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Disparities In Outcomes Among COVID-19 Patients In A Large Health Care System In California

ABSTRACT **As the novel coronavirus disease (COVID-19) pandemic spreads throughout the United States, evidence is mounting that racial and ethnic minorities and socioeconomically disadvantaged groups are bearing a disproportionate burden of illness and death. We conducted a retrospective cohort analysis of COVID-19 patients at Sutter Health, a large integrated health system in northern California, to measure potential disparities. We used Sutter's integrated electronic health record to identify adults with suspected and confirmed COVID-19, and we used multivariable logistic regression to assess risk of hospitalization, adjusting for known risk factors, such as race/ethnicity, sex, age, health, and socioeconomic variables. We analyzed 1,052 confirmed cases of COVID-19 from the period January 1–April 8, 2020. Among our findings, we observed that compared with non-Hispanic white patients, non-Hispanic African American patients had 2.7 times the odds of hospitalization, after adjustment for age, sex, comorbidities, and income. We explore possible explanations for this, including societal factors that either result in barriers to timely access to care or create circumstances in which patients view delaying care as the most sensible option. Our study provides real-world evidence of racial and ethnic disparities in the presentation of COVID-19.**

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In late December 2019 the severe acute respiratory syndrome coronavirus (SARS-CoV-2) was first detected in Wuhan, China, and quickly developed into a devastating international outbreak, the likes of which have not been seen since the influenza pandemic of 1918. According to the Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO), the disease caused by the novel coronavirus (COVID-19) has been detected in more than 100 countries, including in the United States. COVID-19 was officially declared a global pandemic on March 11, 2020.[1] Since February 2020, when the first US community-acquired case was detected in California, the disease quickly spread across the nation, and as of June 1, 2020, the US had an estimated 1.8 million confirmed cases and more than 104,000 COVID-19-related deaths.[2] However, these numbers are suspected to vastly underestimate true disease prevalence because of the widespread shortage of testing kits and an unknown number of asymptomatic cases.[3] Thus, accurate rates of infection and mortality remain elusive.

As the pandemic spreads throughout the US, alarming evidence is emerging to suggest that some racial and ethnic minorities, as well as socioeconomically disadvantaged groups, are bearing a disproportionate burden of illness and death.[4] This is especially concerning in California, a state that has embraced the Afford-

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able Care Act and Medicaid expansion in an attempt to provide coverage and access to the vast majority of its residents. On April 8, 2020, Gov. Gavin Newsom (D) presented a statewide analysis of COVID-19, using partial data, asserting that there were no apparent disparities in rates of testing by race or ethnicity. This was based on the observation that the demographic distribution of testing mirrored the underlying distribution of race and ethnicity across the state.[5] However, the analysis was limited to 54 percent of the population, and race and ethnicity information was available for only 40 percent of the 16,957 people who tested positive for the novel coronavirus in California at the time. As of June 2, 2020, race and ethnicity information was still missing for 29 percent of the 117, 687 people who tested positive.[6]

Testing rates aside, even less is known about how disparities are reflected in the severity of illness and outcomes. Infections with SARS-CoV-2, the virus that causes COVID-19, have caused a range of symptoms, from mild (such as fever and malaise) to life-threatening (such as acute respiratory distress), while some infected people remain asymptomatic.[7] Although efforts in California to expand no-cost COVID-19 testing to all state residents have likely contributed to more equitable testing rates, African Americans account for 6.0 percent of the population of California and, as of June 2, 2020, 5.2 percent of COVID-19 cases, but by contrast represent 10 percent of COVID-19-related deaths (to the extent that race and ethnicity is documented).[6] In late March 2020 the CDC published a report examining sociodemographic and clinical characteristics of cases using hospitalization data from a surveillance network tracking COVID-19 in fourteen states during the month of March, stratified by age, race/ethnicity, and sex.[8] Among those included in the analysis (1,482 patients hospitalized with COVID-19), data on race and ethnicity were available in fewer than half (580). Nevertheless, the CDC's findings indicated that despite representing 18 percent of cases in the analysis, African American patients accounted for 33 percent of those hospitalized, which raises questions about whether the clinical course for African Americans affected by COVID-19 may differ from that for people of other races and ethnicities.[8]

Health systems are the focal point of the COVID-19 pandemic, especially in the absence of widespread community testing, and their experiences are vital to understanding the extent of the pandemic and identifying groups at highest risk. In this study we used electronic health record (EHR) data from Sutter Health, a large not-for-profit integrated health system in northern California, to characterize tested and confirmed COVID-19 cases by key sociodemographic and clinical characteristics, including self-reported race and ethnicity.

Study Data And Methods

SETTING This study was conducted at Sutter Health, a large not-for-profit integrated health system in northern California. Sutter delivers comprehensive medical services in more than one hundred ambulatory clinics and twenty-four acute care hospitals, caring for approximately 3.5 million people each year across twenty-two counties in California, in both urban and rural settings. Ten of those counties are in the San Francisco Bay Area, a highly populated and racially diverse region. Sutter's Epic EHR (Epic Systems Corporation) is fully integrated across all hospital and ambulatory sites. Sutter has collected patient self-reported race/ethnicity, ancestry, and language data since 2010. As of 2019 Sutter patients self-identified as 45.9 percent white, 15.6 percent Hispanic, 15.8 percent Asian, 4.9 percent black/African American, and 17.8 percent other (American Indian/Alaska Native, Native Hawaiian/Pacific Islander, mixed race, declined to state, and unknown). Data were retrospectively extracted from the Sutter EHR for the study period January 1–April 8, 2020. This study was approved by Sutter's Institutional Review Board and was conducted according to Health Insurance Portability and Accountability Act standards.

