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Racial Difference in Hospital and Critical Care Admissions and Mortality before and during the COVID-19 Pandemic

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ABSTRACT

Purpose: To explore the racial difference in hospital and intensive critical care (ICU) admissions and mortality during COVID-19 pandemic compared to the pre-COVID period.

Methods: This was a retrospective observational study.

Results: The racial proportion of hospital admissions was not changed. Either all-cause or non-COVID ICU admission rate increased significantly in White patients (9.7% during vs 8.1% pre-COVID, p<.0001). Non-COVID ICU admission rate increased for Black or African American patients (14.4% during vs 11.0% pre-COVID, p=0.05). For White or Caucasian patients, either all-cause mortality (3.9% during vs 3.0% pre-COVID) or non-COVID mortality (3.8% during vs 3.0% pre-COVID) increased significantly. For Black or African American patients, all-cause mortality increased significantly (3.4% during vs 1.6% pre-COVID, p=.03). Compared to White patients, COVID-19 incidence rate was significantly higher among Asian, Black or African American and Hispanic patients. ICU admission rate and mortality of minority COVID-19 patients were not different from White or Caucasian patients.

Conclusions: The COVID-19 pandemic did not affect the racial proportion of admissions. The ICU admission rate and mortality did not change for most of races except for White or Caucasian and Black or African American patients and the increase was caused by COVID-19 patients as well as non-COVID patients.

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Introduction

The COVID-19 pandemic has had disparate impact on different racial/ethnic groups in incidence rate, severity, hospitalization and mortality [1-4]. Data collected during March1, 2020-November 27, 2021 from the US Centers for Disease Control and Prevention (CDC) showed the age-adjusted laboratory-confirmed COVID-19-associated hospitalization rate per 100,000 population of these races in descending order: Non-Hispanic American Indian or Alaska Native (1659.7), Non-Hispanic Black (1293.4), Hispanic or Latino (1254.5), Non-Hispanic White (510.7), Non-Hispanic Asian or Pacific Islander (418.2). Compared to non-Hispanic Asian or Pacific Islander and non-Hispanic White people, Non-Hispanic American Indian or Alaska Native, Non-Hispanic Black or Latino people have higher hospitalization rates [5]. Black race and Hispanic ethnicity are associated with increased odds of COVID-19 positivity and this association is substantially mediated by socioeconomic factors and comorbidities [6,7].

A large, multicenter, EHR-based analysis showed that Black adults hospitalized with COVID-19 had higher observed mortality than White patients while Hispanic ethnicity was associated with lower mortality [8]. A single-center study showed that, for intubated COVID-19 patients, compared to Whites, African Americans were 3 times more likely to die while Hispanics were 1.3 times more likely to die in the ICU [9]. CDC data showed that Hispanic or Latino, Non-Hispanic Black, and Non-Hispanic American Indian or Alaska Native people have higher proportion of COVID-19 deaths than the racial proportion of population [5]. Regardless of poverty level, compared to substantially-White counties, less diverse, more diverse or substantially non-White counties had higher rate ratio of COVID-19 incidence and death [10].

The hospital admissions in the United States have decreased since the first surge of the COVID-19 pandemic [4-11]. Comparative analyses of data regarding racial factors in hospital admissions, ICU encounters and mortality during COVID-19 pandemic versus pre-COVID period is lacking. Our study intended to explore the changes of hospital admissions, ICU encounters and mortality in different racial groups of patients in our hospital during COVID-19 pandemic, compared to pre-COVID time. The

racial differences in COVID-19 incidence rate among admitted patients during the pandemic, ICU admission rate and mortality among admitted COVID-19 patients were also investigated.

Materials and Methods

This was a retrospective observational study. Data were collected from a single center with 335 inpatient hospital beds and 52 critical care beds. The hospital serves majority of patients from a County with 1.6 million of population and amongst the top 25 counties with highest household income. The racial makeup of the county is 80.0% White, 9.3% Asian, 4.7% Black or African American, 0.2% American Indian, 3.3% from other races, and 2.5% from two or more races. About 6.5% of the population is of Hispanic or Latino origin.

