SPECIAL ARTICLE

Hospitalization and Mortality among Black Patients and White Patients with Covid-19

Eboni G. Price-Haywood, M.D., M.P.H., Jeffrey Burton, Ph.D., Daniel Fort, Ph.D., and Leonardo Seoane, M.D.

From the Ochsner Health Center for Outcomes and Health Services Research (E.G.P.-H., J.B., D.F.) and the University of Queensland Ochsner Clinical School (E.G.P.-H., L.S.) — both in New Orleans. Address reprint requests to Dr. Price-Haywood at the Center for Outcomes and Health Services Research, Academic Center–2nd Fl., 1514 Jefferson Hwy., New Orleans, LA 70121, or at eboni.pricehaywood@ochsner.org.

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ABSTRACT

BACKGROUND

Many reports on coronavirus disease 2019 (Covid-19) have highlighted age- and sex-related differences in health outcomes. More information is needed about racial and ethnic differences in outcomes from Covid-19.

METHODS

In this retrospective cohort study, we analyzed data from patients seen within an integrated-delivery health system (Ochsner Health) in Louisiana between March 1 and April 11, 2020, who tested positive for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2, the virus that causes Covid-19) on qualitative polymerase-chain-reaction assay. The Ochsner Health population is 31% black non-Hispanic and 65% white non-Hispanic. The primary outcomes were hospitalization and in-hospital death.

RESULTS

A total of 3626 patients tested positive, of whom 145 were excluded (84 had missing data on race or ethnic group, 9 were Hispanic, and 52 were Asian or of another race or ethnic group). Of the 3481 Covid-19–positive patients included in our analyses, 60.0% were female, 70.4% were black non-Hispanic, and 29.6% were white non-Hispanic. Black patients had higher prevalences of obesity, diabetes, hypertension, and chronic kidney disease than white patients. A total of 39.7% of Covid-19–positive patients (1382 patients) were hospitalized, 76.9% of whom were black. In multivariable analyses, black race, increasing age, a higher score on the Charlson Comorbidity Index (indicating a greater burden of illness), public insurance (Medicare or Medicaid), residence in a low-income area, and obesity were associated with increased odds of hospital admission. Among the 326 patients who died from Covid-19, 70.6% were black. In adjusted time-to-event analyses, variables that were associated with higher in-hospital mortality were increasing age and presentation with an elevated respiratory rate; elevated levels of venous lactate, creatinine, or procalcitonin; or low platelet or lymphocyte counts. However, black race was not independently associated with higher mortality (hazard ratio for death vs. white race, 0.89; 95% confidence interval, 0.68 to 1.17).

CONCLUSIONS

In a large cohort in Louisiana, 76.9% of the patients who were hospitalized with Covid-19 and 70.6% of those who died were black, whereas blacks comprise only 31% of the Ochsner Health population. Black race was not associated with higher in-hospital mortality than white race, after adjustment for differences in sociodemographic and clinical characteristics on admission.

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Surveillance of the clinical characteristics and outcomes of hospitalized patients with coronavirus disease 2019 (Covid-19) is imperative for elucidating the epidemiology of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in the United States. As of May 13, 2020, the United States had 1,364,061 reported cases with 82,246 deaths.[1] The epidemiologic characteristics are not yet fully known; however, early studies conducted in China[2,3] and Italy[4] have described a full spectrum of illnesses, ranging from mild to severe, with adults 65 years of age or older and people of all ages with chronic conditions having the highest risk of severe disease, including death. Preliminary U.S. data suggested that persons with diabetes, cardiovascular disease, or chronic lung disease are at higher risk for severe Covid-19–associated disease.[5,6] The cumulative incidence of Covid-19 ranged widely across the United States, with eight jurisdictions reporting the highest rates (New York, New Jersey, Louisiana, Massachusetts, Connecticut, Michigan, the District of Columbia, and Rhode Island).[7] Case doubling times in these same jurisdictions have exceeded the nationwide average, and these jurisdictions have had some of the highest mortality rates.

