

COVID-19 at outside facilities on April 2, 2020, or April 3, 2020 (n = 6), had been removed from the shelter population and were excluded from this study.

Participants were asked to report their age, sex, race, ethnicity, and history of cough and shortness of breath and were given the option to report other symptoms. Race and ethnicity were based on fixed response categories. Other reported symptoms were grouped into categories by the investigators. Body temperature measurements were obtained using oral thermometers, with fever defined as a body temperature of at least 100 °F (37.8 °C). Nasopharyngeal specimens were collected by BHCHP clinical staff using a polyester swab and sent to the Massachusetts Department of Public Health State Public Health Laboratory for SARS-CoV-2 polymerase chain reaction (PCR) testing.

We used descriptive statistics to characterize the study sample, the percentage of positive PCR test results, and the symptom profile of individuals with PCR-confirmed infections. This study was exempted by the Partners HealthCare Human Research Committee with a waiver of informed consent.

**Results** | All individuals residing in the shelter (N = 408) underwent symptom assessment and SARS-CoV-2 PCR testing. There were no known refusals. The mean age of the participants was 51.6 years; 71.6% of participants were men, 33.1% were black or African American, and 18.6% were Hispanic or Latino (Table). Among all participants, 1.0% had fever; 8.1% reported cough; 0.7% reported shortness of breath; and 5.9% reported other symptoms, including 1.5% with nasal or sinus symptoms and 1.2% with diarrhea. Overall, 361 individuals (88.5%) reported no symptoms.

A total of 147 participants (36.0%) had PCR test results positive for SARS-CoV-2. Men constituted 84.4% of individuals with PCR-positive results and 64.4% of individuals with PCR-negative results. Among individuals with PCR test results positive for SARS-CoV-2, cough (7.5%), shortness of breath (1.4%), and fever (0.7%) were all uncommon, and 87.8% were asymptomatic.

**Discussion** | Universal SARS-CoV-2 PCR testing of an adult homeless shelter population in Boston shortly after the identification of a COVID-19 case cluster yielded a 36% positivity rate. The majority of individuals with newly identified infections had no symptoms and no fever at the time of diagnosis, suggesting that symptom screening in homeless shelters<sup>2</sup> may not adequately capture the extent of disease transmission in this high-risk setting. Limitations of this study include the cross-sectional nature of the study at a single shelter in Boston where several symptomatic individuals had been removed through prior symptom screening or self-referrals to outside care. These results support PCR testing of asymptomatic shelter residents if a symptomatic individual with COVID-19 is identified in the same shelter.

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*Concept and design:* Baggett, Gaeta.

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## Variation in COVID-19 Hospitalizations and Deaths Across New York City Boroughs

In the US, New York City has emerged as the epicenter of the coronavirus disease 2019 (COVID-19) outbreak.<sup>1</sup> As of April 25, 2020, more than 150 000 cases had been reported, which is approximately 17% of total cases in the US.<sup>2,3</sup> New York City is composed of 5 boroughs (the Bronx, Brooklyn, Manhattan, Queens, and Staten Island), each with unique demographic, socioeconomic, and community characteristics.

Prior analyses have shown health inequities across these boroughs, but whether similar patterns have also emerged amid the COVID-19 pandemic is unknown.<sup>4</sup> Understanding the patterns could inform public health and policy strategies to mitigate the ongoing spread of COVID-19, and future approaches to address a possible resurgence of the disease. Therefore, in this study, we aimed to examine population characteristics and hospital bed capacities across the 5 boroughs and evaluate whether differences in the rates of COVID-19 testing, hospitalizations, and deaths have emerged in these communities.