COHORT IDENTIFICATION We identified patients ages eighteen and older who had at least one encounter at a Sutter facility during the study period. We defined the index encounter as the date of the first encounter during the study period in which a patient satisfied criteria for one of two groups. Group 1 (suspected cases with evidence of testing) included patients with a record of a COVID-19 test in their EHR laboratory records, regardless of the test result or testing location; testing could have occurred at a different institution. Group 2 (confirmed cases) included patients with evidence of a positive test result in the EHR laboratory records, regardless of testing location, or patients who had a documented *International Statistical Classification of Diseases and Related Health Problems,* Tenth Revision (ICD-10), diagnosis of confirmed COVID-19 in the EHR without a positive COVID-19 test result. A random-sample chart review was performed to confirm evidence of COVID-19 positive status (in unstructured notes) for the latter.

DATA EXTRACTION AND MANAGEMENT For all patients we extracted demographic information from the EHR, including patients' dates of birth,

The increased odds of hospitalization among African Americans persisted, even after we adjusted for comorbidities.

sex, self-reported race/ethnicity, and primary insurance. Age was classified as ages 18–29 and in ten-year age categories thereafter, with 80+ as the oldest category. Race and ethnicity were defined by Hispanic identity, followed by racial group. If a patient did not self-identify as Hispanic, we classified them based on their race. Throughout this article, references to racial groups imply non-Hispanic. Insurance status was identified by the active primary payer documented in the EHR at the most recent encounter, classified as commercial, Medicaid, Medicare (Part A/B or Part C), other insurance, or self-pay/not reported. Homelessness status was assessed using documentation on patient registration and patient address associated with the encounter. Homelessness status is assessed at every inpatient and emergency department (ED) encounter with standardized systemwide protocols.

From the EHR, we extracted patients' comorbidities, using ICD-10 diagnoses as of the index encounter, and smoking status reported at the index or most recent encounter during the study period. We extracted post-index hospital admission data and mortality data for all patients. Using chart review, we confirmed mortality for those who died in the hospital and for hospitalized patients who died after they were discharged from the hospital.

For patients in group 2, using patients' last known addresses, we geocoded each patient and acquired median income level by census ZIP Code Tabulation Areas. Household income was categorized by quartiles.

Among patients who were tested for COVID-19 at a Sutter facility, we extracted information on the testing location (ambulatory/outpatient, ED, or inpatient).

STATISTICAL ANALYSES Sociodemographic and clinical characteristics of patients in groups 1 and 2 were summarized using descriptive statistics. We also summarized the sociodemographic and clinical characteristics of hospital-admitted COVID-19 cases and patients who died. Standard univariate tests were used: *t*-tests for continuous variables and chi-square tests for categorical variables. We described testing site stratified by racial/ethnic group.

Among confirmed COVID-19 cases (group 2), we used logistic regression to examine the association between clinical and sociodemographic factors and hospital admission. We built a series of stepwise models that incrementally included more covariates as follows: univariate models for all covariates (unadjusted models); demographics (adjusted model 1); demographics plus clinical characteristics (adjusted model 2); and demographics, clinical characteristics, and sociodemographic characteristics (adjusted model 3; full model). For these models, for age, we combined the two youngest age groups to designate patients 18–39 as the reference group. Odds ratios (ORs) and 95% confidence intervals (CIs) were generated. A p value of <0.05 was considered statistically significant.

We geocoded the current residential addresses of patients in group 2 using Address Verification by Informatica. Of 1,052 confirmed COVID-19 cases, 28 were not geocoded because of missing addresses (18) or because addresses were outside of California (10). We overlaid ZIP Code Tabulation Areas and attributed median household income based on the 2013–18 American Community Survey five-year estimates.[9] One additional patient was removed because their address was outside the boundary of the tabulation areas.

We conducted additional analyses to test the robustness of our findings. To examine possible racial/ethnic disparities in COVID-19 testing, given the limited supply of test kits, we compared the race/ethnicity of patients who presented at the index encounter with symptoms consistent with COVID-19 clinical presentation but were not tested. Details of the ICD-10 codes and definition used to identify this group are in online appendix 1.[10] Additionally, given the rapidly changing nature of the pandemic, we confirmed that our findings were consistent at two different points in time, one week apart within the study period.

Data extraction and statistical analyses were performed in R, version 3.6.3; SAS, version 9.4; and STATA. Geographic data processing and visualizations were designed using R, version 3.6.3, in RStudio.

LIMITATIONS AND STRENGTHS Our study had several limitations. First, the pandemic is very fast moving, and the count of COVID-19 patients is accumulating very quickly, but we had to freeze the cohort in order to process the data and summarize our findings. We addressed this with the sensitivity analysis described above.