At the time of this report, Louisiana had 32,662 reported cases and 2315 deaths.[8] Approximately 43% of the cases and 39% of the reported deaths are in the city of New Orleans and surrounding area. Louisiana was one of the first states to publish public health statistics according to race, which showed that black patients represent 59% of all Covid-19–related deaths in the state, even though blacks represent only 33% of the overall population.[9] Although many reports on Covid-19 have highlighted age- and sex-related differences in health outcomes, racial and ethnic differences in outcomes have yet to be described in depth. The objective of this report is to compare the clinical characteristics and hospital course of laboratory-confirmed cases of Covid-19 among black non-Hispanic and white non-Hispanic subpopulations in Louisiana.

METHODS

STUDY DESIGN, SETTING, AND POPULATION

This retrospective, observational, cohort study included patients seen at an Ochsner Health facility between March 1 and April 11, 2020, who tested positive for SARS-CoV-2 on qualitative polymerase-chain-reaction assay; in-hospital deaths were assessed through May 7, 2020. Ochsner Health, based in New Orleans, is the largest integrated-delivery health system in Louisiana, with 40 owned, managed, and affiliated hospitals; more than 100 health centers and urgent care centers; approximately 25,000 employees; and more than 1300 employed physicians in more than 90 specialties and subspecialties.[10] Ochsner Health facilities are geographically dispersed across the southeastern, western, and northern portions of the state. Among the 522,679 established patients who received care within the past 12 months (e.g., not new to Ochsner Health), 65% identified themselves as white non-Hispanic and 31% as black non-Hispanic. The institutional review board of Ochsner Health approved this study.

DATA COLLECTION

Clinical data were extracted from the health system's electronic medical record system, Epic, with the use of an enterprise data warehouse. The data extraction included the following: demographic characteristics (age, sex, patient-reported race and ethnic group, and insurance plan); chronic conditions documented through diagnosis codes linked to ambulatory primary care and specialty encounters (codes in the *International Classification of Diseases, 10th Revision* [ICD-10]: E66, Z72.0, J45, J44, E10, E11, I10, I50, I25, N18, Z94, K70 through K77, C0 through D49, and B20) and body-mass index (BMI, the weight in kilograms divided by the square of the height in meters) recorded within the previous 12 months; selected outpatient medications (immunosuppressants, glucocorticoids, chemotherapy, and immune modulators); symptoms and diagnosis codes linked to primary care, emergency department (ED), or urgent care encounter during which Covid-19 testing occurred; and vital signs, medications, and laboratory or procedure codes and diagnoses (J10 through J18, N17, K72, I42, J96, J80, E11.10, and E87.2) linked to inpatient encounters. ZIP Codes were used to determine whether patients lived in areas where the percentage of low-income residents exceeds the Louisiana benchmark of 39.5%, as defined by the Uniform Data System Mapper.[11]

STATISTICAL ANALYSIS

We compared characteristics of Covid-19–positive patients according to race (black non-Hispanic vs.

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white non-Hispanic). Patient characteristics are summarized in Table 1 (3481 patients). Covid-19–positive patients who identified themselves as Asian, American Indian or Alaska Native, Native Hawaiian or Pacific Islander, or Hispanic or who did not have a recorded race or ethnic group were excluded from the analysis. Clinical characteristics and outcomes (including length of hospital stay, death from any cause, and survival to discharge) are presented for hospitalized patients in

Table 1. Characteristics of 3481 Patients Who Tested Positive for Coronavirus Disease 2019 (Covid-19) by April 11, 2020.*