We included patients admitted to the hospital mentioned above before COVID-19 pandemic (January 1, 2019- February 27, 2020) and during COVID-19 pandemic (February 28, 2020 – June 30, 2021). During the time window of COVID-19 pandemic, 27,633 patients were admitted. The start time of pre-COVID period was defined as the date when the number of admitted patients before the pandemic was similar to 27,633 (27,624), so that the two groups (during vs pre-) had similar sample size.

The comparison between groups was tested using Chi-Square test (if the numbers were large) or Fisher's exact test (if the numbers were small) or multivariate logistic regression (to calculate odds ratio). The comparison with $p \leq 0.05$ was considered significantly different. The statistical analysis for this study was generated using Statistical Analysis Software (SAS), version 9.4 for Windows (SAS Institute Inc., Cary, NC, USA).

Results

Pre-Covid Period versus Covid-19 Pandemic

Table 1 shows the racial proportion of all-cause and non-COVID hospital admissions before and during the COVID-19 pandemic. The all-cause admission decreased from 2,125/month to 1,842/month after March, 2020 (-13%). Majority of the hospitalized patients were White or Caucasian and the ratio to whole population was not changed significantly (90.57% during vs 90.95% pre-, p=0.12). The ratio of minority to the whole population was not changed except for decreased ratio of Native Hawaiian or Other Pacific Islander (0.01% during vs 0.04% pre-, p=0.03) and increased ratio of "Other" (2.24% during vs 1.99% pre-, p=0.04). After excluding COVID-19 patients, the admission of non-COVID patients decreased from 2,125/month to 1,807/month (-15%) and the racial proportion did not change except for decreased ratio of Native Hawaiian or Other Pacific Islander (0.01% during vs 0.04% pre-, p=0.04).

Table 1: Racial proportion of all-cause and non-COVID hospital admissions before (January 1, 2019 to February 27, 2020) and during (February 28, 2020 to June 30, 2021) the COVID-19 pandemic

All-cause Hospital Admission			
Race	**Before, N=27,624 n(n/N%)**	**During, N=27,633 n(n/N%)**	**P***
White or Caucasian	25,124(90.95%)	25,027(90.57%)	0.1224
Alaska Native	3(0.01%)	3(0.01%)	0.9999
American Indian	43(0.16%)	30(0.11%)	0.1275
Asian	797(2.89%)	845(3.06%)	0.2318
Black or African American	762(2.76%)	763(2.76%)	0.9844
Hispanic	172(0.62%)	195(0.71%)	0.2296
Latin American	7(0.03%)	9(0.03%)	0.6175
Native Hawaiian or Other Pacific Islander	11(0.04%)	3(0.01%)	0.0324
Other	550(1.99%)	619(2.24%)	0.0419
Unknown, Declined, or Unavailable	155(0.56%)	139(0.50%)	0.3480
Non-COVID Hospital Admissions			
Race	**Before, N=27,624 n(n/N%)**	**During, N=27,099 N(n/N%)**	**P***
White or Caucasian	25124(90.95%)	24,587 (90.73%)	0.3732
Alaska Native	3(0.01%)	3(0.01%)	0.9812
American Indian	43(0.16%)	28(0.10%)	0.0890
Asian	797(2.89%)	815(3.01%)	0.3975
Black or African American	762(2.76%)	734(2.71%)	0.7205
Hispanic	172(0.62%)	185(0.68%)	0.3831
Latin American	7(0.03%)	9(0.03%)	0.5902
Native Hawaiian or Other Pacific Islander	11(0.04%)	3(0.01%)	0.0355
Other	550(1.99%)	597(2.20%)	0.0835
Unknown, Declined, or Unavailable	155(0.56%)	138(0.51%)	0.4059

*Chi-Square test

Table 2 shows all-cause and non-COVID ICU admission rate of each race during pandemic compared to pre-COVID period. All-cause ICU admissions increased from 176/month to 184/month during the pandemic. Among the total population, the all-cause ICU admission rate increased significantly (9.97% during vs 8.26% pre-, p<.0001). All-cause ICU admission rate of White or Caucasian patients increased significantly during the pandemic (9.70% during vs 8.10% pre-, p<0.0001). All-cause ICU admission rate of minority patients did not change significantly except for "Other" patients (13.73% during vs 9.45% pre-, p=0.03). ICU admissions of non-COVID patients increased from 176/month to 179/month during the pandemic. For non-COVID patients, the ICU admission rate increased in total patients (9.93% during vs 8.26% pre-, p<0.0001), Whites or Caucasians (9.66% during vs 8.10% pre-, p<0.0001), Black or African Americans (14.44% during vs 11.0% pre-, p=0.05) and "Other" (13.23% during vs 9.45% pre-, p=0.05).

