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Racial disparities in utilization of ECMO in COVID-19 patients: a retrospective population-based analysis.

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ABSTRACT

INTRODUCTION: Extracorporeal membrane oxygenation (ECMO) is a crucial intervention for severe respiratory failure, including in cases of COVID-19. Medical research has shown disparities in multiple fields of healthcare as well as in the utilisation of ECMO. Racial disparities in the utilisation of ECMO among COVID-19 patients are a concern, which requires investigation to ensure equitable access to life-saving treatments. To our knowledge, no study that have specifically evaluated the utilisation of ECMO among COVID-19 patients. Our aim from this study is to explore racial disparities in healthcare care, and specifically in the use of ECMO. The objective of the study was to evaluate any possible disparities that exist in the odds of receiving ECMO based on race after correcting for other confounding factors in patients admitted with COVID-19 pneumonia.

MATERIALS AND METHODS: This retrospective study analysed data from the National Inpatient Sample (NIS) database spanning 2019 to 2020. A total of 1,507,585 admissions for COVID-19 pneumonia were examined, of which 3,070 required ECMO. Statistical analyses, including adjusted odds ratios and multivariate logistic regression models, were employed to assess the association between race and ECMO utilisation using STATA 17 version.

RESULTS: The mean age of the studied population was 48.85 with a standard deviation of 0.5**.** 1075 white patients have utilized the ECMO when admitted to the hospital, compared to 605 black patients, 1055 Hispanics, 90 Asians, 75 Native Americans and 170 patients in 'Others' race group. Adjusted odds ratios for receiving ECMO, compared to Whites as the reference group, did not reveal statistically significant differences for African Americans (OR 1.03; 95% CI 0.75 - 1.40; P value = 0.86) and Asians (OR 1.04; 95% CI 0.75 - 1.75; P value = 0.86). Hispanics showed a significantly higher probability of receiving ECMO (OR 1.32; 95% CI 1.01 - 1.73; P-value=0.04), as did Native Americans (OR 2.16; 95% CI 1.18 - 3.94; P-value=0.012).

CONCLUSIONS: Addressing disparities in ECMO utilisation is crucial to ensure equitable access to lifesaving interventions among COVID-19 patients. Strategies to mitigate racial disparities in healthcare access and treatment are essential to optimise patient outcomes and fostering health equity.

KEY WORDS: Critical care, adult respiratory distress syndrome, mechanical circulatory support, ECMO, COVID.

INTRODUCTION

Extracorporeal membrane oxygenation (ECMO) is an advanced life support measure used in severe cardiac or respiratory failure refractory to standard therapy. It is subclassified as ECMO venoarterial (VA) and venovenous (VV). Additional ECMO configurations are available but not discussed in this article. While VA ECMO's primary function is to provide cardiac support and gas exchange as indicated, VV ECMO focusses on oxygenation and/or CO2 removal. ECMO indications in the treatment of severe COVID-19 are similar to the management of acute respiratory distress syndrome (ARDS) that fails initial therapies. Most commonly, VV ECMO is used in COVID-19 to perform oxygenation and CO2 removal while allowing the failing lungs to recover.

Previous systematic reviews and meta-analyses have demonstrated potential benefit in patients with ARDS related to COVID-19 [1]. Although the mortality rate was noted to be high, approximately 39% in the COVID-19 population that required ECMO treatment, it was comparable to the previous randomised control trial performed in pre-COVID-19 era at 37%, which is significantly lower compared to conventional management [2]. The estimated 60-day survival of patients with COVID-19 was similar to the results published on ECMO for severe ARDS, thus reaffirming the importance of considering patients for ECMO with refractory respiratory failure despite optimised care [3].