Second, we did not consider the severity of comorbid conditions. Instead, we relied only on diagnosis codes, so patients with severe and mild disease were classified together. Third, we assigned income at the ZIP code level because of institutional constraints, though income would have been more accurate at the census tract level.

Fourth, we examined differential patterns of missing values for smoking status by race/ethnicity and found some differences. However, African Americans had the lowest percentage of missing values, so we expect that any bias would be toward no effect. Fifth, statistical analysis of interactions and risk of mortality was limited by power. Finally, we classified 158 patients as confirmed COVID-19 cases with only a diagnosis code but no lab record of a positive test. However, chart review demonstrated that most did have a documented positive lab result, and in the small subset with documentation of a negative test result, some may have recovered or have been false negatives. We therefore believe that this would not have a large effect on our conclusions as, at most, falsely classified group 2 patients would represent a very small percentage of the overall confirmed sample.

The study also had several strengths. Sutter collects patient self-reported race, ethnicity, ancestry, and language data. This is important given the limitations of state and national estimates, which have large proportions of missing race/ethnicity data. Further, Sutter's patient population is representative of the state of California according to underlying racial/ethnic and economic distributions. Finally, Sutter has an integrated systemwide EHR that allowed us to analyze data across our network of clinics and hospitals.

Study Results

CHARACTERISTICS OF SUSPECTED CASES We identified 14,036 patients who were tested for COVID-19 between January 1 and April 8, 2020 (group 1). The average age was 50.7 years, and 68.0 percent of patients were younger than age 60 (exhibit 1). Females accounted for 60.7 percent of patients in this group. Almost half (48.3 percent) of group 1 patients were white, 6.7 percent identified as African American, and 19.1 percent identified as Hispanic; 12.2 percent and 16.9 percent of patients were insured by Medicaid and Medicare, respectively. Approximately one-fourth (27.4 percent) of patients were identified as current or past smokers, and 29.8 percent had hypertension.

A smaller percentage of African Americans (29.9 percent) were tested for COVID-19 in an ambulatory setting compared to whites (56.0 percent), Asians (60.0 percent), and Hispanics (53.8 percent) (exhibit 2). The majority of African Americans were tested in hospitals, either in the ED (37.8 percent) or as inpatients (32.3 percent).

Race and ethnicity play a pivotal role in determining how and when care is accessed, and what the outcome is.

In a sensitivity analysis, we identified 2,648 patients who presented at the index encounter with symptoms consistent with COVID-19 clinical presentation but were not tested (see appendix 1 for the list of symptoms included).[10] The distribution of patients by sex and race/ethnicity was similar to that of patients who were tested (data not shown).

CHARACTERISTICS OF CONFIRMED CASES By April 8, 2020, Sutter had treated 1,052 patients with confirmed COVID-19, representing 5.7 percent of California COVID-19 cases at that time.[11] Most had positive test results, while 158 patients had a formal diagnosis (ICD-10 code) of COVID-19 in the EHR but no laboratory record of a positive result. We reviewed charts for a 20 percent random sample of these (thirty-two charts), of which twenty-eight had positive test results documented in their progress notes. The remaining four had documentation of a negative test result after the formal diagnosis was given. Given this, and the potentially high false-negative rates of the tests, we estimate that at most a very low percentage (12.5 percent of 158, or about 20) of the total confirmed cases were potentially misclassified.

The average age among confirmed cases was 53.0 years, and the majority of these patients (62.7 percent) were younger than 60 years of age (exhibit 1). Approximately half (50.8 percent) of all confirmed cases were female, 5.8 percent were African American, and 25.8 percent were Hispanic. Further, 31.8 percent had hypertension, and 14.3 percent had type 2 diabetes.

Sociodemographic and clinical characteristics of confirmed cases in patients who were admitted to an inpatient setting ($n = 256$; 24.3 percent of confirmed cases) and, further, transferred to an intensive care unit (ICU) ($n = 110$; 10.5 per-

EXHIBIT 1

Sociodemographic and clinical characteristics of tested and confirmed COVID-19 patients in California, 2020