Characteristic	White Non-Hispanic (N=1030)	Black Non-Hispanic (N=2451)
Age — yr	55.5±18.5	53.6±16.1
Sex — no. (%)		
Male	471 (45.7)	923 (37.7)
Female	559 (54.3)	1528 (62.3)
Insurance — no. (%)		
Commercial	590 (57.3)	1155 (47.1)
Medicare	283 (27.5)	673 (27.5)
Medicaid	52 (5.0)	367 (15.0)
Other, such as workers' compensation	13 (1.3)	29 (1.2)
Uninsured or self-pay	88 (8.5)	224 (9.1)
Unknown	4 (0.4)	3 (0.1)
Residence in low-income area — no. (%)	299 (29.0)	1394 (56.9)
Coexisting conditions†		
Charlson Comorbidity Index score‡	0.58±1.32	0.93±1.84
Obesity — no. (%)§	407 (39.5)	1320 (53.9)
Asthma — no. (%)	39 (3.8)	103 (4.2)
COPD — no. (%)	20 (1.9)	59 (2.4)
Diabetes — no. (%)	112 (10.9)	454 (18.5)
Hypertension — no. (%)	246 (23.9)	828 (33.8)
Congestive heart failure — no. (%)	24 (2.3)	104 (4.2)
Coronary artery disease — no. (%)	46 (4.5)	93 (3.8)
Chronic kidney disease — no. (%)	47 (4.6)	231 (9.4)
Solid-organ transplant — no. (%)	0	18 (0.7)
Chronic liver disease — no. (%)	29 (2.8)	30 (1.2)
Cancer — no. (%)	46 (4.5)	112 (4.6)
HIV — no. (%)	1 (0.1)	6 (0.2)
Outpatient medications — no. (%)		
Glucocorticoids	104 (10.1)	256 (10.4)
Immune modulators	6 (0.6)	23 (0.9)
Chemotherapy	9 (0.9)	22 (0.9)
Symptoms when tested — no. (%)¶		
Fever	279 (27.1)	906 (37.0)
Cough	185 (18.0)	520 (21.2)
Dyspnea or shortness of breath	73 (7.1)	270 (11.0)
Abdominal pain or diarrhea	14 (1.4)	49 (2.0)
Myalgia	20 (1.9)	29 (1.2)

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Table 1. (Continued.)

Characteristic	White Non-Hispanic (N=1030)	Black Non-Hispanic (N=2451)
Location of testing — no. (%)		
Primary care	222 (21.6)	337 (13.7)
Urgent care	196 (19.0)	215 (8.8)
Emergency department	391 (38.0)	1601 (65.3)
Inpatient	27 (2.6)	77 (3.1)
Other or unknown service area‖	194 (18.8)	221 (9.0)

* Plus–minus values are means ±SD. Race and ethnic group were reported by the patient. Percentages may not total 100 because of rounding. COPD denotes chronic obstructive pulmonary disease, and HIV the human immunodeficiency virus.
† Absence of diagnoses recorded in the medical record was assumed to mean absence of the conditions.
‡ The score on the Charlson Comorbidity Index predicts the risk of death within 1 year after hospital admission. It is calculated on the basis of the presence of 17 conditions, each of which is assigned a weighted score of 1, 2, 3, or 6. The maximum score is 29. Higher scores indicate more coexisting conditions and a higher risk of death.
§ Obesity was determined by the presence of diagnosis codes or a body-mass index (BMI) of 30 or more that was recorded during previous clinical encounters (1727 patients had a BMI of ≥30; 1071 had a BMI of <30; and 683 had missing data).
¶ Diagnostic codes linked to the clinical encounter in which the qualitative polymerase-chain-reaction assay for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2, the virus that causes Covid-19) was performed were used to ascertain the presence of symptoms.
‖ A total of 95 Covid-19 test orders were missing information on the department in which the order was originally placed (31 white patients and 64 black patients).

Table 2 (1382 patients). Some laboratory studies were performed only in a subgroup of patients; where applicable, the relevant denominators are shown. Calculations for length of hospital stay were restricted to patients for whom the full length of stay could be determined (e.g., those who survived to discharge or died). Categorical measures are presented as percentages. Continuous measures are presented as means and standard deviations or medians and interquartile ranges.