Audio and Video

Table. Population and Hospital Characteristics Among New York City Boroughs<sup>a</sup>

	New York City borough				
	Bronx	Brooklyn	Manhattan	Queens	Staten Island
Total population, No.	1 432 132	2 582 830	1 628 701	2 278 906	476 179
Population density per square mile	33 721	37 163	71 434	21 081	8112
Persons per household, mean	2.74	2.62	2.08	2.86	2.80
Demographic characteristics					
Age, median, y	34.4	35.4	37.6	39.2	40.1
Aged ≥65 y, %	12.8	13.9	16.5	15.7	16.2
Sex, %					
Males	47.1	47.4	47.3	48.5	48.5
Females	52.9	52.6	52.7	51.5	51.5
Non-US-born, %	34.4	35.6	29.2	47.6	25.2
Race/ethnicity, % <sup>b</sup>					
White	25.1	46.6	59.2	39.6	75.1
Black or African American	38.3	33.5	16.9	19.9	11.5
Asian	4.6	13.4	14.0	27.5	11.0
Other race <sup>c</sup>	36.8	10.4	15.4	17.0	5.2
Hispanic <sup>d</sup>	56.4	19.1	25.9	28.1	18.7
Socioeconomic status					
Household income, median, \$	38 467	61 220	85 066	69 320	82 166
Persons living under poverty, % <sup>e</sup>	27.4	19.0	15.5	11.5	11.4
Education level, %					
High school graduate or higher	73.3	83.4	87.7	82.5	87.7
Bachelor's degree or higher	20.7	38.9	61.4	33.5	34.3
Hospital characteristics <sup>f</sup>					
Total short-term acute care hospitals, No.	7	14	16	9	2
Beds per 100 000 population	336	214	534	144	234

<sup>a</sup> The 2018 American Community Survey was used to identify population, demographic, and socioeconomic characteristics of the 5 New York City boroughs. The American Hospital Association 2016 file was used to determine hospital characteristics.

<sup>b</sup> Respondents could self-identify as 1 or more of the following racial groups: white, black or African American, Asian, American Indian and Alaskan Native, Native Hawaiian and other Pacific Islander, or other. Respondents could also identify as Hispanic or Latino or not Hispanic or Latino. Race/ethnicity was assessed because it is associated with health inequities. Race was self-identified singularly or in combination with 1 or more races; therefore, the sum of all races may exceed 100%.

<sup>c</sup> Includes those who self-identified as American Indian and Alaskan Native, Native Hawaiian and other Pacific Islander, or "other race" in the 2018 American Community Survey File.

<sup>d</sup> Indicates Hispanic or Latino of any race.

<sup>e</sup> Poverty status was based on the total income of the householder's family compared with appropriate poverty thresholds, which vary based on family size, number of children, and the age of the householder.

<sup>f</sup> Excluded pediatric, specialty only (eg, orthopedic), psychiatric, and hospice facilities.

**Methods** | The 2018 American Community Survey, an annual nationwide audit conducted by the US Census Bureau, was used to describe the population characteristics of the 5 New York City boroughs. Hospitals and their bed capacities were identified using the American Hospital Association 2016 file and a manual search of hospital websites.

The cumulative number of COVID-19 tests performed, the number of patients with COVID-19 who were hospitalized, and the number of deaths related to COVID-19 according to borough of residence for each patient were obtained using data from the New York City Department of Health and Mental Hygiene and last updated on April 25, 2020.<sup>2</sup> Both laboratory-confirmed and probable COVID-19 deaths were examined.

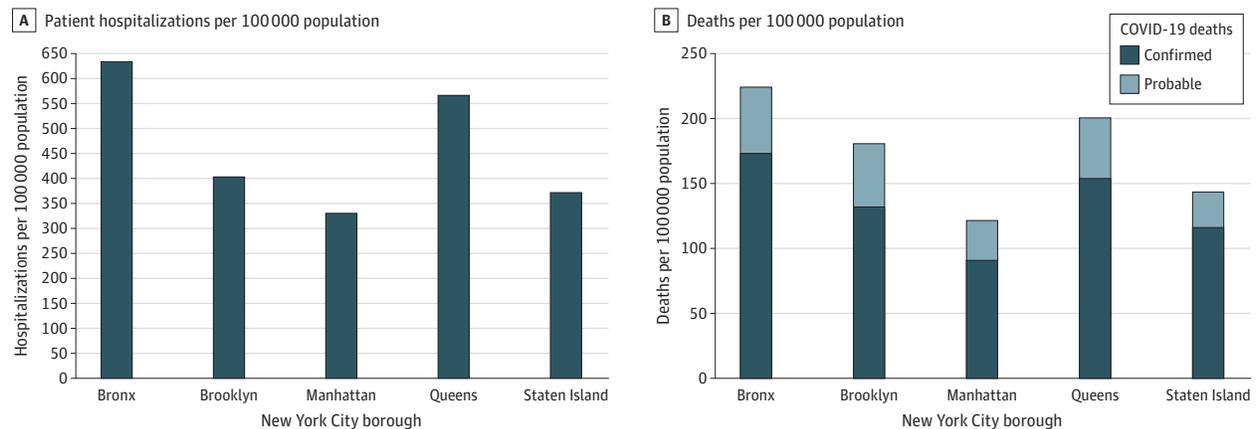
Descriptive statistical analyses were performed to calculate the total number of COVID-19 tests, hospitalizations, and deaths per 100 000 persons using the population of each

