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Cardiothoracic Imaging

Addressing ethnic disparities in imaging utilization and clinical outcomes for COVID-19

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\textbf{A B S T R A C T}

\textbf{Purpose:} Racial and ethnic disparities have exacerbated during the COVID-19 pandemic as the healthcare system is overwhelmed. While Hispanics are disproportionately affected by COVID-19, little is known about ethnic disparities in the hospital settings. This study investigates imaging utilization and clinical outcomes between Hispanic and non-Hispanic COVID-19 patients in the Emergency Department (ED) and during hospitalization.

\textbf{Methods:} Through retrospective chart review, we included 331 symptomatic COVID-19 patients (mean age 53.2 years) at a metropolitan healthcare system from March to June 2020. Poisson regression was used to compare diagnostic imaging utilization and clinical outcomes between Hispanic and non-Hispanic patients.

\textbf{Results:} After adjusting for confounders, no statistically significant difference was found between Hispanic and non-Hispanic patients for the number of weekly chest X-rays. Results were categorized into four clinical outcomes: ED management (0.16 ± 0.05 vs. 0.14 ± 0.05, p:0.79); requiring inpatient management (1.31 ± 0.11 vs. 1.46 ± 0.16, p:0.43); ICU admission without invasive ventilation (1.4 ± 0.17 vs. 1.35 ± 0.26, p:0.86); and ICU admission and ventilator support (3.29 ± 0.22 vs. 3.59 ± 0.37, p:0.38). There were no statistically significant relative differences in adjusted prevalence rate between ethnic groups for all clinical outcomes (p > 0.05). There was a statistically significant longer adjusted length of stay (days) in non-Hispanics for two subcohorts: inpatient admission and ventilator support (3.29 ± 0.31 vs. 9.72 ± 0.5, p < 0.01) and ICU admission without invasive ventilation (10.39 ± 0.57 vs. 13.45 ± 1.13, p < 0.01).

\textbf{Conclusions:} For Hispanic and non-Hispanic COVID-19 patients in the ED or hospitalized, there were no statistically significant differences in imaging utilization and clinical outcomes.

1. Introduction

Since the outbreak of Coronavirus Disease 2019 (COVID-19), many patients have been treated in the Emergency Department (ED) and other clinical settings across the United States.\textsuperscript{1} Of all COVID-19 patients, approximately 14\% have required hospitalization and 2\% have required intensive care unit (ICU) treatment.\textsuperscript{2} During initial triage, patients usually present with fever, respiratory, and/or gastrointestinal symptoms.\textsuperscript{3-5} Hospitalized patients are typically older and with comorbidities, including cardiovascular disease, hypertension, diabetes, chronic obstructive pulmonary disease (COPD), and obesity.\textsuperscript{5} Certain ethnic minority groups (Hispanics, Blacks, and Native Americans) are disproportionately affected by the coronavirus.\textsuperscript{6} Although 18\% of the United States population is Hispanic, 33\% of the nation's COVID-19 cases occurred in the Hispanic community.\textsuperscript{7} While social inequities (income disparity, high population density) are believed to cause ethnic disparities at the population level, once in the hospital setting, little is known about the utilization of healthcare resources at the patient level for those treated for COVID-19.\textsuperscript{8,9} Imaging utilization is one type of healthcare resource essential to patient management in the ED or hospital. Since respiratory infection is the most common manifestation of COVID-19, chest X-ray (CXR) is the first-line imaging modality for assessing disease.\textsuperscript{10,11} Complications from the coronavirus leading to cardiac or abdominal injury, pulmonary embolus, or stroke require more advanced imaging, such as computed tomography (CT), ultrasound (US), or magnetic resonance imaging (MRI), to manage these patients.

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To date, there have been few published works examining imaging utilization in the medical care of COVID-19 patients in the ED and hospital setting, especially among ethnic groups. Before the coronavirus pandemic, Schrag et al. found ethnic and racial differences in diagnostic imaging utilization during ED visits in the United States from 2005 to 2014. Similarly, Gholamrezanezhad et al. showed race and ethnicity are linked to decreased diagnostic imaging received in the ED. More recently, however, a study in a New York City healthcare system reported no disparity in image utilization in vulnerable subgroups with COVID-19 (elderly, racial/ethnic minorities, and socioeconomically underprivileged) as compared to their counterparts when given access to inpatient medical care.