Characteristics	Group 1: evidence of COVID-19 test (*n* = 14,036)	Group 2: evidence of confirmed COVID-19 (*n* = 1,052)	Among confirmed cases (group 2): Admitted to hospital (*n* = 256)	Admitted to ICU (*n* = 110)	Deaths (*n* = 51)
Mean age, years	50.7	53.0	65.6	65.3	79.5
95% CI	(50.4, 51.0)	(51.8, 54.1)	(63.6, 67.7)	(62.2, 68.4)	(75.7, 83.2)
Age group, years					
18–29	12.5%	10.9%	0.8%	0.0%	0.0%
30–39	19.3	16.2	7.4	8.2	0.0
40–49	19.0	16.5	9.8	8.2	2.0
50–59	17.2	19.1	16.0	18.2	9.8
60–69	15.1	17.5	24.2	23.6	9.8
70–79	9.8	10.8	18.4	20.0	21.6
80+	7.1	8.9	23.4	21.8	56.9
Sex					
Female	60.7%	50.8%	42.2%	36.4%	35.3%
Male	39.3	49.2	57.8	63.6	64.7
Race/ethnicity					
White	48.3%	40.7%	43.0%	41.8%	51%
Asian	10.2	11.8	8.6	9.1	13.7
African American	6.7	5.8	12.5	13.6	5.9
American Indian/Pacific Islander[a]	0.7	0.2	0.0	0.0	0.0
Hispanic	19.1	25.8	27.7	26.4	19.6
Other/unknown	15.0	15.8	8.2	9.1	9.8
Insurance type					
Commercial	62.1%	62.9%	39.1%	40.9%	17.6%
Medicaid	12.2	11.3	16.0	13.6	9.8
Medicare	16.9	17.9	35.2	31.8	56.9
Other	0.4	0.3	0.4	0.0	0.0
Self-pay/not reported	8.4	7.6	9.4	13.6	15.7
Smoker status					
Never a smoker	44.8%	50.7%	59.8%	60.0%	51.0%
Current smoker	8.2	2.7	3.9	5.5	2.0
Quit/past smoker	19.2	16.3	24.6	25.5	25.5
Unknown	27.8	30.4	11.7	9.1	21.6
Homeless	2.1%	0.5%	0.8%	0.9%	0.0%
Clinical characteristics					
Cardiovascular disease	10.6%	9.7%	23.8%	23.6%	41.2%
Type 2 diabetes	11.2	14.3	30.9	32.7	27.5
Cancer	6.8	5.2	9.0	10.0	19.6
Depression	10.5	6.1	7.8	7.3	13.7
Congestive heart failure	8.8	5.1	16.8	21.8	37.3
Hypertension	29.8	31.8	56.3	55.5	58.8
Chronic obstructive pulmonary disease	9.2	3.5	9.4	11.8	17.6
Asthma	15.4	11.3	16.8	18.2	19.6

SOURCE Authors' analysis of data from Sutter Health's electronic health records, January 1–April 8, 2020. **NOTES** ICU is intensive care unit. CI is confidence interval.
[a]Category includes those who self-identify as American Indian/Alaska Native or Native Hawaiian/Pacific Islander.

cent) are in exhibits 1 and 3. Overall, 66.0 percent of hospital-admitted patients were age sixty or older, and the mean age was 65.6 years (exhibit 1). Among African American patients with confirmed COVID-19, 52.5 percent were hospitalized, compared to 25.7 percent of white patients (exhibit 3), and a higher proportion of African American patients were transferred to the ICU than their white counterparts (24.6 percent versus 10.7 percent, respectively). A greater proportion of male than female patients were hospitalized, and a higher proportion of males ultimately were transferred to the ICU than females.

Of the total confirmed cases, we geocoded and mapped 97.2 percent ($n = 1{,}023$) (see appendix 2 for visualizations of the income disparities for COVID-19 confirmed cases by race and ethnicity).[10] Median annual household income values ranged from $31,379 to $250,001. Overall,

EXHIBIT 2

Setting of COVID-19 testing in California, by race/ethnicity, 2020

Location of test***	White (*n* = 6,778)	Asian (*n* = 1,427)	African American (*n* = 941)	American Indian/Pacific Islander[a] (*n* = 99)	Hispanic (*n* = 2,687)	Other/ unknown (*n* = 2,104)
Ambulatory	56.0%	60.0%	29.9%	47.5%	53.8%	75.5%
Emergency department	25.5	21.5	37.8	33.3	30.8	16.1
Inpatient	18.5	18.5	32.3	19.2	15.5	8.4

SOURCE Authors' analysis of data from Sutter Health's electronic health records from January 1 to April 8, 2020. **NOTES** Percentage is calculated by column. Location of test is where patient's earliest test was performed. *p* value calculated from Pearson chi-square test of independence across race/ethnicity categories. [a]Category includes those who self-identify as American Indian/Alaska Native or Native Hawaiian/Pacific Islander. ***$p < 0.01$

African Americans with COVID-19 lived in ZIP codes with lower income compared to all other racial/ethnic groups ($p < 0.001$).

Among confirmed COVID-19 cases, 51 patients died (mean age: 79.5 years old). Among admitted patients, 3.4 percent of females died, compared with 6.4 percent of males. By race and ethnicity, 6.1 percent of white patients died, compared with 5.6 percent of Asian patients, 4.9 percent of African American patients, and 3.7 percent of Hispanic patients (data derived from exhibit 1).

RESULTS OF MULTIVARIABLE ANALYSIS Several sociodemographic and clinical characteristics were associated with hospital admission in the full multivariable model, adjusted model 3 (exhibit 4). The odds of hospital admission increased with age: Odds ratios ranged from 2.2 to 19.1 compared to the 18–39 age group. Male patients were nearly twice as likely as female patients to be admitted to the hospital (OR = 1.9; $p = 0.001$). The likelihood of hospital admission for African Americans was more than double that of whites (OR = 2.7; $p = 0.007$). People with Medicaid or who were self-pay or had no reported insurance had twice the odds of being admitted, compared to those with commercial insurance (OR = 2.1 for both; $p < 0.05$).

