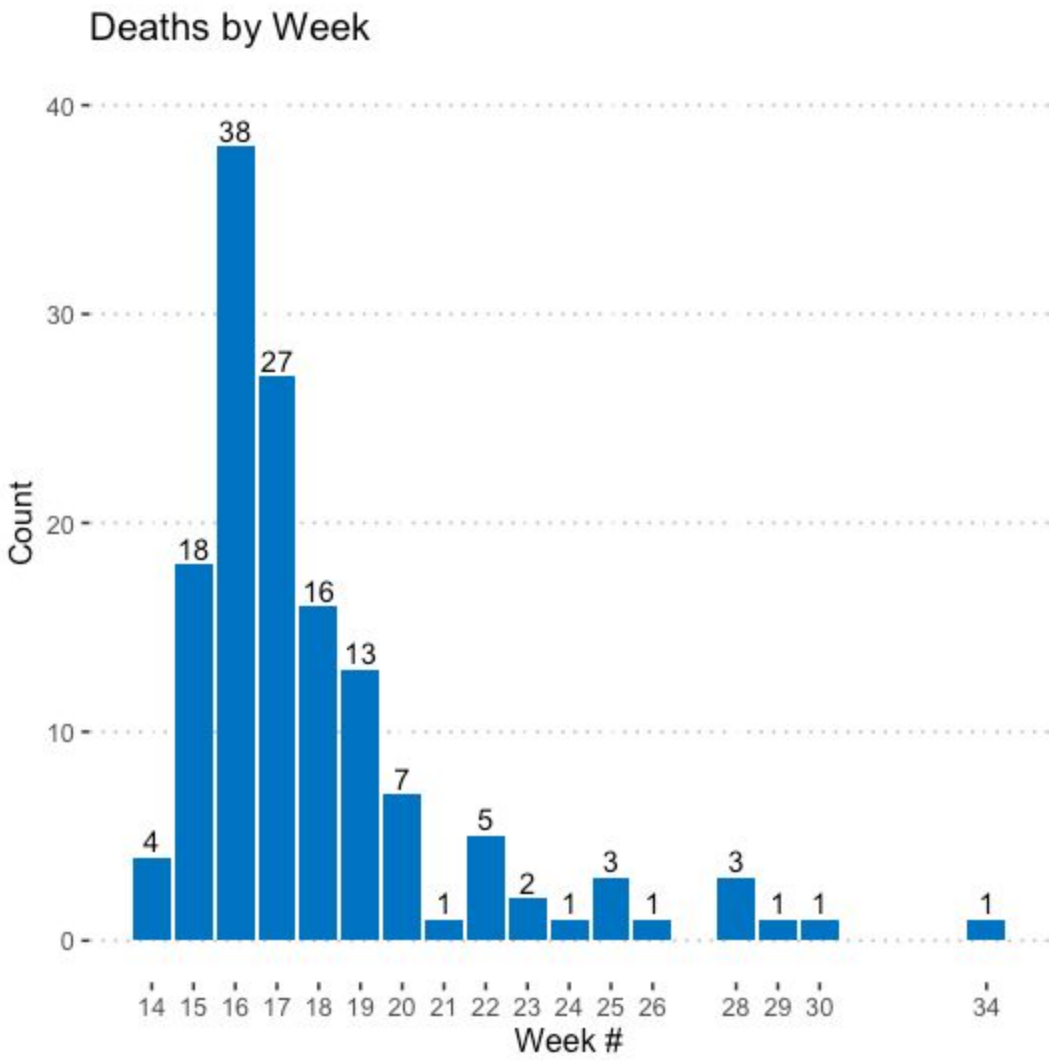
2. **Missing Data:**
   Outcomes: 1711 (51.8%)
   Race: 570 (17.3%)
   Ethnicity: 3292 (99.7%)
   Hispanic: 642 (19.4%)
   Sex: 39 (1.2%)
   Date of symptoms onset: 2708 (82.0%)
   Hospitalization: 1945 (58.9%)
   Discharge from Hospital (among those hospitalized): 179 (62.5%)
   Total number hospitalized - 286
   Employment: 2550 (77.2%)

3. **Cases by dates**

   a. Hospitalizations by dates (weeks): Peak hospitalizations were between weeks 13 and 16 (March 23 to April 19)



b. Deaths by dates: Peak deaths occurred between weeks 15 and 19 (April 6 to May 10)

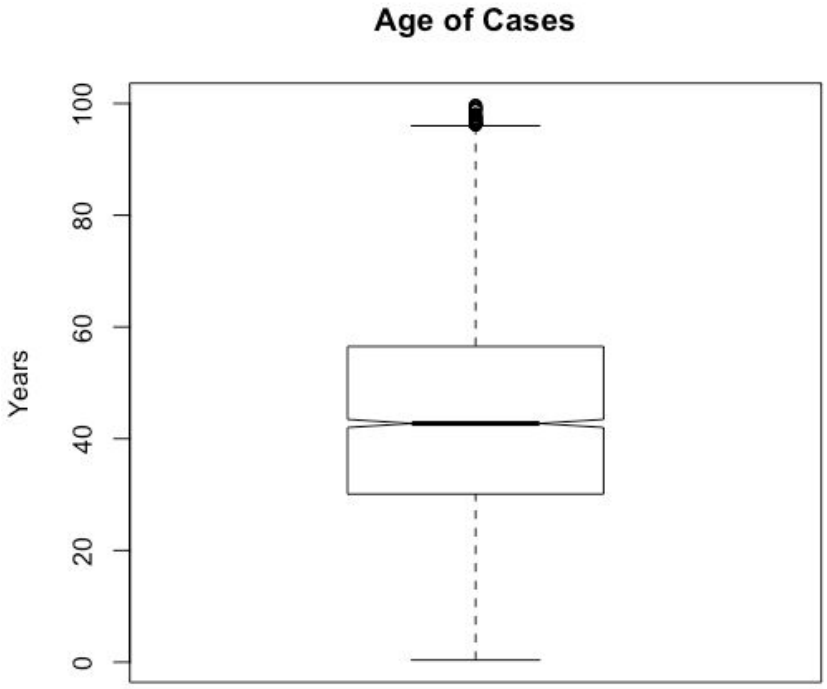


4. **Demographic and Case Information:**

a. Average age of cases: 44.2 years

b. Average age by gender:

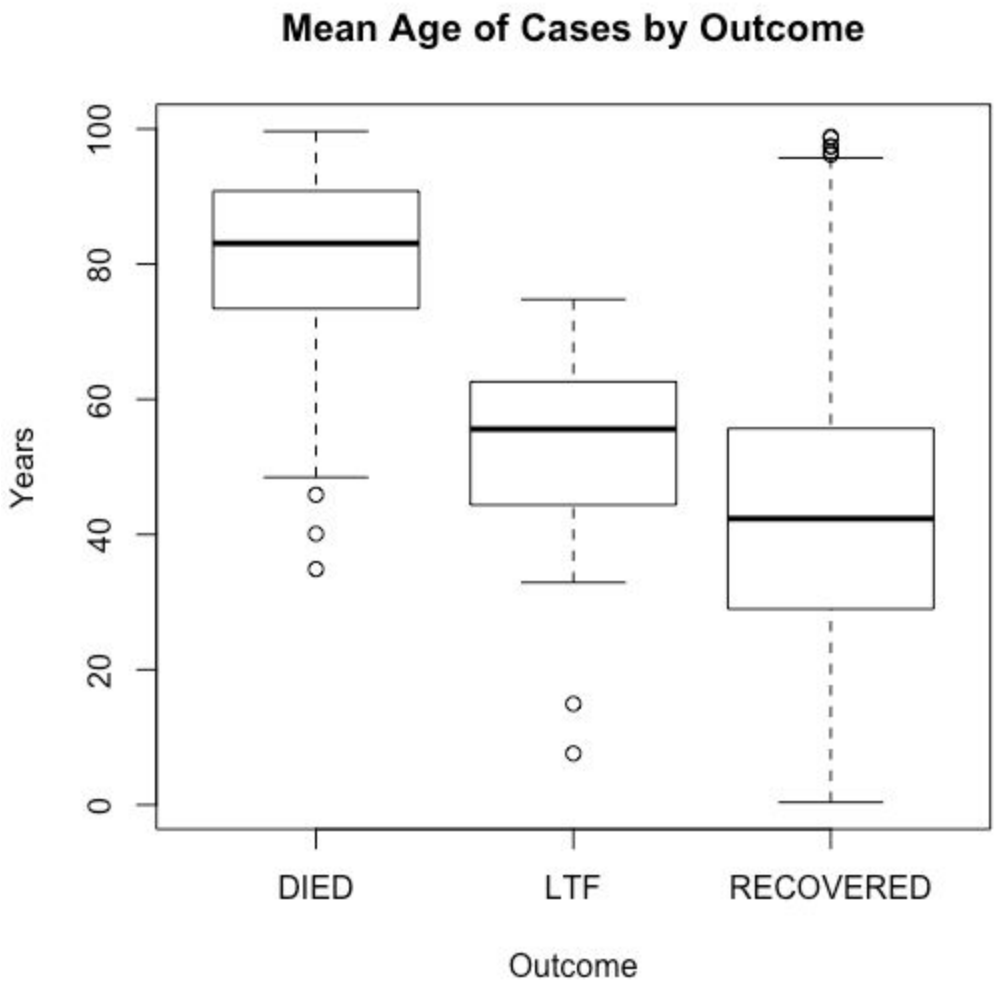
Female - 44.4 years
Male - 43.9 years


Age of Cases
Years
0
20
40
60
80
100


Mean Age of Cases by Gender
Years
0
20
40
60
80
100
Female
Male
Gender

c. Average age by outcome:

Died - 80.7 years
Recovered - 43.2 years
LTF - 49.4 years



d. Mortality related to gender:

	Female	Male
DIED	69	73
RECOVERED	750	662

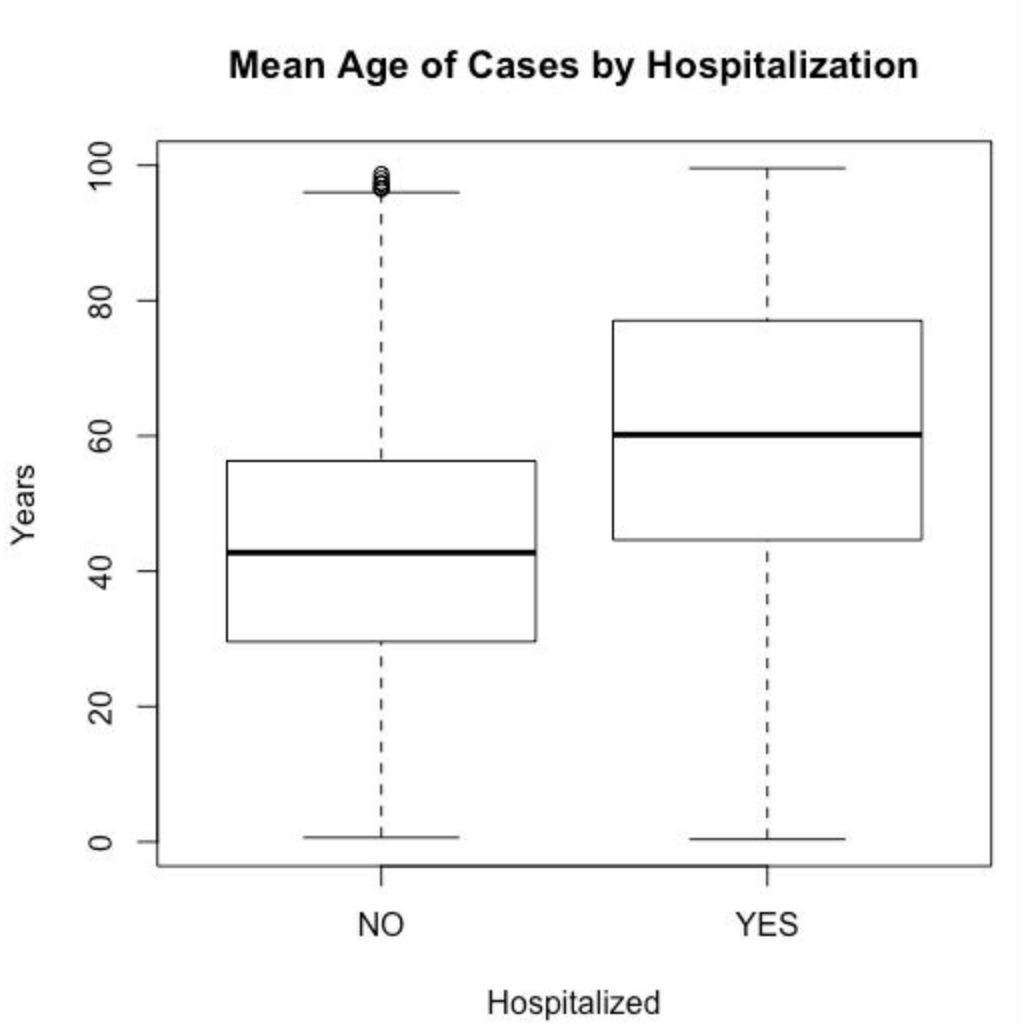
Pearson's Chi-squared test with Yates' continuity correction

data: genderdeath
X-squared = 0.88591, df = 1, p-value = 0.3466

There appears to be no difference in mortality rate of women as compared to men.

e. Average age by hospitalization:

Yes - 58.7 years
No - 44.4 years



f. Cases by race/ethnicity:

Race

American Indian or Alaskan Native	3 (0.1%)
Asian	16 (0.6%)
Black or African American	105 (3.7%)
White	634 (22.2%)
Other	1974 (69.1%)

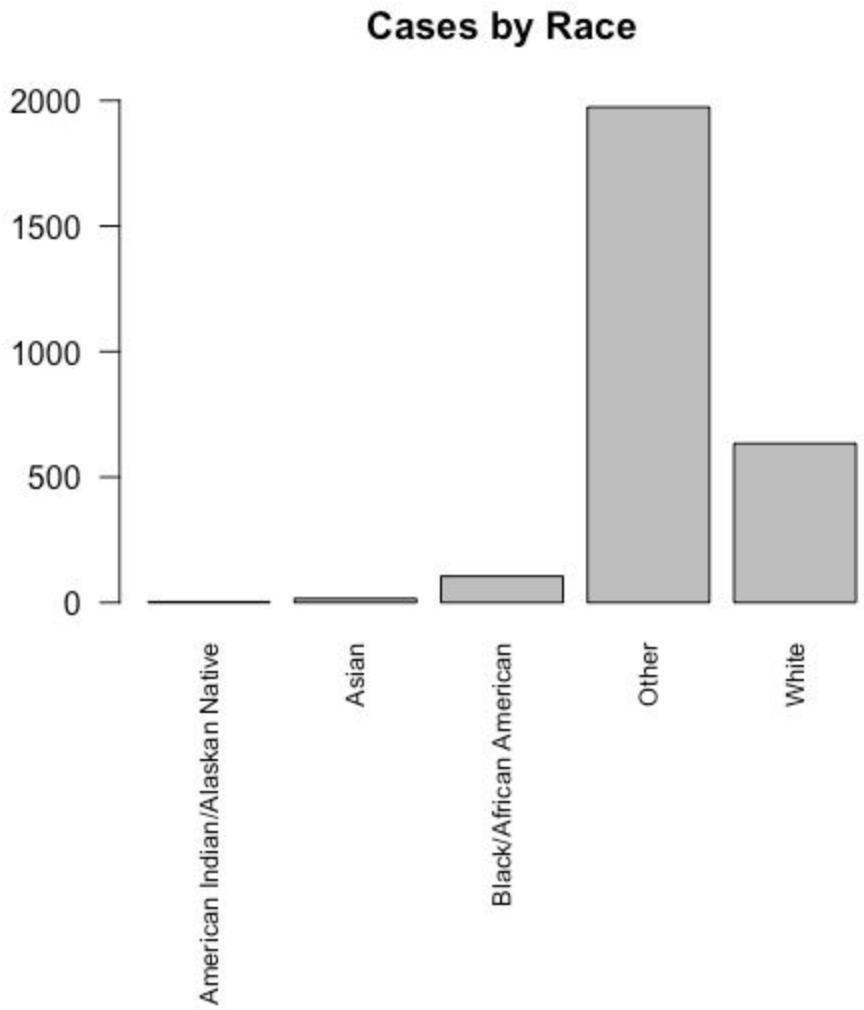
Ethnicity

African American	1 (8.3%)
American	1 (8.3%)
Columbian	1 (8.3%)
Dominican	1 (8.3%)
Honduran	2 (16.7%)
Mexican	1 (8.3%)
Middle Eastern	1 (8.3%)
Puerto Rican	1 (8.3%)
Salvadoran	1 (8.3%)
Unknown	2 (16.7%)