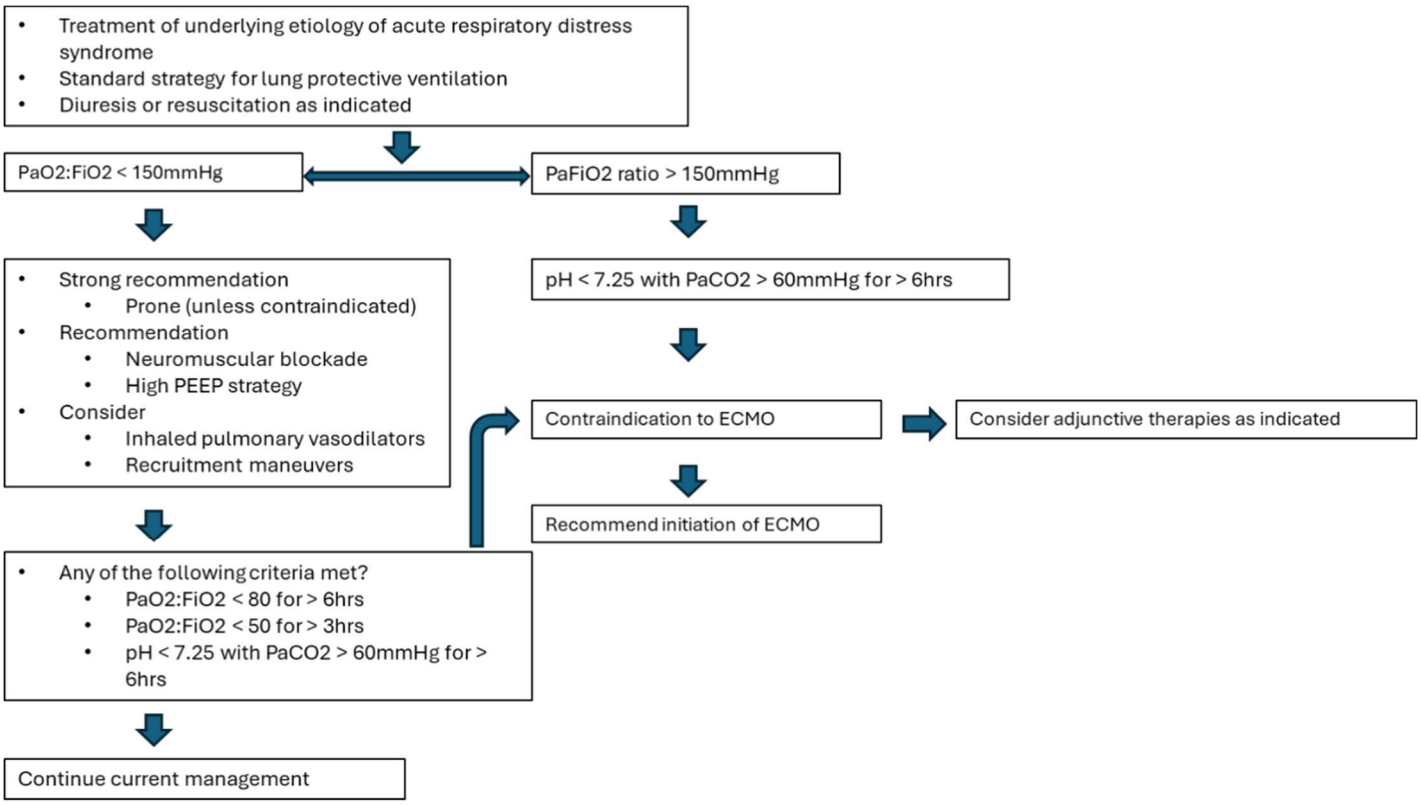

Figure 1. ELSO patient selection guidelines for ECMO consideration [4].

The ECMO selection process is described in detail by Extracorporeal Life Support Organisation (ELSO) guidelines (Figure 1) which are designed to be judicious and equitable while also acknowledging that ECMO capabilities are a finite resource [4]. Although it is tempting to stretch the use of conventional therapy to avoid placing patients on ECMO, there is no evidence to support delaying ECMO initiation.