COVID-19 positive patients residing in ZIP codes within the top two quartiles of income (quartiles 3 and 4) were less likely to be admitted to the hospital than those residing in the bottom-quartile ZIP code (OR = 0.24 and 0.55 for the top

EXHIBIT 3

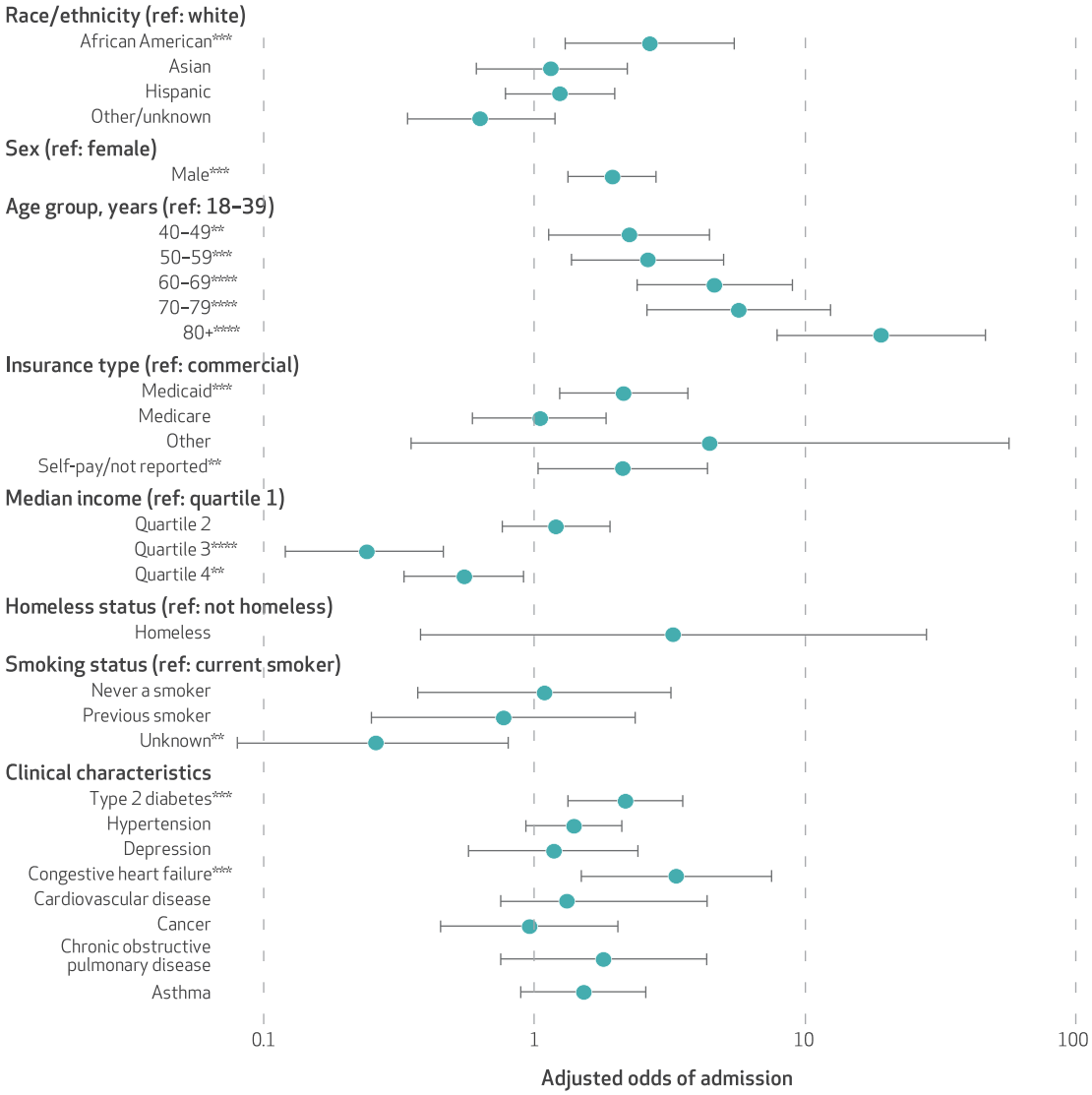
Confirmed cases of COVID-19 in California, locations of treatment, and deaths, by patient characteristics, 2020

Characteristics	Cases with confirmed COVID-19 (*N* = 1,052)	Admitted to hospital	Admitted to ICU	Deaths
Age group, years****				
18–29	115	1.7%	0.0%	0.0%
30–39	170	11.2	5.3	0.0
40–49	174	14.4	5.2	0.6
50–59	201	20.4	10.0	2.5
60–69	184	33.7	14.1	2.7
70–79	114	41.2	19.3	9.6
80+	94	63.8	25.5	30.9
Sex***				
Female	534	20.2%	7.5%	3.4%
Male	518	28.6	13.5	6.4
Race/ethnicity****				
White	428	25.7%	10.7%	6.1%
Asian	124	17.7	8.1	5.6
African American	61	52.5	24.6	4.9
American Indian/Pacific Islander[a]	2	0.0	0.0	0.0
Hispanic	271	26.2	10.7	3.7
Other/unknown	166	12.7	6.0	3.0