Hispanic:

Yes - 1938 (59.7%)
No - 722 (22.2%)
Unknown - 642 (19.4%)

Bar Chart of Cases by Race



5. **Lab testing**

Days between testing and result by Lab

AFC	NaN days
ARUP	4.00 days
BC	0.17 days
BIDMC	0.00 days
BIO	1.67 days
BMC	0.98 days
BMH	1.50 days
BROAD	0.96 days
CAPE	0.00 days
CHA	0.54 days
HVMA	NaN days
LABCORP_NC	7.00 days
LABCORP_NJ	2.33 days
LAHEY	1.00 days
LGH	0.00 days
MAYO	2.20 days
MDL	NaN days
MDPH	1.56 days
MGH	0.41 days
NSM	0.25 days
QUEST	2.03 days
QUEST_CA	7.33 days
QUEST_PA	5.00 days
QUEST_VA	4.57 days
SHATTUCK	NaN days

STLIZ	0.00 days
TUFTS	0.74 days
UMASS	0.00 days
VA	NaN days
VA_CT	NaN days
VA_RX	NaN days

Number of tests by lab

AFC	1
ARUP	1
BC	6
BIDMC	392
BIO	3
BMC	91
BMH	6
BROAD	300
CAPE	1
CHA	63
HVMA	3
LABCORP_NC	1
LABCORP_NJ	116
LAHEY	1
LGH	1
MAYO	5
MDL	1
MDPH	149
MGH 1	1113

NSM	4
QUEST	772
QUEST_CA	3
QUEST_PA	2
QUEST_VA	30
SHATTUCK	1
STLIZ	1
TUFTS	35
UMASS	3
VA	2
VA_CT	4
VA_RX	27

Most frequently used lab by turnaround time:

Lab	**Turnaround time**	**Number of Tests**
BIDMC	0.00 days	392
BROAD	0.96 days	300
LAPCORP NJ	2.33 days	116
MDPH	1.56 days	149
MGH	0.41 days	1113
QUEST	2.03 days	772

Average time between symptom onset and results in general: 7.1 days

6. **Clinical Characteristics:**
    a. Hospitalized
        i. Average hospitalization time: 7.9 days
    b. Outcomes
        i. Recovered - 1434 (90.1%)
        ii. Died - 142 (8.9%)
        iii. Lost to Follow-up - 15 (0.9%)

    c. Underlying illness
        i. Specific comorbidities

1	ADRENAL	1
2	ALCOHOLISM	2
3	ANXIETY	1
4	ARTHRITIS	2
5	ASTHMA	23
6	CANCER	6
7	CARDIAC_DISEASE	18
8	CHRONIC_PULMONARY_DISEASE	31
9	CHRONIC_RENAL_DISEASE_OR_HEMODIALYSIS	9
10	DEMENTIA	4
11	DIABETES	58
12	EMPHYSEMA	1
13	EPILEPSY	1
14	GASTRITIS	2
15	HEART TRANSPLANT	1
16	HEMIPLEGIA	1
17	HYPERTENSION	48
18	IBS	1

19	IMMUNOCOMPROMISED	2
20	KIDNEY TRANSPLANT	1
21	LIVER_DISEASE	3
22	MS	1
23	MYASTHENIA	2
24	ONE KIDNEY	1
25	PARAPLEGIA	1
26	PARKINSONS	1
27	PRE-DIABETES	2
28	PREGNANT	6
29	SEIZURES	4
30	SINUSITIS	1
31	SLEEP APNEA	1
32	STROKE	3
33	THYROID	3
34	ANEMIA	1
35	CARDIOVASCULAR DISEASE	2
36	CEREBRAL PALSY	1
37	CIRRHOSIS	2
38	CORONARY ARTERY DISEASE	2
39	HYPERLIPIDEMIA	1
40	OBESITY	1
41	OTHER	1
42	PARKINSON'S DISEASE	1
43	DIASTOLIC DYSFUNCTION	1
44	GANGRENOUS LIMB	1

Summary of most frequent comorbidities:

1	ASTHMA	23
2	CARDIAC_DISEASE	18
3	CHRONIC_PULMONARY_DISEASE	31
4	DIABETES	58
5	HYPERTENSION	48
6	PREGNANT	6

ii. Comorbidities related to deaths

1	ALCOHOLISM	2
2	CANCER	3
3	CARDIAC_DISEASE	10
4	CHRONIC_PULMONARY_DISEASE	12
5	CHRONIC_RENAL_DISEASE_OR_HEMODIALYSIS	5
6	DEMENTIA	3
7	DIABETES	13
8	HEART TRANSPLANT	1
9	HEMIPLEGIA	1
10	HYPERTENSION	17
11	LIVER_DISEASE	3
12	MYASTHENIA	1
13	PARAPLEGIA	1
14	PARKINSONS	1
15	SEIZURES	4
16	CARDIOVASCULAR DISEASE	2
17	CEREBRAL PALSY	1

18	CIRRHOSIS	1
19	CORONARY ARTERY DISEASE	2
20	OBESITY	1
21	OTHER	1
22	PARKINSON'S DISEASE	1
23	STROKE	2
24	DIASTOLIC DYSFUNCTION	1
25	GANGRENOUS LIMB	1
26	HIGH BLOOD PRESSURE	1

d. Symptoms:
    i. Among those who answered, 865 (65.1%) had symptoms -
        1. Single symptom - 92 (6.9%)
        2. Multiple symptoms - 773 (58.2%)
    ii. 463 (34.9%) had no symptoms

e. Average time between symptoms onset date and results
    i. By race/ethnicity

Asian	4.3 days
Black or African American	4.9 days
White	7.5 days
Other	6.7 days
Unknown	6.9 days
American Indian or Alaskan Native	missing
Hispanic	7.7 days

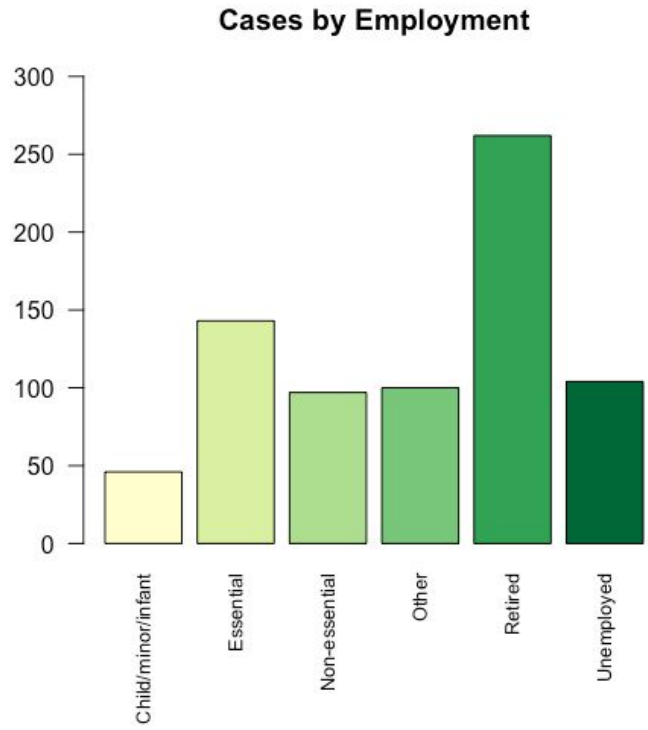
7. Employment:

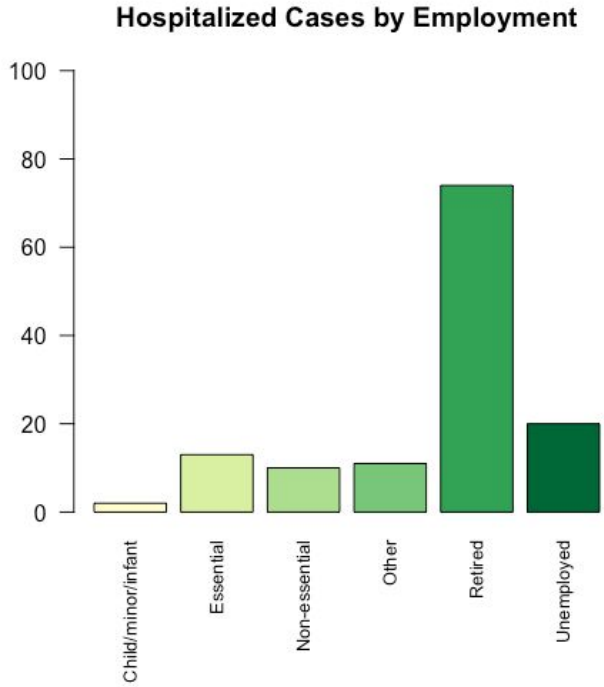
a. Cases by Type of employment:

Essential	143 (19.0%)
Non-essential	97 (12.9%)
Retired	262 (34.8%)
Unemployed	104 (13.8%)
Child/minor/infant	46 (6.1%)
Other	100 (13.3%)

Among those hospitalized:

Essential	13 (10.0%)
Non-essential	10 (7.7%)
Retired	74 (56.9%)
Unemployed	20 (15.4%)
Child/minor/infant	2 (1.5%)
Other	11 (8.5%)


Cases by Employment
300
250
200
150
100
50
0
Child/minor/infant
Essential
Non-essential
Other
Retired
Unemployed


Hospitalized Cases by Employment
100
80
60
40
20
0
Child/minor/infant
Essential
Non-essential
Other
Retired
Unemployed

8. Health Equity analysis

Health Equity analysis involved logistic regression and Odds Ratios to understand the relationship between social determinants of health (gender, race and comorbidities) to outcomes of COVID-19 (symptoms, hospitalization and mortality).
Four research questions guided the analysis and are summarized below with responses. The full regression tables and Odds Ratios are presented in the appendix for the reader's clarity and ease.

1. Are symptoms related to gender, race or comorbidities?

We can conclude that there is no significant difference in symptoms reported according to race, gender, or comorbidities.

2. Are outcomes related to gender, race, employment, or comorbidities?

After controlling for gender and comorbidities, we conclude that compared to those who are White, those who identify as Other have 0.11 times the odds of dying ($p < 0.05$). Therefore, those who identify as Other are 89% less likely to die than those of other races.

After controlling for gender and race, we conclude that compared to those who have no comorbidities, those who had cardiac disease had 132.6 times the odds of dying ($p < 0.05$), those who had chronic pulmonary disease had 131.4 times the odds of dying ($p < 0.05$), those who had diabetes had 40.3 times the odds of dying ($p < 0.05$), and those who had hypertension had 116.5 times the odds of dying ($p < 0.05$).

2b. Do certain jobs affect the outcome of the disease?

After controlling for gender and race, we conclude that compared to those who work in essential services, those who were retired had 78.5 times the odds of dying ($p < 0.05$).

3. Is there any variable that can explain a higher risk of hospitalization?

After controlling for comorbidities and type of employment, we conclude that females had 0.38 times the odds of hospitalization compared to men ($p < 0.05$). Therefore, females are 62% less likely to be hospitalized.

After controlling for gender and type of employment, we conclude that those who were pregnant had 27.45 times the odds of hospitalization compared to those with no comorbidities ($p<0.05$).

After controlling for gender and comorbidities, we conclude that those who were unemployed had 5.94 times the odds of hospitalization compared to those working in essential services ($p<0.05$) and those who were retired had 17.44 times the odds of hospitalization compared to those working in essential services ($p<0.05$).

4. Do jobs, gender, race, or comorbidities affect the type of symptoms reported?
We can conclude that there is no significant difference in abdominal pain, appetite loss, cough, diarrhea, loss of smell or taste, or vomiting symptoms reported according to race, gender, comorbidities, or employment.

Chills:
After controlling for race, gender, and comorbidities, we can conclude that those who are retired have 0.02 times the odds or are 98% less likely to report chills compared to those who work in essential services. Children have 0.16 times to the odds or are 84% less likely to report chills compared to those who work in essential services ($p<0.05$).

Shortness of Breath:
After controlling for gender, comorbidities, and employment, we can conclude that those who identified themselves as Other had 4.70 times the odds of reporting shortness of breath or difficulty breathing compared to those who identified themselves as White ($p<0.05$).

After controlling for gender, race, and employment, we can conclude that those who had asthma had 6.1 times the odds of reporting shortness of breath or difficulty breathing compared to those who did not report comorbidities ($p<0.05$).

Fever:
After controlling for gender, comorbidities, and race, we can conclude that those who are retired had 0.24 the odds or are 76% less likely to report fever compared to those who work in essential services ($p<0.05$).

Headache:
After controlling for gender, comorbidities, and race, we can conclude that those who are retired had 0.02 times the odds or 98% less likely to report a headache compared to those who work in essential services ($P<0.05$). Children had 0.23 times the odds or were 77% less likely to report a headache compared to those who work in essential services ($P<0.05$).

After controlling for gender, employment, and race, we can conclude that those with diabetes had 0.35 times the odds, or 65% less likely to report a headache compared to those who work in essential services ($P<0.05$).

Muscle Aches and Pain:
After controlling for gender, comorbidities, and race, we can conclude that those who are retired had 0.02 times the odds, or are 98% less likely to report muscle aches and pain compared to those who work in essential services ($P<0.05$) . Children had 0.09 times the odds, or are 91% less likely to report muscle aches and pain compared to those who work in essential services ($P<0.05$)

Sore Throat:
After controlling for gender, comorbidities, and race, we can conclude that those who are retired had 0.05 times the odds, or are 95% less likely to report a sore throat compared to those who work in essential services ($P<0.05$).

Conclusion and Discussion:

The data analysis reveals some conclusions similar to the national impact of COVID and others specific to the City of Chelsea. While it will always be difficult to determine exactly what caused Chelsea to have such high rates of COVID, we can determine aspects of the health and behavior of Chelsea residents that contributed to the spread and outcomes of the pandemic.

Although this research provides important insights into the pandemic's impact on Chelsea residents, it is important to note that it also has several limitations that must be stated. The lack of consistent data collection on variables such as race/ethnicity, employment, and outcome may have limited the results. We believe that more complete data collection would reveal more refined analysis and may suggest that other comorbidities also impact the outcome of the disease. These limitations reveal the importance of improving the training and on-boarding of contract tracers, as from April to August volunteers from the Academic Public Health Volunteer Corps and staff from Partners in Health assisted the city in contact tracing. They also highlight the importance of trust-building between government officials who call residents to solicit private information during a time of mass fear and uncertainty over the pandemic. We do not know how many of the missing variables are due to "refused to answer" as this option is not available in the dataset. Adding this option would provide improved insight onto where to direct data quality improvements.

A second important limitation is that the data presented offers insight into the pandemic's first six months. Since August, testing capacity and access have significantly improved in Chelsea, and rates have gone down. It would be important to carry out monthly assessments of disease behavior and 3 month or six month analysis to observe changes in disease impact to evaluate public health interventions and outcomes of COVID-19 cases in the city.

In Chelsea, those most likely to get COVID are Hispanic essential workers in their 40´s and retired persons. Patients take about one week between the onset of symptoms to testing, which may lead to increased spreading during that week, putting both co-workers, family, and friends at risk for exposure. Disease spread is particularly salient among the almost 35% of cases that reported no symptoms.

The majority (34.8%) of COVID cases in Chelsea were among retired persons who are more likely to be hospitalized and die of COVID. This cohort is also less likely to experience fever, chills, body aches, sore throat, and headaches, which tend to be socially understood as classic

COVID symptoms. The data suggest that there may be significant delays in seeking COVID testing and care in retired persons due to a lack of identifiable symptoms of the disease. Again, this may contribute to the spread and may also contribute to the gravity of symptoms and outcomes.