Outcomes were assessed with unadjusted and multivariable models. Factors that are associated with hospitalization were examined with the use of multivariable logistic regression. Factors that are associated with in-hospital death were investigated with the use of Cox proportional-hazards models. Each outcome (hospitalization and in-hospital death) was assessed with three models: model 1 included race only, model 2 included race with additional covariates of age and sex, and model 3 included race with additional covariates of age, sex, Charlson Comorbidity Index score (with higher scores indicating a greater burden of illness),[12,13] residence in a low-income area (yes vs. no), and obesity (yes vs. no). In addition, insurance was included in model 3 for hospitalization. A fourth model for in-hospital death included baseline vital signs and laboratory measures (detailed below). All model covariates were selected a priori on the basis of clinical relevance or results of bivariate analyses with outcomes. The selected covariates have been studied previously and shown to be associated with clinical outcomes or health care use.[14,15] Select interactions with race were investigated, but associations were negligible.

For variables for which less than 25% of the data was missing, values were imputed with the use of multiple imputation by fully conditional specification.[16] The multiple-imputation models incorporated all available baseline data, and 50 imputations were carried out. BMI was imputed for 683 Covid-19–positive patients. Baseline laboratory measures for venous lactate level (268 patients), C-reactive protein level (287), procalcitonin level (305), and lymphocyte count (32) were imputed among hospitalized patients. Results from the analysis of hospitalization are presented in Table 3 as odds ratios. Results from the analyses of in-hospital death are presented in Table 4 as hazard ratios.

The models for in-hospital death all considered time to death, with data from patients discharged alive or still admitted treated as censored observations. Before the construction of the multivariable models for in-hospital death, baseline laboratory measures and vital signs were compared between outcome groups (dead vs. alive) through standardized differences (Tables S1 and S2 in

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Table 2. Clinical Characteristics of 1382 Covid-19–Positive Patients Hospitalized between March 1 and April 11, 2020.*

Characteristic	White Non-Hispanic (N=319)	Black Non-Hispanic (N=1063)
Age — yr	69.2±16.6	60.5±14.8
Female sex — no. (%)	127 (39.8)	578 (54.4)
Charlson Comorbidity Index score	1.0±1.8	1.3±2.2
Insurance — no. (%)		
Commercial	89 (27.9)	417 (39.2)
Medicare	178 (55.8)	458 (43.1)
Medicaid	18 (5.6)	124 (11.7)
Self-pay or other	34 (10.7)	64 (6.0)
Residence in low-income area — no. (%)	108 (33.9)	643 (60.5)
Vital signs at admission		
Blood pressure — mm Hg		
Systolic	129.2±15.0	130.0±16.1
Diastolic	70.0±8.2	72.1±8.5
Respiratory rate ≥24 breaths/min — no. (%)	235 (73.7)	803 (75.5)
Temperature ≥38°C — no. (%)	176 (55.2)	741 (69.7)
Oxygen saturation <94% — no. (%)	278 (87.1)	895 (84.2)
Laboratory measures at admission†		
White-cell count <4000/μl — no. (%)	81 (25.4)	198 (18.6)
Absolute lymphocyte count <1000/μl — no./total no. (%)	191/310 (61.6)	520/1040 (50.0)
Platelet count <150,000/μl — no. (%)	116 (36.4)	277 (26.1)
Sodium <130 mmol/liter — no. (%)	36 (11.3)	85 (8.0)
Creatinine >1.5 mg/dl — no. (%)	85 (26.6)	422 (39.7)
Total bilirubin ≥1.2 mg/dl — no. (%)	43 (13.5)	126 (11.9)
Aspartate aminotransferase >40 U/liter — no. (%)	176 (55.2)	659 (62.0)
Alanine aminotransferase >40 U/liter — no. (%)	123 (38.6)	393 (37.0)
Venous lactate >2.2 mmol/liter — no./total no. (%)	43/266 (16.2)	139/848 (16.4)
Troponin I ≥0.06 ng/ml — no./total no. (%)	60/256 (23.4)	210/828 (25.4)
Brain-type natriuretic peptide >100 pg/ml — no./total no. (%)	89/232 (38.4)	177/794 (22.3)
Procalcitonin >0.25 ng/ml — no./total no. (%)	73/244 (29.9)	311/833 (37.3)
C-reactive protein >8.2 ng/ml — no./total no. (%)	211/247 (85.4)	801/848 (94.5)
Ferritin >300 ng/ml — no./total no. (%)	138/185 (74.6)	487/609 (80.0)
Hospital course		
Acute medical conditions — no. (%)		
Coinfection with pneumonia	116 (36.4)	407 (38.3)
Acute renal failure	34 (10.7)	163 (15.3)
Acute hepatic injury	2 (0.6)	2 (0.2)
Cardiomyopathy or congestive heart failure	0	2 (0.2)
Hypoxic respiratory failure	79 (24.8)	270 (25.4)