borough as a denominator. Institutional review board approval was not sought due to the use of publicly available, de-identified data, per usual institutional policy.

**Results** | The total population of New York City was 8 398 748. Across the 5 boroughs, the population density ranged from 8112 per square mile in Staten Island to 71 434 per square mile in Manhattan (**Table**). The proportion of older adults (aged ≥65 years) was lowest in the Bronx (12.8%) and highest in Manhattan (16.5%), whereas the proportion of black or African American persons was highest in the Bronx (38.3%) and lowest in Staten Island (11.5%).

Household median income was lowest in the Bronx (\$38 467) as was the proportion of persons with a bachelor's degree or higher (20.7%). There were 48 short-term acute care hospitals. The number of hospitals per borough ranged from 2 in Staten Island to 16 in Manhattan. The number of hospital

Figure. Rates of Coronavirus Disease 2019 (COVID-19) Hospitalizations and Deaths by New York City Borough



The New York City Department of Health and Mental Hygiene (DOHMH) estimates the number of patients with COVID-19 who have ever been hospitalized through data linkages with the New York City DOHMH syndromic surveillance database and the New York State Department of Health Hospital Emergency Response Data System based on key fields from known cases that are reported by laboratories to New York City DOHMH.<sup>2</sup> Probable COVID-19 deaths are defined by the New York City DOHMH as patients who have no known positive laboratory test for severe acute respiratory syndrome coronavirus 2, but for whom the death certificate lists COVID-19 (or an equivalent) as a cause of death. Fifteen deaths were excluded because the

borough of residence was unknown. The number of patients with COVID-19 who were hospitalized per 100 000 population was 634 in the Bronx; 404 in Brooklyn; 331 in Manhattan; 568 in Queens; and 373 in Staten Island. The total number of deaths per 100 000 population was 224 in the Bronx; 181 in Brooklyn; 122 in Manhattan; 200 in Queens; and 143 in Staten Island. The number of laboratory-confirmed COVID-19 deaths per 100 000 population was 173 in the Bronx; 132 in Brooklyn; 91 in Manhattan; 154 in Queens; and 117 in Staten Island. The number of probable COVID-19 deaths per 100 000 population was 51 in the Bronx; 49 in Brooklyn; 31 in Manhattan; 46 in Queens; and 27 in Staten Island.

beds per 100 000 population was lowest in Queens (144 beds) and highest in the Bronx (336 beds) and in Manhattan (534 beds).

Among New York City boroughs, there was variation in the number of COVID-19 tests performed per 100 000 population (4599 in the Bronx; 2970 in Brooklyn; 2844 in Manhattan; 3800 in Queens; and 5603 in Staten Island). The number of patients with COVID-19 who were hospitalized per 100 000 population was highest in the Bronx (634) and lowest in Manhattan (331). The number of deaths related to COVID-19 per 100 000 population was also highest in the Bronx (224) and lowest in Manhattan (122) (Figure).

**Discussion** | The substantial variation in the rates for COVID-19 hospitalizations and deaths across the New York City boroughs is concerning. The Bronx, which has the highest proportion of racial/ethnic minorities, the most persons living in poverty, and the lowest levels of educational attainment had higher rates of hospitalization and death related to COVID-19 than the other 4 boroughs.