SOURCE Authors' analysis of data from Sutter Health's electronic health records from January 1 to April 8, 2020. **NOTES** Percentage calculated by row. *p* values calculated from chi-square test of independence of cases with confirmed COVID-19 who were hospitalized, hospitalized with intensive care unit (ICU) admission, and died. [a]Category includes those who self-identify as American Indian/Alaska Native or Native Hawaiian/Pacific Islander. ***$p < 0.01$ ****$p < 0.001$

EXHIBIT 4

Adjusted odds of hospital admission among confirmed COVID-19 cases in California, 2020



SOURCE Authors' analysis of data from Sutter Health's electronic health records from January 1 to April 8, 2020. **NOTES** Ref is the reference category for odds ratio. For clinical characteristics, the reference category is not having the condition. **$p < 0.05$ ***$p < 0.01$ ****$p < 0.001$

two quartiles). Having congestive heart failure (OR = 3.3) or type 2 diabetes (OR = 2.2) was also associated with an increased odds of hospital admission, compared to not having those conditions.

In a comparison of stepwise models, the increased odds for hospital admission among African Americans versus whites was statistically significant across all models, although it was attenuated slightly with the inclusion of sociodemographic factors (insurance type and income; see appendix 3 for full regression results).[10] Additionally, most underlying clinical conditions were significantly associated with hospital admission in univariate models, but these relationships were nullified after we adjusted for age, sex, and race/ethnicity.

Discussion

Health systems are the front line in the current COVID-19 pandemic, as symptomatic people flock to hospitals and clinics in search of testing and treatment. Data from integrated health systems such as Sutter Health are vital for understanding the impact of the epidemic, especially in the absence of widespread testing and community-based sampling. On April 9, 2020, the

California Department of Public Health reported that approximately 177,600 people in California had been tested for COVID-19. Of these, 7.9 percent (14,036) were Sutter patients.[12] At that time, Sutter had treated about 5.7 percent (1,052) of the estimated 18,309 confirmed cases in the state. The distributions of COVID-19 cases by age and sex were similar for Sutter and the state.

Despite predictions that the COVID-19 pandemic would be the "great equalizer," sparing no segment of the population from risk, reports of disparities in testing, treatment, and outcomes are emerging. California's death rate among African Americans is higher than that group's representation in the population (10 percent mortality versus 6 percent population) and even more disproportionate in some counties.[6] Recent data from Los Angeles County show a 14 percent mortality rate among African Americans, who make up 9 percent of that county's population.[13,14] The California Health Care Foundation has identified the elevated risk among African Americans in the context of this pandemic as "a perfect storm of irrefutable evidence that people of color are caught in a web of social inequality."[15] While we did not find mortality differences by race and ethnicity in our study, the study was not powered to detect such differences.

We found that African Americans with confirmed COVID-19 are significantly more likely to be admitted to the hospital than their white counterparts, after sociodemographics, clinical factors, and income are controlled for. There are several possible explanations for these observed disparities, which likely result from a constellation of factors.

The greater odds of hospital admission may indicate that African Americans have more advanced or severe illness at the time of presenting for COVID-19 testing and medical care. We hypothesize that these results are primarily explained by societal factors that either result in barriers to timely access to care or create circumstances in which patients view delaying care as the most sensible option.[16] This is supported by our observation that although there were not apparent racial disparities in testing, African American patients were more likely to have been tested at a hospital than in the ambulatory environment. Our sensitivity analysis did not reveal any racial or ethnic differences among those presenting with symptoms but not tested. The disparity therefore might not be in who is tested, but in when testing occurs.

Our prior research has found that Sutter's African American patients are more likely to access care later, in the acute setting. Even those with ambulatory care–sensitive conditions, such as asthma, have been found to present through the ED and hospital rather than ambulatory settings.[17] The pattern we observed with COVID-19 testing is similar. For African Americans, this is likely not due to lack of insurance coverage. Compared with other states, support in California for the Affordable Care Act and expansion of Medicaid has resulted in a high level of insurance coverage among African Americans.[18] However, having insurance does not guarantee access to primary care, which can be affected by structural inequities as well as personal agency.

In addition, unconscious biases on the part of providers[19] and patients' prior negative experiences with health care can lead to distrust and the decision to seek care only in the most extreme circumstances. This has been documented in health care settings across the US and remains a major threat to health equity.[19–21] Presentation and testing in the ED and hospital may indicate that African Americans seek care at a later stage, leading to the higher rates of admissions. Policies that support community-based outreach, testing, and access to culturally competent care within African American communities hold the promise of earlier testing, diagnosis, and the potential to have a positive impact on some of the disparities we have observed. In the case of COVID-19, early identification is especially important, as this can reduce the community spread of the disease.

Given that financial stress may contribute to a need to continue employment and delay medical care despite symptoms,[22] we also explored the potential for underlying socioeconomic disparities to increase the odds of hospital admission resulting from COVID-19. We found disparities among Medicaid versus commercially insured beneficiaries and among lower-income (twenty-fifth percentile of ZIP code median household income) versus higher-income (fifty-first percentile and above) patients. As a group, African American patients tended to live in lower-income areas. While the adjustment for income level attenuated the effect of race and ethnicity, it did not explain the entire effect. However, as we acknowledge in the limitations of this study, measurement of median household income at a more granular level may provide additional clarity.