Table 2: All-cause and non-COVID ICU admission rate of different ethnic groups before (January 1, 2019 to February 27, 2020) and during (February 28, 2020 to June 30, 2021) the COVID-19 pandemic

All-cause Hospital Admission			
Race	**Before, N=27,624 all-cause hospital admissions n/N_{race}(%)**	**During, N=27,633 all-cause Hospital admissions n/N_{race}(%)**	**P***
Total	2,283/27,624(8.26%)	2,755/27,633(9.97%)	<0.0001
White or Caucasian	2,034/25,124(8.10%)	2,428/25,027(9.70%)	<0.0001
Alaska Native	0/3(0%)	0/3(0%)	NA
American Indian	4/43(9.30%)	4/30(13.33%)	0.7093
Asian	71/797(8.91%)	89/845(10.53%)	0.2799
Black or African American	84/762(11.02%)	109/763(14.29%)	0.0643
Hispanic	11/172(6.40%)	21/195(10.77%)	0.1937
Latin American	1/7(14.29%)	0/9(0%)	0.4375
Native Hawaiian or Other Pacific Islander	1/11(9.09%)	0/3(0%)	1.0000
Other	52/550(9.45%)	85/619(13.73%)	0.0285
Unknown, Declined, or Unavailable	25/155(16.13%)	20/139(14.39%)	0.7467
Non-COVID ICU Admission Rate			
ICU encounter	**Before, N=27,624 non-COVID hospital admissions n/N_{race}(%)**	**During, N=27,099 non-COVID hospital admissions n/N_{race}(%)**	**P***
Total	2,283/27,624(8.26%)	2,690/27,632(9.93%)	<0.0001
White or Caucasian	2,034/25124(8.10%)	2,376/24,587(9.66%)	<0.0001
Alaska Native	0/3(0%)	0/3(0%)	NA
American Indian	4/43(9.30%)	2/28(7.14%)	1.0000
Asian	71/797(8.91%)	87/815(10.67%)	0.2418
Black or African American	84/762(11.02%)	106/734(14.44%)	0.0521
Hispanic	11/172(6.40%)	20/185(10.81%)	0.1875
Latin American	1/7(14.29%)	0/9(0%)	0.4375
Native Hawaiian or Other Pacific Islander	1/11(9.09%)	0/3(0%)	1.000
Other	52/550(9.45%)	79/597(13.23%)	0.0508
Unknown, Declined, or Unavailable	25/155(16.13%)	20/138(14.49%)	0.7471

*Chi-square test for Total and White patients; Fisher's Exact test for minorities.

Table 3 shows all-cause and non-COVID hospital mortality of each race during the pandemic compared to pre-COVID period. For overall population, all-cause mortality increased significantly during the pandemic compared to pre-COVID period (3.94% during vs 2.97% pre-, p<0.0001). All-cause mortality increased significantly in White or Caucasian patients (3.91% during vs 3.01% pre-, p<0.0001), Black or African American (3.41% during vs 1.57% pre-, p=0.03) and "Other" patients (3.88% during vs 1.64% pre-, p=0.02). All-cause mortality did not changed significantly in Alaska Native, American Indian, Asian, Hispanic, Native Hawaiian or Other Pacific Islander, or Unknown, Declined, or Unavailable patients. After excluding COVID-19 patients, the increase of non-COVID mortality was still significant in White or Caucasian (3.79% during vs 3.01% pre-, p<0.001) and "Other" (4.02% during vs 1.64% pre-, p=0.02), and a trend in Black or African American (3.13% during vs 1.57% pre-, p=0.059).