Our objectives were to evaluate for possible underlying racial disparities in the topic of ECMO and to assess whether race was an major factor when it comes to receiving and utilising ECMO after correcting for other confounders. It was previously established that there are racial and ethnic disparities in out-patient COVID-19 treatment. Prescriptions for Nirmatrelvir/Ritonavir are approximately 36 and 30% lower among black and Hispanic patients [5]. Not only is there a considerably higher risk of COVID-19 positivity, but intensive care unit (ICU) admission rates were higher in black, Hispanic and Asian American individuals compared to their white cohort [6,7].

MATERIALS AND METHODS

Data Source and Study Population

The analysis was performed using data extracted from the National Inpatient Sample (NIS) database from January 1, 2019 to December 31, 2020. NIS is the largest publicly available all-payer inpatient healthcare database in the United States, designed to enable analysis of health policy implications on a national level. This database contains information on demographics, diagnoses, procedures, outcomes, and hospital characteristics of the patients. Access to the NIS can be sought

Statistical analysis

We utilised STATA software, version 17, to perform and conducting statistical analyses. The analysis calculated adjusted odds ratios for various population groups in comparison to whites, who served as the reference category. To explore the potential disparities in the use of ECMO among different racial groups, we employed multivariate logistic regression models. These models were adjusted for a variety of confounders to accurately assess the association between race and ECMO use among hospitalized COVID-19 patients. Different confounders were included in the analysis, such as age, sex, income, insurance type, co-morbid conditions.

The analysis was adjusted for medical confounders including hypertension (HTN), hyperlipidemia (HLD), heart failure (HF), coronary artery disease (CAD), chronic obstructive pulmonary disease (COPD), chronic kidney disease (CKD), end-stage renal disease (ESRD), obesity, peripheral vascular disease, cardiomyopathy, history of myocardial infarction (MI). For the purpose of our analysis, we selected the control race to be the White race and compared all races with the control (White population) using Walde's Chi-square test.

Data Extraction and Coding

For the purpose of this study, we identified cases using relevant codes from the 10th revision of the International Classification of Diseases (ICD-10) codes associated with COVID-19 pneumonia.

Furthermore, the utilization of ECMO during the hospital stay was verified by the corresponding ICD-10 procedural code ICD-10. This allowed for the targeted extraction of data related to our research objectives, focussing on the association between race and ECMO utilisation. Further details on the ICD-10 codes that were used can be found in the supplementary file. The use of ICD-10 codes allowed a homogeneous and standardized classification of disease states and medical procedures, facilitating the reliability and validity of our analysis.

Admission records were eligible for inclusion if the patient was diagnosed with COVID-19 and ECMO was administered during their hospitalisation. We excluded records of individuals under the age of 18 to focus on the adult population. Records were also excluded if they contained incomplete demographic information or if the patient did not require ECMO during hospitalization.

RESULTS

Baseline Characteristics

We identified a total of 1,525,020 admissions for COVID-19 pneumonia, among whom 3,082 patients required ECMO. 162 patients were excluded from the study due to incomplete demographic data. The studied population (patients admitted with Covid-19 pneumonia) consisted of 769,740 Whites, 285,715 Blacks, 336,835 Hispanics, 50,305 Asians, 15,995 Native Americans, and 66,430 Others (table 1). When it comes to usage of ECMO, 1085 White patients have utilized the ECMO when admitted to the hospital, compared to 615 Black patients, 1055 Hispanics, 90 Asians, 75 Native Americans, and 170 patients in 'Others' race group (see figure 2). The mean age of the studied population was 48.85 with a standard deviation of 0.5. We sub-stratified the studied population into 3 groups, young adults (18-30 years of age), adults (31-65 years of age), and older adults (>65 years of age).

Table 1. Baseline characteristics of the patients when admitted with Covid-19 pneumonia and requiring ECMO.