Since March 2020, our densely populated metropolitan city bore the brunt of the COVID-19 cases in the state, which significantly impacted the Hispanic population in our healthcare system. It is well documented that Hispanics have about 4.7 times higher hospitalization rates than non-Hispanics. The purpose of this study is to compare medical care in terms of imaging utilization and clinical outcomes between Hispanic and non-Hispanic COVID-19 patients in the ED and hospital settings.

2. Patients and methods

Data for this study was extracted from an Institutional Review Board (IRB) approved and Health Insurance Portability and Accountability Act (HIPAA) compliant COVID-19 repository containing imaging and associated clinical data for COVID-19 positive patients. The IRB waived informed patient consent. Our healthcare system consists of an urban academic tertiary/quaternary referral center, a county Level I trauma center, and a community hospital located in the city’s suburbs. These facilities service a high proportion of Hispanic individuals living in a densely populated area. Repository data elements include sociodemographic data (age, gender, race, ethnicity), travel and contact history, comorbidities, symptoms, physical examination, imaging examinations (type, date, and findings), vital signs, laboratory, and outcomes data (ED management, inpatient management (non-ICU), ICU admission without invasive ventilation, ICU admission and ventilator support, and death).

Study data were collected and managed using the REDCap electronic data capture tool. This study used data from reverse transcription-polymerase chain reaction (RT-PCR) positive COVID-19 patients seen in the ED and those admitted to any of our hospitals from March 12, 2020, to June 30, 2020. Only patients with clinical symptoms consistent with COVID-19 were included in the study. Patients who were COVID-19 positive with no symptoms and admitted for unrelated medical conditions were excluded. Follow-up data for all patients were obtained through June 30, 2020.

The primary outcome was the number of imaging studies completed per week to manage COVID-19 patients in the Emergency Department (ED) or hospital settings. During the COVID pandemic, hospital guidelines and policies were set at all our facilities to reduce transmission, facilitate patient management, and effectively use available resources, including imaging. For COVID-19 patients, portable radiographs were obtained as needed. Chest CT was not used for screening but was ordered for inpatients to evaluate disease complications, such as abscesses or pulmonary embolism, as per the American College of Radiology (ACR) guidelines. CT, MRI, and ultrasound were performed when indicated on an urgent basis for patient management.

The secondary outcome was a composite of clinical outcomes categorized in order of least to most critically ill patients: ED management, requiring inpatient management (non-ICU), requiring ICU admission without invasive ventilation, requiring ICU admission and ventilator support, and death. Another secondary outcome was the patient’s length of stay (days) in the ED and hospital. The primary exposure of interest was self-reported ethnicity based on information available in the patient’s medical records. Ethnicity was categorized as Hispanic, non-Hispanic, and unknown. The unknown category represented a small portion of the cohort and was excluded from the study.

The potential confounders associated with ethnicity or number and type of imaging studies included age and medical comorbidities. This information was collected at the time of admission from the electronic medical record and manually entered into the COVID-19 repository.

3. Statistical methods

Data distribution for the number of imaging examinations and length of stay were examined by histogram and all skewed to the right. They are typical log transformation data; therefore, the Poisson regression model with log link function was used for model fitting. The statistical test compared the log-transformed mean, and the log means were then back-transformed to the original scale for interpretation. The Poisson regression model was used to estimate the relative difference (prevalence rate ratio between Hispanic and non-Hispanic patients) for binary outcomes: death, ICU stay, and intubation status. To identify potential confounders to ethnicity, we conducted the confounder filtering using Elastic-Net. Elastic-Net was designed to combine Ridge regression and Least Absolute Shrinkage and Selection Operator (LASSO) penalties. It balances having a parsimonious model with borrowing strength from many correlated comorbidities and demographic measurements. Those predictors were used as covariates in the model with ethnicity to obtain the adjusted estimate. Model integrity was diagnosed using residual plots. Overdispersion was examined using a negative binomial model’s dispersion parameter. For time to mortality and time to intubation, we have examined hazard ratio (HR) between ethnic groups using the Cox regression model. Proportional hazard (PH) assumption was assessed by the Supremum test and Schoenfeld residual plots. Benjamini and Hochberg procedure was used to correct false discovery rate from subgroup analysis. All data analyses were conducted by SAS 9.4.