Table 3: All-cause and non-COVID hospital mortality of different ethnic groups before (January 1, 2019 to February 27, 2020) and during (February 28, 2020 to June 30, 2021) the COVID-19 pandemic

All-cause Hospital Mortality			
Race	**Before, N=27,624 all-cause hospital admissions n/N_{race}(%)**	**During, N=27,633 all-cause hospital admissions n/N_{race}(%)**	**P***
Total	821/27,624(2.97%)	1,088/27,633(3.94%)	<0.0001
White or Caucasian	756/25,124(3.01%)	979/25,027(3.91%)	<0.0001
Alaska Native	0/3(0%)	0/3(%)	NA
American Indian	3/43(6.98%)	1/30(3.33%)	0.6391
Asian	25/797(3.14%)	39/845(4.62%)	0.1276
Black or African American	12/762(1.57%)	26/763(3.41%)	0.0314
Hispanic	2/172(1.16%)	6/195(3.08%)	0.2915
Latin American	0/7(0%)	0/9(0%)	NA
Native Hawaiian or Other Pacific Islander	0/11(0%)	1/3(33.33%)	0.2143
Other	9/550(1.64%)	24/619(3.88%)	0.0218
Unknown, Declined, or Unavailable	14/155(9.03%)	12/139(8.63%)	1.0000
Non-COVID Hospital Mortality			
Race	**Before, N=27,624 non-COVID admissions n/N_{race}(%)**	**During, N=27,099 non-COVID admissions n/N_{race}(%)**	**P***
Total	821/27,624(2.97%)	1,036/27,099(3.82%)	<0.0001
White or Caucasian	756/25,124(3.01%)	933/24,587(3.79%)	<0.0001
Alaska Native	0/3(0%)	0/3(%)	NA
American Indian	3/43(6.98%)	1/28(3.57%)	1.0000
Asian	25/797(3.14%)	36/815(4.42%)	0.1932
Black or African American	12/762(1.57%)	23/734(3.13%)	0.0588
Hispanic	2/172(1.16%)	6/185(3.24%)	0.2861
Latin American	0/7(0%)	0/9(0%)	NA
Native Hawaiian or Other Pacific Islander	0/11(0%)	1/3(33.33%)	0.2143
Other	9/550(1.64%)	24/597(4.02%)	0.0204
Unknown, Declined, or Unavailable	14/155(9.03%)	12/138(8.70%)	1.0000

*Chi-square test for Total and White patients; Fisher's Exact test for minorities.

Covid-19 Positive Patients

Table 4 shows COVID-19 incidence rate (COVID-19 positive cases per 100 admitted patients of each race). The incidence rate of COVID-19 positive cases among a specific race was compared to the incidence rate of White or Caucasian patients. Among 27,633 patients admitted during the COVID-19 pandemic, 534 patients (1.93%) were COVID-19 positive. Among 25,027 White or Caucasian patients admitted during the pandemic, 440 patients (reference incidence rate 1.76%, p=1.000) were COVID-19 positive. These races had significantly higher COVID-19 incidence rate than White or Caucasian: Asian (3.55%, p=0.0005), Black or African American (3.80%, p=0.0003), Hispanic (5.13%, p=0.003), "Other" (3.55%, p=0.003). Age and sex adjusted logistic regression analysis revealed that, compared to White or Caucasian patients, the COVID-19 incidence rate was about twice higher among admitted Asians (odds ratio:2.07, 95%CI: 1.42-3.02), Black or African Americans (odds ratio: 2.26, 95%CI: 1.53-3.32), or Other patients (odds ratio:2.11, 95%CI: 1.36-3.29), and was about three times higher among admitted Hispanic patients (odds ratio: 3.18, 95%CI:1.66-6.09).

Table 4: COVID-19 incidence rate of each race compared to White or Caucasian

Race	N_{race}	COVID rate $n(n/N_{race}\%)$	P*	Age-Sex-adjusted Odds ratio (95%CI)**
Total	27,633	534(1.93%)	---	----
White or Caucasian	25,027	440(1.76%)	1.000	1.00(Reference)
Alaska Native	3	0(0%)	1.000	<.001(<.001->999.99)
American Indian	30	2(6.67%)	0.0978	3.83(0.91-16.17)
Asian	845	30(3.55%)	0.0005	2.07(1.42-3.02)
Black or African American	763	29(3.80%)	0.0003	2.26(1.53-3.32)
Hispanic	195	10(5.13%)	0.0028	3.18(1.66-6.09)
Latin American	9	0(0%)	1.0000	<.001(<.001->999.99)
Native Hawaiian or Other Pacific Islander	3	0(0%)	1.0000	<.001(<.001->999.99)
Other	619	22(3.55%)	0.003	2.11(1.36-3.29)
Unknown, Declined, or Unavailable	139	1(0.72%)	0.5246	0.40(0.06-2.89)