Our findings are in agreement with other studies whose findings suggest that advanced age and severe underlying health conditions increase the risk of developing serious COVID-19 illness.[23] According to the CDC, the most commonly reported conditions co-occurring with COVID-19 were diabetes mellitus, chronic lung disease, and cardiovascular disease.[8] Because African Americans continue to bear a dispro-

portionate burden of chronic disease, with pronounced disparities in type 2 diabetes, congestive heart failure, and hypertension,[24] there are concerns that existing racial and ethnic disparities will be exacerbated and compounded by COVID-19.[25,26] We found that type 2 diabetes and congestive heart failure were independently associated with increased odds of hospital admission in the fully adjusted model. We did not find that hypertension, cardiovascular disease, chronic obstructive pulmonary disease, or asthma were independent risk factors for admission after adjustment for age, sex, and race/ethnicity. While some of these conditions have been associated with increased risk for COVID-19, our focus was hospitalization. Of note, the increased odds of hospitalization among African Americans persisted, even after we adjusted for all of these comorbidities.

Our finding that males with confirmed COVID-19 had twice the odds of hospital admission compared with females also supports other recent findings. The CDC, for example, reports that despite the fact that 49 percent of COVID-19 cases were male, males made up 54 percent of the hospitalizations, reflecting earlier case reports from China, Italy, and South Korea.[8,27,28] Studies have shown that females tend to access health care and preventive care more frequently than males,[29] which may help explain why more females are tested for COVID-19, but both sexes in our study appear to be infected in comparable proportions. More investigation of these differences is needed.

Conclusion

The COVID-19 pandemic has presented an enormous and unprecedented test of the adequacy of health systems around the world to provide appropriate care with high-quality outcomes to large numbers of people. Despite the fact that California, one of the most populous and diverse US states, has embraced policies designed to provide extended health care coverage for all, challenges remain to providing equitable care, with comparable outcomes for all. The experience of Sutter Health highlights the fact that race and ethnicity play a pivotal role in determining how and when care is accessed, and what the outcome is. Our findings suggest that the greatest risk, in terms of hospitalization, is borne by African Americans. The COVID-19 pandemic offers the opportunity to identify and quantify these inequities and to seek solutions. Health systems have an ethical obligation to ensure that all patients receive the right care at the right time, especially in times of crisis. ■

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NOTES

1 World Health Organization. WHO director-general's opening remarks at the media briefing on COVID-19 [Internet]. Geneva: WHO; 2020 Mar 11 [cited 2020 Jun 1]. Available from: https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020

2 Centers for Disease Control and Prevention. Coronavirus (COVID-19) [Internet]. Atlanta (GA): CDC; [cited 2020 May 19]. Available from: https://www.cdc.gov/coronavirus/2019-ncov/index.html

3 Hernandez D, Cohen B. Why it's so difficult to stop the spread of the coronavirus. Wall Street Journal [serial on the Internet]. 2020 Mar 22 [cited 2020 May 19]. Available from: https://www.wsj.com/articles/why-its-so-difficult-to-stop-the-spread-of-the-coronavirus-11584871200

4 Reyes C, Husain N, Gutowski C, St. Clair S, Pratt G. Chicago's coronavirus disparity: black Chicagoans are dying at nearly six times the rate of white residents, data show. Chicago Tribune [serial on the Internet]. 2020 Apr 7 [cited 2020 May 19]. Available from: https://www.chicagotribune.com/coronavirus/ct-coronavirus-chicago-coronavirus-deaths-demographics-lightfoot-20200406-77nlylhiavgjzb2wa4ckivh7mu-story.html

5 Gov Crowley K. Newsom: California is analyzing COVID-19 data on basis of race, first update released. Mercury News [serial on the Internet]. 2020 Apr 8 [cited 2020 May 19]. Available from: https://www.mercurynews.com/2020/04/08/gov-newsom-california-is-analyzing-covid-19-data-on-basis-of-race-first-update-released/

6 California Department of Public Health. COVID-19 race and ethnicity data [Internet]. Sacramento (CA): CDPH; [last updated 2020 May 19; cited 2020 May 19]. Available from: https://www.cdph.ca.gov/Programs/CID/DCDC/Pages/COVID-19/Race-Ethnicity.aspx

7 World Health Organization. Coronavirus [Internet]. Geneva: WHO; 2020 [cited 2020 May 19]. Available from: https://www.who.int/health-topics/coronavirus

8 Centers for Disease Control and Prevention COVID-19 Response Team. Preliminary estimates of the prevalence of selected underlying health conditions among patients with coronavirus disease 2019—United States, February 12–March 28, 2020. MMWR. 2020; 69(13):382–6.