Regarding social determinants of health, as seen in the rest of the country, the presence of cardio-vascular comorbidities are highly correlated with mortality in outcomes. While Hispanics are less likely to die of COVID, individuals with cardiac or pulmonary diseases, hypertension, and diabetes are much more likely to die of COVID, regardless of their race, ethnicity, or gender. In addition, while women are less likely than men to be hospitalized, pregnant women are highly likely to be hospitalized. While their outcomes tend to be favorable, we are aware that pregnant women with COVID may have an increased risk of premature birth, induced labor, and cesarean birth, all of which pose important health risks to the mother and the baby both in the short and long term. Finally, those with asthma, those unemployed and retired persons are much more likely to be hospitalized.

Recommendations and Next Steps:

The analysis provided insight into both the quality of data collected on COVID cases and the impact of COVID on Chelsea residents. Therefore, we recommend that the City take steps to integrate the analysis results into Public Health management and policy.

Data Quality:

1. Revise current protocols for classifying race/ethnicity/Hispanic and ensure that all Hispanics are consistently classified.
2. Establish a protocol to ensure there is consistent classification of Hispanics.
3. Code for Ethnicity according to federal standards, which are Hispanic and Latino or non-Hispanic and Latino.
4. Establish a protocol to explain the difference in coding for: Unknown, NA and No.
5. Propose an additional response- RTA (Refused to answer) and LTF (lost to follow up) to determine pubic behavior and trust in the contact tracing system.
6. Ensure all variables in the dataset are completed, especially those pertaining to employment.
7. Check to see if "possible exposure location" is captured on MAVEN and if it is not, discuss the possibility of adding this variable since it is already being collected at a local level.
    i. Establish a clear protocol on how locations will be collected to ensure external researchers can understand location.
8. Establish monthly monitoring and analysis of the database to provide feedback to contact tracers and city staff on the importance and relevance of data quality.

Public Health Information and Interventions:

1. Public health messaging to inform the public that 35% of COVID cases in Chelsea are asymptomatic.
2. Public health messaging should consider these results and target subgroups specifically to inform them of added risks:
    a. Targeting youth- that younger people are not at risk of being hospitalized and dying, their older family members are. They can keep their elders safe by stopping the spread of COVID to older generations and those with asthma, hypertension, and heart disease.
    b. Targeting seniors- The senior center and other culturally relevant spaces could inform elders with hypertension, pulmonary and cardiac disease, and asthma of

their elevated risk of mortality to take extra precautions and get tested for COVID regularly.

   c. Reach out to the Senior Center and Soldiers home to inform staff and residents about the discrepancies in symptoms among elders who present significantly less fever, chills, and aches than younger adults.

3. Direct messaging efforts at getting tested. Residents should get regularly tested (every two to four weeks) as symptoms vary by age groups and a third of cases do not present symptoms. Waiting to develop symptoms of COVID to get tested is not ideal.
4. Target the unemployed to register for MassHealth to reduce delays in seeking care and access preventative health.

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Appendix 1: Lab Codes

	Recode as:	Lab Facility
1	AFC	AFC Urgent Care
2	ARUP	Associated Regional and University Pathologists Inc - 500 Chipeta Way, Salt Lake City, Ut 84108, (801) 583-2787
3	BIDMC	Beth Israel Deaconess Medical Center/East - 330 Brookline Avenue, Boston, MA 02215, (617) 735-3648
4	BIO	Bio Reference Laboratories Inc. - 481 Edward H Ross Drive, Elmwood Park, NJ 07407 (201) 791-2600
5	BC	Boston Children's Hospital Clinical Labs - 300 Longwood Avenue, Boston, MA 02115, (617) 355-6000
6	BMC	Boston Medical Center - One Boston Medical Center Place, Boston, MA 02118, (617) 638-8000
7	BMC	Boston Medical Center/Department of Anatomic Pathology - One Boston Medical Center Place, Boston, MA 02118, (617) 414-5314
8	BWH	Brigham and Women's Hospital Clinical Laboratories - 75 Francis Street Amory 2 Room 215, Boston, MA 02115, (617) 732-6360
9	BROAD	Broad Institute CRSP - Clinical Research Sequencing Platform, LLC Broad Institute of MIT and Harvard 320 Charles St. Cambridge, MA 02141
10	CHA	Cambridge Health Alliance Laboratory - 1493 Cambridge Street, 3rd Floor Lab Cambridge, MA 02139, (617) 665-1226
11	CAPE	Cape Cod Hospital - 27 Park Street, Hyannis, MA 02601, (508) 862-5024
12	HVMA	HVMA-Needham - 152 Second Avenue , Needham, MA 02494, (781) 292-7200
13	LABCORP_NC	Laboratory Corporation of America - 1447 York Court, Burlington, NC 27215 (336) 584 -5171
14	LABCORP_NJ	Laboratory Corporation of America - 69 First Avenue, Raritan, NJ 08869 (908) 526-2400
15	LAHEY	Lahey Clinic Medical Center - 41 Mall Road Box 541, Burlington, MA 01805, (781) 744-5100
16	LGH	Lawrence General Hospital, Lab Satellite GE - 34 Haverhill Street, Lawrence,

	MA 01841, (978) 683 4000
17 SHATTUCK	Lemuel Shattuck Hospital - 170 Morton Street, Jamaica Plain, MA 02130, (617) 971-3550
18 MGH	Massachusetts General Hospital Department Of Pathology - 55 Fruit Street, GRB 539, Boston, MA 02114, (617) 726-2275
19 MAYO	Mayo Clinic Labs, 3050 Superior Drive Northwest, Rochester, MN 55901 (507) 538-7260
20 MDL	Medical Diagnostic Laboratories, L.L.C., 2439 Kuser Road, Hamilton, NJ 08690 (609) 570-1000
21 NA	NA
22 NSM	North Shore Medical Center Salem - 81 Highland Avenue, Salem, MA 01970, (978) 354-4130
23 NA	Other Hospital/Health Facility
24 QUEST	Quest Diagnostics - 200 Forest Street 3rd Floor, Marlborough, MA 01752, (774) 369-3900
25 QUEST_CA	Quest Diagnostics Infectious Disease, Inc - 33608 Ortega Hwy Bldg B-West Wing, (714) 220-1900
26 QUEST_VA	Quest Diagnostics Nichols Institute - 14225 Newbrook Drive PO Box 10841, Chantilly, VA 20153, (703) 802-6900
27 QUEST_PA	Quest Diagnostics Of Pennsylvania Inc - 875 Greentree Road 4 Parkway Center, Pittsburgh, PA 15220, (420) 920-7675
28 STLIZ	Steward St. Elizabeth's Medical Center Laboratory - 736 Cambridge Street Cbr-2, Boston, MA 02135, (617)789-3299
29 TUFTS	Tufts Medical Center - 800 Washington Street, Floating 3 MS Box 115, Boston, MA 02111, (617) 636-7216
30 UMASS	UMass Memorial Medical Center Incorporated - 365 Plantation Street, Worcester, MA 01605, (774) 442-9615
31 VA	VA Boston Healthcare System - Boston Opc - 251 Causeway Street 2nd Fl Rm 270, Boston, MA 02114, (617) 248-1173
32 VA_RX	VA Boston Healthcare System - West Roxbury - 1400 VFW Parkway Orea Bldg 1st Fl 1B02, West Roxbury, MA 02132, (617) 323-7700
33 VA_CT	VA Connecticut Healthcare System - 950 Campbell Avenue, West Haven, CT

	06156 (203) 932-5711
34 MDPH	William A Hinton State Laboratory Institute - 305 South Street, Jamaica Plain, MA 02130, (617) 983-6201

Appendix 2: Statistical Analysis of symptoms related to gender, race and comorbidities

Health Equity Statistical Results

1. **Are symptoms related to gender, race or comorbidities?**

*reference group for gender = Male,
ref group for race = White,
ref group for comorbidities = None

Call:
glm(formula = sympff ~ + + , family = binomial,
data = chelds_comp)

Deviance Residuals:

Min	1Q	Median	3Q	Max
-2.5721	0.2747	0.3093	0.3976	0.5545

Coefficients:

	Estimate Std.	Error	z value	Pr(>|z|)
(Intercept)	2.4982	0.6005	4.160	3.18e-05 ***
Female	0.7489	0.4491	1.667	0.0954
ASIAN	15.9932	4610.2829	0.003	.9972
BLACK/AFRICAN AMERICAN	15.4749	2275.7149	0.007	0.9946
OTHER	-0.2313	0.5986	-0.386	0.6992
ASTHMA	15.7257	1483.3376	0.011	0.9915
CARDIAC DISEASE	-0.4723	1.1324	-0.417	0.6766
CHRONIC PULMONARY DISEASE	0.1537	1.0699	0.144	0.8858
DIABETES	0.7723	1.0478	0.737	0.4611
HYPERTENSION	0.5791	1.0523	0.550	0.5821
PREGNANT	15.5502	2662.8561	0.006	0.9953

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

(Dispersion parameter for binomial family taken to be 1)

Null deviance: 171.17 on 406 degrees of freedom
Residual deviance: 162.78 on 396 degrees of freedom
(2895 observations deleted due to missingness)

AIC: 184.78

Number of Fisher Scoring iterations: 17

We can conclude that there is no significant difference in symptoms reported according to race, gender, or comorbidities.