Characteristics	[N] (%)
Males	2095 (68.24%)
Females	975 (31.75%)
Age	
18-30	275 (8.95%)
31-65	2665 (86.8%)
>65	130 (4.2%)
Race	
Whites	1075 (35%)
Blacks	605 (21.1%)
Hispanics	1055 (34.3%)
Asians	90 (2.9%)
Native American	75 (2.4%)
Other	170 (5.5%)

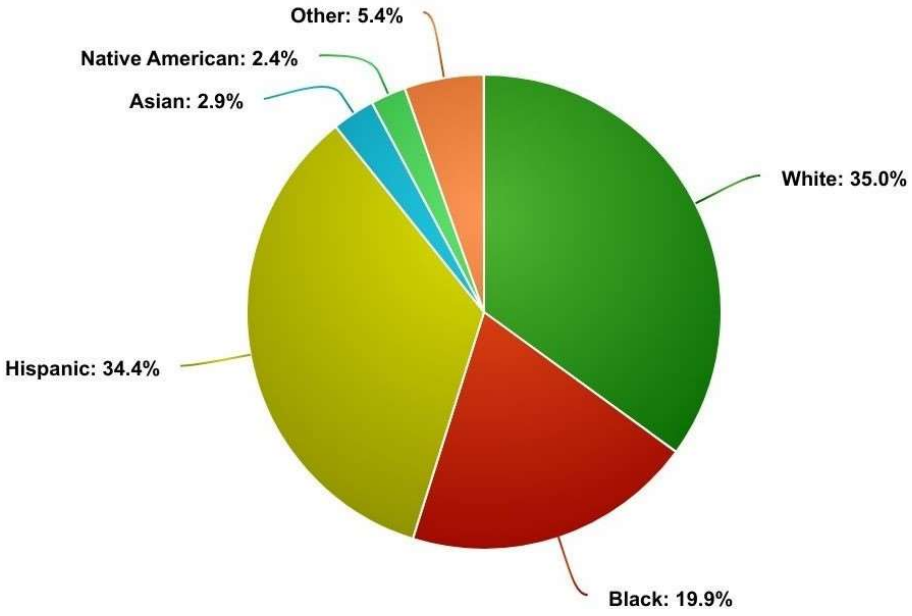

Figure 2. Utilisation of ECMO by race.

ECMO Therapy with the Accounting for Racial Differences

Adjusted odds ratios for receiving ECMO, compared to Whites as the reference group, did not reveal statistically significant differences for African Americans (OR 1.03; 95% CI 0.75 - 1.40; P value = 0.86) and Asians (OR 1.04; 95% CI 0.75 - 1.75; P value = 0.86). Hispanics showed a significantly higher probability of receiving ECMO (OR 1.32; 95% CI 1.01 - 1.73; P-value=0.04), as did Native Americans (OR 2.16; 95% CI 1.18 - 3.94; P-value=0.012). The category ‘Others’ did not show a statistically significant difference (OR 1.2; 95% CI 0.79 - 1.82; P-value=0.38).

Table 2. Adjusted odds ratio (aOR) of using ECMO in different races.

Race	aOR	95% CI	P-value
Blacks	1.026	0.754 - 1.396	0.867
Hispanics	1.322	1.011 - 1.730	0.041
Asians	1.044	0.624 - 1.746	0.868
Native American	2.158	1.181 - 3.945	0.012
Others	1.201	0.791 - 1.822	0.388

DISCUSSION

Patient selection disparities are observed in the selection of ECMO. It has previously been speculated that limited access in lower socioeconomic neighbourhoods, restrictive/biased interhospital transfer practices, and implicit provider bias contributed to these disparities [6]. A national hospital sample (NIS) analysis performed by Richardson et al. revealed that approximately 68% of patients with ECMO were classified as White, whereas only 18% and 10% were black and Hispanic, respectively [8]. Those who were of Asian/Pacific Islander race had higher odds of mortality compared to white patients with adjusted odd ratio (aOR) of 1.4 (CI 1.1-2.0) [8]. However, studies on racial disparities in patients with ECMO mortality in severe COVID-19 demonstrated different findings. Significantly higher in-hospital mortality was observed in Hispanic patients (OR 1.39, 95% CI 1.16-1.67, $p < 0.001$) compared to white patients [9]. Although our study did not show significant differences in the utilisation of ECMO therapy in COVID19 patients among African-American and Asian patients, it highlights an increase in usage among Hispanics and Native Americans compared to White Americans. The implications as to why this disparity exists are unclear, but likely multifactorial.