9 Census Bureau. American Community Survey: median household income in the past 12 months (in 2018 inflation-adjusted dollars), table B19013 [Internet]. Washington (DC): Census Bureau; [cited 2020 Jun 1]. Available from: https://data.census.gov/cedsci/table?q=B19013&tid=ACSDT1Y2018.B19013&vintage=2018

10 To access the appendix, click on the Details tab of the article online.

11 California Department of Public Health. COVID-19 [Internet]. Sacramento (CA): CDPH; [last updated 2020 May 18; cited 2020 May 19]. Available from: https://www.cdph.ca.gov/programs/cid/dcdc/pages/immunization/ncov2019.aspx

12 California Department of Public Health [Internet]. Sacramento (CA): CDPH; 2020. Press release, State officials announce latest COVID-19 facts; 2020 Apr 9 [cited 2020 May 19]. Available from: https://www.cdph.ca.gov/Programs/OPA/Pages/NR20-048.aspx

13 Poston B, Barboza T, Jennings A. L.A. releases first racial breakdown of coronavirus fatalities; blacks have higher death rate. Los Angeles Times [serial on the Internet]. 2020 Apr 7 [cited 2020 May 19]. Available from: https://www.latimes.com/california/story/2020-04-07/l-a-releases-first-racial-breakdown-of-coronavirus-fatalities-african-americans-have-higher-death-rate

14 Los Angeles County Department of Public Health. COVID-19 racial, ethnic, and socioeconomic data and strategies report [Internet]. Los Angeles (CA): LA County Department of Public Health; 2020 Apr 28 [cited 2020 May 19]. Available from: http://www.lapublichealth.org/docs/RacialEthnicSocioeconomicDataCOVID19.pdf

15 Hernández SR, Carter K. COVID-19: a perfect storm of health care inequality [Internet]. Oakland (CA): California Health Care Foundation; 2020 Apr 10 [cited 2020 May 19]. Available from: https://www.chcf.org/blog/covid-19-perfect-storm-health-care-inequality/

16 Agirdas C, Holding JG. Effects of the ACA on preventive care disparities. Appl Health Econ Health Policy. 2018;16(6):859–69.

17 Pressman A, Lockhart S, Petersen J, Robinson S, Moreno M, Azar KMJ. Measuring health equity for ambulatory care sensitive conditions in a large integrated health care system: the development of an index. Health Equity. 2019;3(1):92–8.

18 Artiga S, Orgera K, Damico A. Changes in health coverage by race and ethnicity since the ACA, 2010–2018 [Internet]. San Francisco (CA): Henry J. Kaiser Family Foundation; 2020 Mar [cited 2020 May 19]. Available from: http://files.kff.org/attachment/Issue-Brief-Changes-in-Health-Coverage-by-Race-and-Ethnicity-since-the-ACA-2010-2018.pdf

19 FitzGerald C, Hurst S. Implicit bias in healthcare professionals: a systematic review. BMC Med Ethics. 2017;18(1):19.

20 Hall WJ, Chapman MV, Lee KM, Merino YM, Thomas TW, Payne BK, et al. Implicit racial/ethnic bias among health care professionals and its influence on health care outcomes: a systematic review. Am J Public Health. 2015;105(12):e60–76.

21 Zestcott CA, Blair IV, Stone J. Examining the presence, consequences, and reduction of implicit bias in health care: a narrative review. Group Process Intergroup Relat. 2016;19(4):528–42.

22 McMorrow S, Kenney GM, Goin D. Determinants of receipt of recommended preventive services: implications for the Affordable Care Act. Am J Public Health. 2014;104(12):2392–9.

23 Koma W, Neuman T, Claxton G, Rae M, Kates J, Michaud J. How many adults are at risk of serious illness if infected with coronavirus? Updated data [Internet]. San Francisco (CA): Henry J. Kaiser Family Foundation; 2020 Apr 23 [cited 2020 May 19]. Available from: https://www.kff.org/global-health-policy/issue-brief/how-many-adults-are-at-risk-of-serious-illness-if-infected-with-coronavirus/

24 Smedley BD, Stith AY, Nelson AR, editors. Unequal treatment: confronting racial and ethnic disparities in health care. Washington (DC): National Academies Press; 2003.

25 Centers for Disease Control and Prevention. Health, United States spotlight: racial and ethnic disparities in heart disease [Internet]. Atlanta (GA): CDC; 2019 Apr [cited 2020 May 19]. Available from: https://www.cdc.gov/nchs/hus/spotlight/HeartDiseaseSpotlight_2019_0404.pdf

26 Whyte LE, Zubak-Skees C. Underlying health disparities could mean coronavirus hits some communities harder. National Public Radio [serial on the Internet]; 2020 Apr 1 [cited 2020 May 19]. Available from: https://www.npr.org/sections/health-shots/2020/04/01/824874977/underlying-health-disparities-could-mean-coronavirus-hits-some-communities-harde

27 Epidemiology Working Group for NCIP Epidemic Response, Chinese Center for Disease Control and Prevention. The epidemiological characteristics of an outbreak of 2019 novel coronavirus diseases (COVID-19) in China. Chinese Journal of Epidemiology. 2020;41(2):145–51.

28 Liu Y, Sun W, Li J, Chen L, Wang Y, Zhang L, et al. Clinical features and progression of acute respiratory distress syndrome in coronavirus disease 2019. MedRxiv [serial on the Internet]. 2020 Feb 27 [cited 2020 May 19]. Available from: https://www.medrxiv.org/content/10.1101/2020.02.17.20024166v3

29 Bertakis KD, Azari R, Helms LJ, Callahan EJ, Robbins JA. Gender differences in the utilization of health care services. J Fam Pract. 2000;49(2):147–52.