Appendix 3: Statistical Analysis of outcomes related to gender, race, employment and comorbidities

2. Are outcomes related to gender, race, employment, or comorbidities?

*reference group for gender = Male,
ref group for race = White,
ref group for comorbidities = None,
ref group for outcomes = Recovered,
ref group for employment = Essential

high collinearity between employment and comorbidities - did 2 different regressions

A. Gender, race, comorbidities - Do certain jobs affect the outcome of the disease?

Coefficients:

	Estimate Std.	Error	z value	Pr(>|z|)
(Intercept)	-3.8877	1.0713	-3.629	0.000285 ***
Female	-0.7352	0.4999	-1.471	0.141370
ASIAN	1.4487	2.6865	0.539	0.589722
BLACK_AFRICAN_AMERICAN	-0.9179	0.9425	-0.974	0.330113
OTHER	-2.1835	0.5337	-4.091	4.29e-05 ***
ASTHMA	-12.2079	1630.6945	-0.007	0.994027
CARDIAC_DISEASE	4.8873	1.1803	4.141	3.46e-05 ***
CHRONIC_PULMONARY_DISEASE	4.8781	1.1347	4.299	1.72e-05 ***
DIABETES	3.6957	1.1583	3.191	0.001420 **
HYPERTENSION	4.7580	1.1248	4.230	2.33e-05 ***
PREGNANT	-11.7596	2662.8563	-0.004	0.996476

ODDS RATIO + 95% CI of significant variables

	OR	2.5 %	97.5 %
OTHER	0.11	.037	0.31
CARDIAC_DISEASE	132.6	18.4	2886.8
CHRONIC_PULMONARY_DISEASE	131.4	20.4	2707.8
DIABETES	40.3	5.7	851.1
HYPERTENSION	116.5	18.70	2388.3

After controlling for gender and comorbidities, we conclude that compared to those who are White, those who identify as Other have 0.11 times the odds of dying ($p < 0.05$).

After controlling for gender and race, we conclude that compared to those who have no comorbidities, those who had cardiac disease had 132.6 times the odds of dying ($p < 0.05$), those who had chronic pulmonary disease had 131.4 times the odds of dying ($p < 0.05$), those who had diabetes had 40.3 times the odds of dying ($p < 0.05$), and those who had hypertension had 116.5 times the odds of dying ($p < 0.05$).

2B. Gender, race, employment - Do certain jobs affect the outcome of the disease?

No comorbidities

Coefficients:

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	-4.2306	1.0587	-3.996	6.44e-05
Non-essential	-14.8159	1218.5738	-0.012	0.9903
Unemployed	0.9695	1.2341	0.786	0.4321
Retired	4.3626	1.0433	4.181	2.90e-05 ***
Other	-14.8679	1210.6036	-0.012	0.9902
Child/minor/infant	-14.9340	1713.1631	-0.009	0.9930
Female	-0.3640	0.2773	-1.313	0.1893
AMERICAN_INDIAN_ALASKAN_NATIVE	-19.3340	10754.0130	-0.002	0.9986
ASIAN	-0.7195	1.2361	-0.582	0.5605
BLACK_AFRICAN_AMERICAN	-1.1949	0.6772	-1.764	0.0777 .
OTHER	-0.3363	0.3741	-0.899	0.3688

	OR	2.5 %	97.5%
Retired	78.5	15.6	1434.8

After controlling for gender and race, we conclude that compared to those who work in essential services, those who were retired had 78.5 times the odds of dying ($p < 0.05$).

Appendix 4: Statistical Analysis of risk of hospitalization

2. **Is there any variable that can explain higher risk of hospitalization? (sex) (race/ethnicity) (employment) (symptoms) (comorbidities)**
   *reference group for gender = Male,
   ref group for race = White,
   ref group for comorbidities = None,
   ref group for occupation = Essential

Coefficients:

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	-2.13427	0.69814	-3.057	0.002235 **
Female	-0.95770	0.39881	-2.401	0.016331 *
ASIAN	0.28781	2.12735	0.135	0.892381
BLACK_AFRICAN_AMERICAN	1.40793	1.09201	1.289	0.197295
OTHER	0.54967	0.57404	0.958	0.338292
ASTHMA	1.51374	0.81988	1.846	0.064849 .
CARDIAC_DISEASE	0.33738	1.06645	0.316	0.751732
CHRONIC_PULMONARY_DISEASE	0.83413	0.64675	1.290	0.197150
DIABETES	-0.07754	0.60166	-0.129	0.897454
HYPERTENSION	-0.62242	0.69464	-0.896	0.370237
PREGNANT	3.31236	1.24797	2.654	0.007950 **
Non-essential	0.33068	0.64060	0.516	0.605706
Unemployed	1.78128	0.55318	3.220	0.001281 **
Retired	2.85879	0.78927	3.622	0.000292 ***
Other	0.10250	0.59849	0.171	0.864011
Child/minor/infant	-0.76105	1.13173	-0.672	0.501289

	OR	2.5 %	97.5 %
Female	0.38	0.17216333	0.8305422
ASTHMA	4.54	0.80714068	22.0413209
PREGNANT	27.45	2.84959840	615.7311514
Unemployed	5.94	2.06063327	18.3640559
Retired	17.44	3.97326117	89.7731536

After controlling for comorbidities and type of employment, we conclude that females had 0.38 times the odds of hospitalization compared to men ($p < 0.05$).

After controlling for gender and type of employment, we conclude that those who were pregnant had 27.45 times the odds of hospitalization compared to those with no comorbidities ($p<0.05$).

After controlling for gender and comorbidities, we conclude that those who were unemployed had 5.94 times the odds of hospitalization compared to those working in essential services ($p<0.05$) and those who were retired had 17.44 times the odds of hospitalization compared to those working in essential services ($p<0.05$).

Appendix 5: Statistical Analysis of the impact of jobs, gender, race or comorbidities on type of symptoms reported

4. Do jobs, gender, race, or comorbidities affect the type of symptoms? *Controlling for gender, race, and comorbidities

Abdominal pain

Coefficients:

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	-1.497e+00	7.367e-01	-2.032	0.0422 *
Non-essential	3.733e-01	5.068e-01	0.737	0.4614
Unemployed	2.459e-01	5.433e-01	0.453	0.6509
Retired	-1.679e+01	3.395e+03	-0.005	0.9961
Other	-9.295e-03	5.316e-01	-0.017	0.9860
Child/minor/infant	-1.010e+00	1.153e+00	-0.876	0.3809
Female	-1.971e-01	4.036e-01	-0.488	0.6254
ASIAN	-1.707e+01	6.523e+03	-0.003	0.9979
BLACK_AFRICAN_AMERICAN	-1.670e+01	3.412e+03	-0.005	0.9961
OTHER	6.898e-01	6.300e-01	1.095	0.2736
ASTHMA	-1.766e+01	2.428e+03	-0.007	0.9942
CARDIAC_DISEASE	1.069e+00	1.480e+00	0.722	0.4702
CHRONIC_PULMONARY_DISEASE	-1.730e+01	2.025e+03	-0.009	0.9932
DIABETES	4.280e-01	5.687e-01	0.753	0.4517
HYPERTENSION	3.196e-01	9.029e-01	0.354	0.7234
PREGNANT	1.932e+01	6.523e+03	0.003	0.9976

We can conclude that there is no significant difference in abdominal pain reported according to race, gender, comorbidities, or employment.