*Fisher's Exact Test **Multivariate logistic regression analysis

In Table 5, the ICU admission rate of admitted COVID-19 positive patients of each minority was compared to White or Caucasian patients. Among total 534 COVID-19 positive patients, 440 (82.4%) patients were White or Caucasian. Among 440 White or Caucasian patients with positive COVID-19, 52 patients were admitted to ICU (reference ICU admission rate 11.82%, p=1.000). These races had higher ICU admission rate: American Indian (100%, p=0.01) and "Other" (27.27%, p=0.045). These races had similar ICU admission rate: Asian (6.67%, p=0.6), Black or African American (10.34%, p=1.0), Hispanic (10%, p=1.0). Age and sex adjusted regression analysis did not find any significant difference of ICU admission rate of COVID-19 patients between Whites and any other race except for "Other" (odds ratio: 2.92, 95%CI: 1.06-8.04).

Table 5: ICU admission rate and hospital mortality of COVID-19 positive patients of each race compared to White or Caucasian

ICU Admission Rate				
Race	COVID cases N_{COVID}	ICU rate $n(n/N_{COVID})$	P*	Age-Sex-adjusted Odds ratio (95%CI)**
Total	534	66(12.36%)	--	--
White or Caucasian	440	52(11.82%)	1.000	1.00(reference)
Alaska Native	0	N/A	N/A	N/A
American Indian	2	2(100%)	0.0147	>999(<.001 - >999)
Asian	30	2(6.67%)	0.5587	0.62(0.14-2.71)
Black or African American	29	3(10.34%)	1.0000	0.88(0.25-3.05)
Hispanic	10	1(10%)	1.0000	1.06(0.13-8.80)
Latin American	0	N/A	N/A	N/A
Native Hawaiian or Other Pacific Islander	0	N/A	N/A	N/A
Other	22	6(27.27%)	0.0450	2.92(1.06-8.04)
Unknown, Declined, or Unavailable	1	0(0%)	1.0000	<.001(<.001- >999)
Hospital Mortality				
Total	534	52(9.74%)	--	--
White or Caucasian	440	46(10.45%)	1.000	1.00(Reference)
Alaska Native	0	N/A	N/A	N/A
American Indian	2	0(0%)	1.0000	<.001(<.001 - >999)
Asian	30	3(10.00%)	1.0000	1.45(0.40-5.26)
Black or African American	29	3(10.34%)	1.0000	1.81(0.49-6.68)
Hispanic	10	0(%)	0.6084	<.001(<.001 - >999)
Latin American	0	N/A	N/A	N/A

Native Hawaiian or Other Pacific Islander	0	N/A	N/A	N/A
Other	22	0(0%)	0.1506	<.001(<.001 - >999)
Unknown, Declined, or Unavailable	1	0(0%)	1.0000	<.001(<.001 - >999)

*Fisher's Exact Test **Multivariate logistic regression analysis

Also in Table 5, the mortality of hospitalized COVID-19 positive patients of each race was compared to White or Caucasian patients. For total of 534 COVID-19 patients, the mortality was 9.74%. Among 440 White or Caucasian patients with positive COVID-19, 46 patients died (reference mortality 10.45%, p=1.000). There was no difference of mortality between any race and White or Caucasian.

Discussion

Majority of patients admitted to our hospital were White and made up higher percentage (91%) than the county proportion of White persons (80%). This higher proportion of White patients could be due to the location of our hospital adjacent to several towns of substantially White residents. The monthly admission decreased during the COVID-19 pandemic (-13% all-cause admissions and -15% non-COVID admissions). The racial proportion of White or Caucasian, Alaska Native, American Indian, Asian, Black or African American, Hispanic, or Latin American was not changed during the COVID-19 pandemic when compared to pre-pandemic admissions.