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Table 2. (Continued.)

Characteristic	White Non-Hispanic (N=319)	Black Non-Hispanic (N=1063)
Level of hospital care — no. (%)‡		
Critical care: intensive care units	94 (29.5)	380 (35.7)
Ventilator	67 (21.0)	297 (27.9)
No ventilator	27 (8.5)	83 (7.8)
Noncritical care: medicine–surgical units	225 (70.5)	683 (64.3)
Clinical outcome — no. (%)		
Still admitted	13 (4.1)	49 (4.6)
Discharged alive from hospital	210 (65.8)	784 (73.8)
Died	96 (30.1)	230 (21.6)
Median length of hospital stay (IQR) — days§	7.0 (3.0–13.0)	6.0 (3.0–12.0)

* Plus–minus values are means ±SD. To convert the values for creatinine to micromoles per liter, multiply by 88.4. To convert the values for bilirubin to micromoles per liter, multiply by 17.1. IQR denotes interquartile range.
† Variables with missing data have a denominator shown.
‡ Shown is the highest level of hospital care received at any time during the hospital course.
§ Only deceased or discharged patients were used for calculations of length of hospital stay.

Table 3. Odds Ratios for Hospitalization among 3481 Covid-19–Positive Patients.*

Variable	Model 1	Model 2	Model 3
		odds ratio (95% CI)	
Race: black vs. white	1.71 (1.46–1.99)	2.35 (1.97–2.80)	1.96 (1.62–2.37)
Age, in 5-yr units	—	1.34 (1.30–1.37)	1.29 (1.25–1.33)
Sex: female vs. male	—	0.57 (0.49–0.66)	0.56 (0.48–0.65)
Charlson Comorbidity Index score	—	—	1.05 (1.00–1.10)
Residence in low-income area: yes vs. no	—	—	1.22 (1.04–1.43)
Insurance			
Medicare vs. commercial	—	—	1.73 (1.39–2.14)
Medicaid vs. commercial	—	—	1.65 (1.29–2.12)
Other vs. commercial	—	—	0.91 (0.70–1.20)
Obesity: yes vs. no	—	—	1.43 (1.20–1.71)

* Model 1 is the unadjusted race-only model; model 2 includes race with the additional covariates of age and sex; and model 3 includes race with the additional covariates of age, sex, Charlson Comorbidity Index score, residence in a low-income area, insurance plan, and obesity.

the Supplementary Appendix, available with the full text of this article at NEJM.org). Oxygen saturation was not included in the model because of a moderate correlation with respiratory rate as well as a recent meta-analysis that indicated that dyspnea is a strong prognostic indicator of Covid-19 progression.[17] Levels of troponin I, brain-type natriuretic peptide, and ferritin were not considered because these are not standard laboratory measures at admission that are relevant to all patients. Alanine aminotransferase (ALT) was not considered because of a high correlation with aspartate aminotransferase (AST). Variables with standardized differences greater

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Table 4. Hazard Ratios for In-Hospital Death among 1382 Patients Hospitalized for Covid-19.*