Appetite loss

Coefficients:

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	-2.95326	0.88845	-3.324	0.000887 ***
Non-essential	0.03090	0.74823	0.041	0.967063
Unemployed	0.68136	0.66432	1.026	0.305052

Retired	0.58915	1.08544	0.543	0.587285
Other	0.93862	0.61814	1.518	0.128896
Child/minor/infant	1.15359	0.85100	1.356	0.175234
Female	-0.33204	0.46645	-0.712	0.476554
ASIAN	-15.75383	4603.31677	-0.003	0.997269
BLACK_AFRICAN_AMERICAN	-15.71004	2523.09121	-0.006	0.995032
OTHER	1.01062	0.74073	1.364	0.172453
ASTHMA	-16.80855	2134.75936	-0.008	0.993718
CARDIAC_DISEASE	-16.20949	2311.25331	-0.007	0.994404
CHRONIC_PULMONARY_DISEASE	-0.31775	0.87695	-0.362	0.717101
DIABETES	-0.06001	0.71999	-0.083	0.933574
HYPERTENSION	-1.00627	1.11128	-0.906	0.365197
PREGNANT	-16.75241	3213.48306	-0.005	0.995841

We can conclude that there is no significant difference in appetite loss reported according to race, gender, comorbidities, or employment.

Chills

Coefficients:

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	-0.01306	0.56125	-0.023	0.981441
Non-essential	-0.50409	0.43103	-1.169	0.242203
Unemployed	0.44395	0.44839	0.990	0.322126
Retired	-3.95654	1.18235	-3.346	0.000819 ***
Other	-0.23964	0.41602	-0.576	0.564598
Child/minor/infant	-1.83435	0.83526	-2.196	0.028081 *
Female	0.15450	0.32692	0.473	0.636492
ASIAN	2.03839	2.31468	0.881	0.378514
BLACK_AFRICAN_AMERICAN	-0.82217	1.07048	-0.768	0.442467
OTHER	0.18919	0.46815	0.404	0.686128
ASTHMA	-0.20447	0.72653	-0.281	0.778379
CARDIAC_DISEASE	0.03490	1.35450	0.026	0.979442
CHRONIC_PULMONARY_DISEASE	-0.09413	0.62957	-0.150	0.881145
DIABETES	1.13487	0.58726	1.932	0.053302 .
HYPERTENSION	-0.91084	0.64889	-1.404	0.160410
PREGNANT	-1.49532	1.18627	-1.261	0.207482

Odds ratio + 95% CI

	OR	2.5 %	97.5 %
Retired	0.02	0.0008659556	0.1349239
Child/minor/infant	0.16	0.0226360211	0.6984897

After controlling for race, gender, and comorbidities, we can conclude that those who are retired have 0.02 times the odds of reporting chills compared to those who work in essential services and those who are child/minor/infant have 0.16 times to the odds of reporting chills compared to those who work in essential services ($p<0.05$).

Cough

Coefficients:

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	-2.657e+01	2.280e+05	0	1
Non-essential	1.143e-14	2.439e+05	0	1
Unemployed	3.660e-14	2.121e+05	0	1
Retired	2.866e-14	2.524e+05	0	1
Other	-1.034e-14	2.110e+05	0	1
Child/minor/infant	4.001e-15	2.636e+05	0	1
Female	1.198e-14	1.219e+05	0	1
ASIAN	4.044e-16	3.944e+05	0	1
BLACK_AFRICAN_AMERICAN	-2.274e-15	3.150e+05	0	1
OTHER	3.340e-15	1.654e+05	0	1
ASTHMA	-4.768e-15	4.192e+05	0	1
CARDIAC_DISEASE	-3.182e-14	3.101e+05	0	1
CHRONIC_PULMONARY_DISEASE	-2.899e-14	2.118e+05	0	1
DIABETES	-2.614e-14	2.387e+05	0	1
HYPERTENSION	-2.624e-14	1.798e+05	0	1
PREGNANT	-5.377e-16	2.571e+05	0	1

We can conclude that there is no significant difference in cough symptoms reported according to race, gender, comorbidities, or employment.

Diarrhea

Coefficients:

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	-0.44085	0.60534	-0.728	0.4665
Non-essential	-0.53832	0.47625	-1.130	0.2583
Unemployed	0.15949	0.45141	0.353	0.7238

Retired	-30.37738	2036.06925	-0.015	0.9881
Other	-0.11414	0.44973	-0.254	0.7997
Child/minor/infant	-1.94648	1.10220	-1.766	0.0774 .
Female	-0.05214	0.35377	-0.147	0.8828
ASIAN	15.98527	1439.73365	0.011	0.9911
BLACK_AFRICAN_AMERICAN	-19.10071	3897.70797	-0.005	0.9961
OTHER	-0.15764	0.50434	-0.313	0.7546
ASTHMA	0.21749	0.75939	0.286	0.7746
CARDIAC_DISEASE	-16.94355	3149.06325	-0.005	0.9957
CHRONIC_PULMONARY_DISEASE	-0.71147	0.82007	-0.868	0.3856
DIABETES	1.04398	0.53511	1.951	0.0511 .
HYPERTENSION	-0.31399	0.71382	-0.440	0.6600
PREGNANT	-18.92569	5361.20078	-0.004	0.9972

ODDS RATIO + 95% CI of significant variables

	OR	2.5 %	97.5 %
Child/minor/infant	3.18e-08	NA	6.240809e+19
DIABETES	1.14	0.40520130	3.117961e+00

We can conclude that there is no significant difference in diarrhea symptoms reported according to race, gender, comorbidities, or employment.

SOB

Coefficients:

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	-1.8917	0.7028	-2.692	0.00711 **
Non-essential	-0.4748	0.4628	-1.026	0.30485
Unemployed	0.3085	0.4417	0.698	0.48487
Retired	-1.4711	0.9326	-1.577	0.11470
Other	-0.3487	0.4426	-0.788	0.43084
Child/minor/infant	-17.2644	1010.9907	-0.017	0.98638
Female	0.1351	0.3453	0.391	0.69552
ASIAN	-15.2188	2732.7346	-0.006	0.99556
BLACK_AFRICAN_AMERICAN	1.3927	1.0844	1.284	0.19905
OTHER	1.5472	0.6173	2.506	0.01220 *
ASTHMA	1.8089	0.8914	2.029	0.04243 *
CARDIAC_DISEASE	0.4829	1.2870	0.375	0.70754
CHRONIC_PULMONARY_DISEASE	0.3593	0.6190	0.580	0.56162
DIABETES	0.1353	0.5142	0.263	0.79244

HYPERTENSION	-1.3038	0.8036	-1.622	0.10471
PREGNANT	-0.8927	1.1854	-0.753	0.45137

ODDS RATIO + 95% CI of significant variables

	OR	2.5 %	97.5 %
OTHER	4.70	1.53665141	1.817026e+01
ASTHMA	6.10	1.22430444	4.723659e+01

After controlling for gender, comorbidities, and employment, we can conclude that those who identified themselves as Other had 4.70 times the odds of reporting shortness of breath or difficulty breathing compared to those who identified themselves as White ($p<0.05$).

After controlling for gender, race, and employment, we can conclude that those who had asthma had 6.1 times the odds of reporting shortness of breath or difficulty breathing compared to those who did not report comorbidities ($p<0.05$).

Fever

Coefficients:

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	0.43328	0.52063	0.832	0.4053
Non-essential	-0.32789	0.42971	-0.763	0.4454
Unemployed	0.07445	0.44463	0.167	0.8670
Retired	-1.44190	0.64463	-2.237	0.0253 *
Other	0.27893	0.43271	0.645	0.5192
Child/minor/infant	-1.21168	0.68475	-1.770	0.0768 .
Female	0.39792	0.31037	1.282	0.1998
ASIAN	0.45050	1.61509	0.279	0.7803
BLACK_AFRICAN_AMERICAN	-1.93760	1.19809	-1.617	0.1058
OTHER	-0.04579	0.42818	-0.107	0.9148
ASTHMA	-0.88550	0.72395	-1.223	0.2213
CARDIAC_DISEASE	-0.38520	0.98899	-0.389	0.6969
CHRONIC_PULMONARY_DISEASE	-0.32568	0.56106	-0.580	0.5616
DIABETES	-0.21869	0.48148	-0.454	0.6497
HYPERTENSION	-0.37161	0.55422	-0.671	0.5025
PREGNANT	-1.97559	1.18221	-1.671	0.0947 .