In contrast, the rates for hospitalizations and deaths were lowest among residents of the most affluent borough, Manhattan, which is composed of a predominately white population. Manhattan and the Bronx have the highest number of per capita hospital beds, and Manhattan has the highest population density, indicating that other factors, such as underlying comorbid illnesses, occupational exposures, socioeconomic determinants, and race-based structural inequities may explain the disparate outcomes among the boroughs.<sup>5,6</sup>

This study has limitations, including an ecological design and limited follow-up through April 25, 2020. Demographic

characteristics for patients who died were not available by borough of residence. The rate of COVID-19 cases was not evaluated given significant variability in testing.

Further studies are needed to examine whether the disproportionate burden of COVID-19 is being borne by lower income and minority communities in other regions of the US.

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## Characteristics of Hospitalized Adults With COVID-19 in an Integrated Health Care System in California

Coronavirus disease 2019 (COVID-19) has resulted in increased hospital and intensive care unit (ICU) use. In the United States, few reports have characterized patients treated outside of the ICU.<sup>1</sup> Northern California was an early epicenter of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) community transmission in the United States. We report hospitalization and ICU admissions from Kaiser Permanente Northern California (KPNC), a regional integrated health care system serving 4.4 million members, constituting 30% of the area's insured population.

**Methods** | We performed a retrospective cohort study of adults (≥18 years) with nasal/throat swabs positive for SARS-CoV-2 by polymerase chain reaction hospitalized between March 1, 2020,

and March 31, 2020, at 21 KPNC hospitals. Tests were approved by infectious disease physicians based on public health and local guidelines. Patients were triaged according to clinician judgment. No patients were lost to follow-up.

We characterized patients by demographics, comorbid disease,<sup>2</sup> severity of illness,<sup>2</sup> ICU use, laboratory/chest film data, and highest level of respiratory support. Patients were treated according to national guidelines for pneumonia and acute respiratory distress syndrome. We report numbers (percentages) for binary/categorical variables and medians (interquartile ranges) for continuous variables. As of April 9, 2020, 14.8% of the cohort was still hospitalized. In-hospital mortality estimates were calculated for patients with discharge dispositions as of April 9, 2020.

The KPNC institutional review board approved the project with a waiver of informed consent.

**Results** | Of 16 201 tests in adults, results from 1299 patients (8.0%) were positive for SARS-CoV-2. Of these patients, 377 (29.0%) were treated as inpatients and 113 (8.7%) were treated in the ICU.

The median age was 61.0 years (interquartile range, 50.0-73.0 years); 56.2% were men (Table). The most common comorbidity was hypertension (n = 164, 43.5%). Of 166 patients who underwent testing for influenza A/B or respiratory syncytial virus (44.0% of the cohort), none tested positive. Bilateral infiltrates on chest film were seen in 63.4% (n = 239). Overall, 34 patients (9.0%) received a prednisone-equivalent dosage of 20 mg/d or more.

Most patients were treated on the general ward or intermediate care unit (n = 264 [70.0%]); of whom 54.9% received supplemental oxygen through nasal cannula/face mask. A total of 113 inpatients (30.0%) required ICU admission and 110 (29.2%) received invasive mechanical ventilation.

Patients aged 60 to 69 years represented the most common age group both hospitalized (n = 93 [24.6%]) and admitted to the ICU (n = 31 [27.4%]) (Figure). However, adults of all ages were admitted, and the proportion of younger and middle-aged adults (≤59 years) who were hospitalized (n = 172 [45.6%]) was similar to the proportion of older adults (≥60 years) who were hospitalized (n = 205 [54.4%]).

Of 321 patients with discharge dispositions, 50 (15.6%) died in the hospital. Of 253 patients treated on the ward with discharge dispositions, 16 (6.3%) died. Of 68 patients treated in the ICU with discharge dispositions, 34 (50.0%) died.

**Discussion** | Estimates of patients with positive SARS-CoV-2 test results who were (1) admitted to a KPNC hospital (29.0%) and (2) treated in an ICU (8.7%) are broadly similar to those from the US Centers for Disease Control and Prevention (21%-31% and 5%-12%, respectively) and contain less missing data.<sup>3</sup> The KPNC estimate of ICU admissions using positive tests as denominator (8.7%) is lower than Italy (12%)<sup>4</sup> but higher than China (5%).<sup>5</sup> Given the differences in care among countries, it is important to report data from the United States. The KPNC mortality estimate is preliminary but reasonably consistent with the early Seattle, Washington, experience.<sup>1</sup>