Variable	Model 1	Model 2	Model 3	Model 4
		hazard ratio (95% CI)		
Race: black vs. white	0.78 (0.62–0.99)	1.08 (0.84–1.38)	1.14 (0.88–1.49)	0.89 (0.68–1.17)
Age, in 5-yr units	—	1.18 (1.13–1.23)	1.19 (1.13–1.24)	1.18 (1.13–1.24)
Sex: female vs. male	—	0.63 (0.50–0.79)	0.62 (0.49–0.78)	0.88 (0.68–1.13)
Charlson Comorbidity Index score	—	—	0.99 (0.94–1.03)	0.99 (0.95–1.04)
Residence in low-income area: yes vs. no	—	—	0.84 (0.67–1.06)	0.89 (0.71–1.13)
Obesity: yes vs. no	—	—	1.05 (0.83–1.34)	0.99 (0.77–1.27)
Respiratory rate ≥24 breaths/min	—	—	—	2.00 (1.34–2.99)
Absolute lymphocyte count <1000/μl	—	—	—	1.33 (1.01–1.74)
Platelet count <150,000/μl	—	—	—	1.26 (1.00–1.60)
Creatinine >1.5 mg/dl	—	—	—	1.32 (1.02–1.71)
Aspartate aminotransferase >40 U/liter	—	—	—	1.28 (0.97–1.68)
Bilirubin ≥1.2 mg/dl	—	—	—	1.17 (0.88–1.55)
Venous lactate >2.2 mmol/liter	—	—	—	1.64 (1.26–2.13)
Procalcitonin >0.25 ng/ml	—	—	—	1.40 (1.06–1.84)
C-reactive protein >8.2 ng/ml	—	—	—	1.01 (0.49–2.08)

* Model 1 is the unadjusted race-only model; model 2 includes race with the additional covariates of age and sex; model 3 includes race with the additional covariates of age, sex, Charlson Comorbidity Index score, residence in a low-income area, and obesity; and model 4 includes race with the additional covariates of age, sex, Charlson Comorbidity Index score, residence in a low-income area, obesity, and indicators for baseline vital signs and laboratory measures above or below predefined clinical thresholds (respiratory rate; levels of aspartate aminotransferase, venous lactate, creatinine, bilirubin, procalcitonin, and C-reactive protein; and counts of lymphocytes and platelets). Multiple imputation was used to estimate missing values for BMI; levels of venous lactate, procalcitonin, and C-reactive protein; and lymphocyte count.

than 0.1 between outcome groups were then incorporated into the final analysis (model 4).

After balance diagnostics were performed, the final Cox proportional-hazards model incorporated race, age, sex, Charlson Comorbidity Index score, residence in a low-income area (yes vs. no), insurance, obesity (yes vs. no), respiratory rate, AST level, venous lactate level, platelet count, creatinine level, bilirubin level, procalcitonin level, C-reactive protein level, and lymphocyte count. The proportional-hazards assumption for the Cox models was investigated and confirmed graphically through survival functions over time. All model-based results are presented with 95% confidence intervals. All analyses were conducted with the use of the SAS System for Windows, version 9.4 (SAS Institute).

RESULTS

CHARACTERISTICS OF COVID-19—POSITIVE PATIENTS

A total of 3626 patients tested positive, of whom 145 were excluded (84 had missing data on race or ethnic group, 9 were Hispanic, 43 were Asian, 6 were American Indian or Alaska Native, and 3 were Native Hawaiian or Pacific Islander). Among the 3481 patients included in the analysis, the mean age was 54 years, most were female (60.0%), and 70.4% were black non-Hispanic (Table 1). The percentage of black patients with Medicaid insurance was three times as high as the percentage of white non-Hispanic patients, and black patients were almost twice as likely to live in low-income areas as white patients. Black patients had higher prevalences of obesity, diabetes, hypertension, and chronic kidney disease than white patients. Black patients were also more likely than white patients to present with fever, cough, or dyspnea at the time of Covid-19 testing. Most patients were tested for Covid-19 in the ED (1992 patients, 57.2%), with a higher percentage of black patients having been tested in the ED than white patients (65.3% vs. 38.0%).