A study based on data from 201 hospitals showed that hospital admissions in the United States had fallen dramatically during the early period (March, 2020 to July 2020) after declaration of COVID-19 pandemic, with substantially lower non-COVID admissions for patients residing in majority-Hispanic neighborhoods. In our hospital, Hispanic patients made up 0.68% of non-COVID admissions during the pandemic and 0.62% before [4]. The racial disparity in hospital admission might not caused by race itself. Instead, it is the different neighborhood that caused the racial difference in hospital admission. The race documented as "Other" had increased proportion of admissions during the pandemic. Native Hawaiian or Other Pacific Islander patients made up 0.04% of pre-pandemic admissions and decreased to 0.01% of admissions during the pandemic (no COVID-19 case) and this could be due to restricted travel.

The overall all-cause ICU admissions increased from 8.26% before the pandemic to 9.97% during the pandemic. White or Caucasian and "Other" patients had significant increase of all-cause ICU admission while American Indian, Asian, Black or African American, and Hispanic had insignificant increase of all-cause ICU admission. The statistical insignificance might be due to small number of these minorities among the overall patient population. We also observed that ICU admission of non-COVID patients increased in overall population, and specifically, White or Caucasian, and Black and African patients. The COVID-19 pandemic has led to severe shortages of critical care facilities and admitting physicians may face clinical and ethical difficulties to allocate ICU beds. Unbiased clinical criteria such as severe acute respiratory infection should be in place in order to mitigate the inadequacies and deficiencies in the treatment of non-COVID-19 patients [12,13]. Our hospital had made a lot of effort to increase the ICU capacity to accommodate the increasing ICU admission [14]. The increased ICU admissions partially resulted from COVID-19 positive patients and partially could be attributed to the stressful impact of the pandemic on non-COVID patients with pre-existing medical conditions [15]. The mortality followed the same trend as ICU admission. In a single-center study, compared to pre-COVID, African Americans increased ICU admission proportion during COVID-19 pandemic (35.24% during vs 28.65% pre-) while Whites decreased the racial proportion of ICU admissions (53.33% during vs 65.84% pre-) [16,17]. We observed similar trend in ICU admission proportion change (Black or African American: 3.94% during vs 3.68% pre-; White or Caucasian: 88.32% during vs 89.09% pre-) [18]. To the best of our knowledge, there was no study comparing the absolute ICU admission rate or mortality of different racial groups (ICU admission frequency or death of the race per 100 hospital admissions of the same race) between pre-pandemic period and during the COVID-19 pandemic.

Compared to White or Caucasian patients, Asian and Black or African American patients had twice higher incidence rate of COVID-19; Hispanic patients had three times higher; American Indian patients had four times higher. Our findings about racial disparities in COVID-19 incidence rate were more significant than what CDC data showed: Non-Hispanic White (Reference ratio=1), Non-Hispanic Black (2.11), Non-Hispanic Asian (0.93), Non-Hispanic multi races (1.02), Non-Hispanic American Indian or Alaska Native (2.43), Non-Hispanic Native Hawaiian or other Pacific Islander (2.88), Hispanic or Latino (3.06) [19]. In the state of Michigan, Blacks experienced 5.5 times higher incidence rate and 6.7 times higher mortality than Whites [20]. A meta-analysis showed that the COVID-19 incidence rate was higher in most ethnic minorities, but there was no clear racial inequality in outcomes among hospitalized COVID-19 patients except for the high risk of death in ethnic minorities in Brazil [21]. We did not observe any significant racial difference in ICU admission rate and mortality among hospitalized COVID-19 patients.

Our study was based on the data from a single hospital, which served substantially-White neighborhoods. The results may not be generalizable to other types of communities. The numbers of minority patients were relatively small, which limited the statistical power of the racial comparison tests. We compensated the limitation with long period of accumulation of data (13 months prior to the COVID-19 pandemic and 15 months during the pandemic) and balanced numbers of admissions in the two comparative groups.

Conclusion

In our hospital serving substantially-White neighborhoods, the proportion of hospital admissions was not changed for each race during the COVID-19 pandemic compared to pre-COVID time. The ICU admission rate and mortality did not change for most of races except for White or Caucasian and Black or African American patients and the increase was caused by COVID-19 patients as well as non-COVID patients. Although Asian, Black or African American and Hispanic patients had higher COVID-19 incidence rate than White or Caucasian patients, the ICU admission rate and mortality of these COVID-19 patients

were not different. These results may be generalized to hospitals serving substantially-White neighborhoods.

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