ODDS RATIO + 95% CI of significant variables

	OR	2.5 %	97.5 %
Retired	0.24	0.063822113	0.8120746

After controlling for gender, comorbidities, and race, we can conclude that those who are retired had 0.24 times the odds of reporting fever compared to those who work in essential services (p<0.05).

Headache

Coefficients:

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	0.41255	0.55199	0.747	0.45484
Non-essential	-0.52650	0.43403	-1.213	0.22510
Unemployed	0.03854	0.44797	0.086	0.93144
Retired	-3.78432	1.27999	-2.957	0.00311 **
Other	-0.32255	0.42502	-0.759	0.44791
Child/minor/infant	-1.45588	0.68995	-2.110	0.03485 *
Female	0.19581	0.32825	0.597	0.55082
ASIAN	1.87831	2.55774	0.734	0.46273
BLACK_AFRICAN_AMERICAN	-1.13139	1.22370	-0.925	0.35519
OTHER	0.24915	0.45493	0.548	0.58392
ASTHMA	0.29340	0.75793	0.387	0.69868
CARDIAC_DISEASE	1.10317	1.37314	0.803	0.42175
CHRONIC_PULMONARY_DISEASE	-0.79740	0.63756	-1.251	0.21104
DIABETES	-1.04377	0.52329	-1.995	0.04608 *
HYPERTENSION	-0.89100	0.62068	-1.436	0.15114
PREGNANT	-1.89052	1.18295	-1.598	0.11001

ODDS RATIO + 95% CI of significant variables

	OR	2.5 %	97.5 %
Retired	0.02	0.0007927844	0.1787427
Child/minor/infant	0.23	0.0545745496	0.8616654
DIABETES	0.35	0.1205283973	0.9648301

After controlling for gender, comorbidities, and race, we can conclude that those who are retired had 0.02 times the odds of reporting a headache compared to those who work in essential services (P<0.05) and those who are child/minor/infant had 0.23 times the odds of reporting a headache compared to those who work in essential services (P<0.05).

After controlling for gender, employment, and race, we can conclude that those with diabetes had 0.35 times the odds of reporting a headache compared to those who work in essential services (P<0.05).

Aches

Coefficients:

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	0.5446	0.5799	0.939	0.347712
Non-essential	-0.2871	0.4522	-0.635	0.525491
Unemployed	0.2738	0.4861	0.563	0.573340
Retired	-4.1439	1.1752	-3.526	0.000422 ***
Other	-0.2294	0.4364	-0.526	0.599111
Child/minor/infant	-2.3963	0.8416	-2.847	0.004408 **
Female	0.3672	0.3390	1.083	0.278768
ASIAN	1.7147	2.5175	0.681	0.495817
BLACK_AFRICAN_AMERICAN	-1.0917	1.0579	-1.032	0.302100
OTHER	0.1712	0.4830	0.355	0.722953
ASTHMA	-0.4511	0.7434	-0.607	0.543961
CARDIAC_DISEASE	-0.6856	1.3740	-0.499	0.617818
CHRONIC_PULMONARY_DISEASE	-0.3745	0.6471	-0.579	0.562741
DIABETES	0.5223	0.6009	0.869	0.384724
HYPERTENSION	-0.8245	0.6148	-1.341	0.179903
PREGNANT	-2.2005	1.1879	-1.852	0.063965 .

ODDS RATIO + 95% CI of significant variables

	OR	2.5 %	97.5 %
Retired	0.02	0.0007289643	0.1102708
Child/minor/infant	0.09	0.0127837709	0.4032843
PREGNANT	0.11	0.0052811927	0.9285076

After controlling for gender, comorbidities, and race, we can conclude that those who are retired had 0.02 times the odds of reporting muscle aches and pain compared to those who work in essential services (P<0.05) and those who are child/minor/infant had 0.09 times the odds of reporting a muscle aches and pain compared to those who work in essential services (P<0.05)

Sore throat

Coefficients:

	Estimate	Std. Error	z value	Pr(>|z|)	
(Intercept)	-1.04799	0.60271	-1.739	0.0821	.
Non-essential	-0.01244	0.43466	-0.029	0.9772	
Unemployed	-0.15822	0.44751	-0.354	0.7237	
Retired	-2.99211	1.30659	-2.290	0.0220	*
Other	-0.55115	0.45428	-1.213	0.2250	
Child/minor/infant	-0.64727	0.73982	-0.875	0.3816	
Female	0.26960	0.33865	0.796	0.4260	
ASIAN	-14.43497	1390.43425	-0.010	0.9917	
BLACK_AFRICAN_AMERICAN	-0.08285	1.22549	-0.068	0.9461	
OTHER	0.63226	0.51191	1.235	0.2168	
ASTHMA	-0.19584	0.74908	-0.261	0.7937	
CARDIAC_DISEASE	1.88094	1.30356	1.443	0.1490	
CHRONIC_PULMONARY_DISEASE	-1.80436	1.07106	-1.685	0.0921	.
DIABETES	0.23420	0.51584	0.454	0.6498	
HYPERTENSION	-0.22754	0.64476	-0.353	0.7242	
PREGNANT	-16.25045	1190.36981	-0.014	0.9891	

ODDS RATIO + 95% CI of significant variables

	OR	2.5 %	97.5 %
Retired	.05	0.001664796	4.168060e-01

After controlling for gender, comorbidities, and race, we can conclude that those who are retired had 0.05 times the odds of reporting a sore throat compared to those who work in essential services (P<0.05).

Loss of taste/smell

Coefficients:

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	2.044e-01	5.694e-01	0.359	0.7196
Non-essential	-4.545e-03	4.533e-01	-0.010	0.9920
Unemployed	2.059e-01	4.606e-01	0.447	0.6549
Retired	-1.796e+01	1.041e+03	-0.017	0.9862
Other	1.606e-01	4.474e-01	0.359	0.7195
Child/minor/infant	-4.956e-01	7.103e-01	-0.698	0.4854
Female	-9.579e-02	3.463e-01	-0.277	0.7821

ASIAN	-1.759e+01	3.611e+03	-0.005	0.9961
BLACK_AFRICAN_AMERICAN	-1.822e+01	2.447e+03	-0.007	0.9941
OTHER	-8.036e-01	4.599e-01	-1.747	0.0806
ASTHMA	3.480e-01	7.166e-01	0.486	0.6273
CARDIAC_DISEASE	1.673e-01	1.460e+00	0.115	0.9088
CHRONIC_PULMONARY_DISEASE	-1.738e+00	1.077e+00	-1.614	0.1066
DIABETES	6.455e-02	5.378e-01	0.120	0.9045
HYPERTENSION	-1.048e+00	8.179e-01	-1.281	0.2003
PREGNANT	-1.796e+01	3.253e+03	-0.006	0.9956

We can conclude that there is no significant difference in loss of smell or taste according to race, gender, comorbidities, or employment.

Vomit

Coefficients:

	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	-1.97278	0.75079	-2.628	0.0086 **
Non-essential	0.82288	0.61295	1.342	0.1794
Unemployed	-0.06266	0.70538	-0.089	0.9292
Retired	-0.93192	1.04385	-0.893	0.3720
Other	0.79569	0.61159	1.301	0.1932
Child/minor/infant	-0.02352	1.19323	-0.020	0.9843
Female	0.71247	0.48630	1.465	0.1429
ASIAN	-15.15640	2740.44429	-0.006	0.9956
BLACK_AFRICAN_AMERICAN	-0.26761	1.29892	-0.206	0.8368
OTHER	-0.92042	0.54021	-1.704	0.0884 .
ASTHMA	-0.49650	1.13065	-0.439	0.6606
CARDIAC_DISEASE	-15.55098	1385.87449	-0.011	0.9910
CHRONIC_PULMONARY_DISEASE	-0.12824	0.85848	-0.149	0.8813
DIABETES	0.51963	0.61975	0.838	0.4018
HYPERTENSION	0.10070	0.84895	0.119	0.9056
PREGNANT	-15.61376	1953.21647	-0.008	0.9936

We can conclude that there is no significant difference in vomiting symptoms reported according to race, gender, comorbidities, or employment.