In general, there are disparities in healthcare literacy and income levels between various demographic groups, including Native American and Hispanic communities [10,11]. This may be due to socioeconomic status or cultural belief. However, low socioeconomic status encompassed by low health literacy, poor access to care, and poor insurance status hinders a person's ability to understand and utilise information effectively to make informed decisions about their health [8,11,12]. Access to health care insurance significantly increases the patient's access to timely medical necessities and drastically improves one's well-being. Lack of health coverage predisposes to postponing necessary medical attention and ultimately worsening outcomes. The complete absence of health insurance, however, constitutes enormous financial strain due to the substantial expenses that are often associated with medical treatment. [8,10,12,13].

Sixteen percent of Native Americans under 65 years of age do not have health insurance, compared to 19% of Hispanic Americans and 75% of White Americans [11-13]. This suggests a greater likelihood of health insurance nonownership among Native Americans and Hispanics. Native Americans and Hispanics are more likely to work in industries that do not provide healthcare. As a result, Native Americans and Hispanics tend to be much less likely to have insurance, with rates of 54% and 68%, respectively, compared to white people, who have a rate of 78%. This is one possible explanation for why Native American and Hispanics patients may delay routine appointments, which may aggravate their chronic conditions, particularly obesity, type II diabetes, hypertension, and chronic obstructive pulmonary disease, all of which are risk factors for worse outcomes in patients with COVID-19. [10-14]. Although accessibility and poor insurance status contribute more to the socioeconomic portion of the picture, genetics play a significant role, especially with respect to the probability of a pre-test. Hispanics and Native Americans exhibit elevated propensities for obesity, type II diabetes mellitus, and cardiovascular disease [8,13,14].

The Third National Health and Nutrition Examination Survey (NHANES III, 1988–1994) revealed that the age-adjusted diabetes rate was 7.3% for white non-Hispanic adults and 13.8% for people of Mexican descent [8,13,14]. All of this might be contributing to our findings of the increased usage of ECMO in these specific racial groups. This retrospective analysis shows the intricate dynamics underlying the severe management of COVID-19 that warrants ECMO intervention. By dissecting the information embedded within the NIS, which encapsulates a diverse array of demographic data from patients and clinical scenarios, this study offers crucial information to refine therapeutic modalities and optimise allocation of healthcare resources in the relentless challenges posed by the COVID-19 pandemic [8,13,14]. Although future studies are needed, this study builds on existing evidence that highlights racial disparities that exist with ECMO use in severe COVID-19 management.

Limitations - The present study is affected by several limitations that are inherent in its design. First, due to its retrospective nature, this study cannot definitively establish causal relationships. Although the NIS provides a comprehensive multivariate data set for all hospital admissions in the United States, it does not include crucial physiological parameters, laboratory values, and the patient's functional status. These factors are important as they coincide with socioeconomic factors that possibly led to the utilisation of ECMO yet were not integrated into the analysis [8,10-14].

CONCLUSIONS

Significant disparities in the utilisation of ECMO were observed among Hispanic and Native American patients compared to white patients. While Black and other racial groups exhibited trends toward increased utilisation, the differences were not statistically significant. Addressing these disparities is crucial to ensure equitable access to life-saving interventions like ECMO among demographically diverse populations affected by COVID-19.

SUPPLEMENTARY INFORMATION

Funding: *No fund was received related to this study.*
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Informed Consent Statement: *Not applicable*
Data Availability Statement: *The datasets generated and analyzed during the current study are available from the corresponding author on reasonable request.*
Conflicts of Interest: *The authors declare no conflicts of interest.*

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