CHARACTERISTICS AND OUTCOMES OF HOSPITALIZED PATIENTS

A total of 39.7% of the patients who tested positive for Covid-19 were hospitalized. Among the

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1992 patients tested for Covid-19 in the ED, 40.3% of black patients (646 of 1601 patients) and 44.2% of white patients (173 of 391 patients) were admitted to the hospital on the same day they were tested. Overall, black patients composed 76.9% of the hospital admissions (Table 2). A higher percentage of black patients than white patients were febrile on admission. A higher percentage of white patients than black patients presented with low white-cell, lymphocyte, or platelet counts; low sodium levels; or elevated levels of brain-type natriuretic peptide. However, a higher percentage of black patients than white patients presented with elevated levels of creatinine, AST, procalcitonin, and C-reactive protein. The most common acute medical conditions observed among all patients at any time during hospitalization were hypoxic respiratory failure and pneumonia coinfection (defined as a Covid-19–positive test and viral or bacterial pneumonia). A higher percentage of black patients than white patients had acute renal failure during hospitalization (15.3% vs. 10.7%). More than one third of admitted patients (474 patients) received care in an intensive care unit, among whom 80.2% were black patients. Among the 364 patients receiving mechanical ventilation, 81.6% were black.

Of the 326 patients who died in the hospital, 230 (70.6%) were black. Among deceased patients, a higher percentage of black patients than white patients had been treated with mechanical ventilation (73.9% vs. 36.5%). The unadjusted case-fatality rate for white patients was 30.1%, as compared with 21.6% among black patients. The median length of hospital stay was similar across racial groups. Additional descriptions of the clinical course of care for patients who received critical care services are provided in Tables S3 and S4.

FACTORS ASSOCIATED WITH HOSPITALIZATION

Table 3 shows the unadjusted and adjusted odds of hospital admission. In the adjusted analysis (model 3), black race was associated with approximately twice the odds of hospital admission as white race (odds ratio, 1.96; 95% confidence interval [CI], 1.62 to 2.37). In addition, increasing age, a higher score on the Charlson Comorbidity Index, public insurance (Medicare or Medicaid), residence in a low-income area, and obesity were associated with an increased odds of admission, whereas female sex was associated with lower odds of admission.

FACTORS ASSOCIATED WITH IN-HOSPITAL DEATH

Table 4 shows the Cox proportional-hazards models for factors associated with in-hospital death. In the adjusted time-to-event analyses (model 4), variables that were associated with higher in-hospital mortality were increasing age and presentation with an elevated respiratory rate; elevated levels of venous lactate, creatinine, or procalcitonin; or low platelet or lymphocyte counts. However, black race was not independently associated with risk of in-hospital death (hazard ratio, 0.89; 95% CI, 0.68 to 1.17).

DISCUSSION

This study examined the characteristics and clinical outcomes of a large cohort of Covid-19–positive patients in Louisiana. Blacks and female patients represented the majority of all Covid-19–positive patients. Black patients had higher prevalences of obesity, diabetes, hypertension, and chronic kidney disease at baseline than white patients. Although black patients represent 31% of the patients routinely cared for by Ochsner Health, they made up 76.9% of Covid-19–positive patients hospitalized within the health system. A higher percentage of blacks than whites presented with elevated levels of creatinine, AST, or inflammatory markers. Among the patients who received critical care or mechanical ventilation, approximately 80% were black. Black race, increasing age, a higher score on the Charlson Comorbidity Index, public insurance (Medicare or Medicaid), residence in a low-income area, and obesity were associated with increased odds of hospital admission. Blacks were overrepresented among all patients who died in the hospital (70.6%). However, black race was not associated with higher in-hospital mortality than white race, after adjustment for differences in sociodemographic and clinical characteristics on admission; this finding is similar to that of a recent study in the state of Georgia in which 80% of hospitalized patients with Covid-19 were black.[18]

The racial differences in the frequency of Covid-19 observed in the study population are probably multifactorial. They may reflect underlying racial differences in the types of jobs that may have an increased risk of community expo-

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sure (e.g., service occupations). In a 2015 report on the civilian labor force in Louisiana, most service workers in New Orleans and surrounding areas were members of minority groups.[19] Approximately 40% of service occupations in New Orleans were jobs related to food preparation and serving. Racial differences in Covid-19 that were observed may also reflect differences in the prevalence of chronic conditions that appear to increase the risk of severe illness. According to a 2018 Health Report Card,[20] Louisiana ranked 45th of 50 states for obesity, 46th for heart disease or strokes, and 47th for diabetes. The report further showed that the incidences of obesity and diabetes were higher in the black population than in the white population. The incidences of these conditions are also higher among persons with lower education and low-income levels across all race groups.

This study confirms previously described clinical presentations, laboratory findings, and outcomes of Covid-19–related hospital admissions[2-6,21-23] but also highlights racial differences. Hypoxic respiratory failure and pneumonia coinfection were the most common acute medical conditions during hospitalization (25.3% and 37.8%, respectively, of all patients). Frequent laboratory abnormalities included leukopenia and thrombocytopenia with elevated levels of creatinine, aminotransferases, and markers of inflammation. Unlike in previous studies, we observed racial differences in several laboratory results. This difference in clinical presentation may reflect a longer wait to access care among black patients, resulting in more severe illness on presentation to health care facilities. It is notable that similar percentages of black patients and white patients presented with severe illness requiring hospitalization on the same day that the disease was diagnosed (40.3% and 44.2% respectively). However, for the remaining patients who had tested positive as outpatients and were subsequently admitted, the type and frequency of interim care received in the ambulatory setting and whether there were racial differences in the receipt of care remain unclear.

The observed differences in clinical presentation may also reflect differences in underlying chronic conditions on hospital presentation. For example, chronic renal insufficiency at baseline and acute renal failure during hospitalization were more common among black patients than white patients. Black patients were more likely to have fever on testing or elevated levels of procalcitonin, or C-reactive protein. These findings may suggest a different immune response to Covid-19 according to race. In a study examining population differences in the immune response to pathogens, Nédélec et al. found that African ancestry was associated with a stronger inflammatory response to pathogens than European ancestry.[24] Our findings suggest that more studies are warranted to assess the immune response to this novel coronavirus with regard to racial and ethnic differences, other factors that may influence the difference in hospitalizations, and the effect on outcomes.

This study also showed associations between the risk of in-hospital death and demographic factors (age) and clinical factors (respiratory rate) as well as several biomarkers (levels of venous lactate, creatinine, procalcitonin and platelet count), findings similar to those of other studies. For example, in a meta-analysis of 13 studies (involving 3027 Covid-19–positive patients), Zheng et al. reported that fever and dyspnea were associated with progression of disease.[17] In a meta-analysis of 21 studies (involving 3377 patients and 33 laboratory variables), Henry et al. reported that biomarkers of cardiac injury, liver and kidney function, and inflammation and coagulation measures were significantly elevated in patients with severe and fatal Covid-19.[25] It remains unclear whether the direction and strength of the associations between these biomarkers and in-hospital death differ in their prognostic implications across different populations. Further research on predictive modeling of in-hospital death is needed to better inform management of the care of inpatients with Covid-19.

This study has several limitations. The study analysis was limited to one integrated-delivery health system in Louisiana and therefore may have limited external generalizability to other health care settings. However, the strength of this study is the addition of Covid-19 epidemiologic data based on a large population of black non-Hispanic patients in the southern region of the United States. Patients with chronic lung disease and conditions that are associated with immunosuppression and related therapy were only a small percentage of the population tested. We cannot draw any conclusions regarding those subpopu-

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lations. Not all laboratory studies were performed in all patients. Therefore, their roles in the clinical presentation of the study population may not be sufficiently represented. Nonetheless, variation in laboratory testing probably reflects rapid changes in clinical management of Covid-19 as the public health crisis unfolded globally. Finally, this study relied solely on structured data captured in the electronic medical record. Study findings are therefore subject to the accuracy and completeness of electronic documentation by the care team.

Notwithstanding these limitations, this study provides comparative epidemiologic characteristics of black non-Hispanic patients who are underrepresented in the Covid-19 medical literature to date. The study also sheds light on differences in clinical presentations.

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