4. Results

This study is based on 418 patients who tested positive for COVID-19 from March to June 2020. The following patients were excluded: 52 with no COVID-19 symptoms and admitted for other medical reasons, 15 “test only” or “phone visit only” patients, and 20 self-reported as “unknown” for ethnicity. The final sample size was 331 patients treated in the Emergency Department (ED) and/or admitted for hospitalization for COVID-19 related symptoms. The male-to-female sex distribution was 200:131. The mean age was 53.2 years, with a standard deviation of 16.7 years (Table 1). There were 247 (74.6%) Hispanic and 84 (25.4%) non-Hispanic patients. Symptoms upon initial presentation included cough, shortness of breath, fever, myalgia, chest pain, chills, fatigue, nausea, vomiting, diarrhea, throat pain, and loss of taste. One or more comorbidities were identified in 286 (86.4%) of all patients (n = 331), in 210 (85%) of Hispanic patients (n = 247), and in 76 (90.5%) of non-Hispanic patients (n = 84) (Table 1). Age, sex, and comorbidities have been adjusted for all statistical comparisons using LASSO.

Of 331 patients, 74 (22.4%) were seen in the ED and discharged, while 257 (77.6%) patients were admitted to the hospital. Of the 257 patients admitted, 33 had previously been seen in the ED and discharged. For this study, these 33 patients were included only in a hospital sub-cohort. Among all 331 patients (Hispanic: non-Hispanic, 247:84), 74 (22.4%) were ED management (discharged home) (Hispanic: non-Hispanic, 55:19), 145 (43.8%) inpatient management (non-ICU) (Hispanic: Non-Hispanic, 107:38), 45 (13.6%) ICU admission without invasive ventilation (Hispanic: Non-Hispanic, 35:10), and 67 (20.2%) ICU admission and ventilator support (Hispanic: Non-Hispanic, 50:17) (Table 2).

We generated a list of the imaging studies obtained for all patients (Table 3). The most frequent study was chest X-ray (CXR) (n = 1037, 74.77%), followed by abdominal X-ray (n = 182, 13.12%), CT head/brain (n = 35, 2.52%), CT abdomen (n = 23, 1.66%), ultrasound abdomen (n = 19, 1.37%), ultrasound lower extremity venous system (n = 19, 1.37%)
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Hispanic: non-Hispanic, 51:17) did not receive any imaging studies. The rest of the studies listed in Table 3 were much less frequent. Sixty-eight patients (Hispanic: non-Hispanic, 51:17) did not receive any imaging studies. The Hispanic: non-Hispanic ratio for patients not receiving any imaging studies provided an appropriate standardized ratio with a sufficient sample size to compare imaging studies per week instead of per day because it accounting for different frequencies in imaging demand of the hospital and statistical outliers. Imaging studies per day would be a less reliable data point because it is more easily skewed by high daily volumes of imaging ordered for patients in the critical care setting. Weekly imaging studies provided a more accurate indication of a patient’s overall hospital setting of the studied population.

| Table 2 | Hospital setting of the studied population. |
|---------|---------------------------------------------|
| Total n = 331 | Hispanic n = 247 | Non-Hispanic n = 84 |
| ED management (discharged home) | 74 | 55 (22.3%) | 19 (22.6%) |
| Requiring inpatient management (non-ICU) | 145 | 107 (43.3%) | 38 (45.2%) |
| Requiring ICU admission without invasive ventilation | 45 | 35 (14.2%) | 10 (11.9%) |
| Requiring ICU admission and ventilator support | 67 | 50 (20.2%) | 17 (20.2%) |

ED: Emergency department, ICU: Intensive Care Unit.

CVA: Cerebrovascular event, COPD: Chronic Obstructive Pulmonary Disease, ESRD: End Stage Renal Disease, ILD: Interstitial Lung Disease, TB: Tuberculosis, Neurological and psychological disorders: Dementia, Schizophrenia, and intracranial hemorrhage.

Table 3 | Frequency of the employed imaging exam on the studied population. |
|---------------------------------------------|
| Imaging type | Count | Percent |
| XR abdomen | 182 | 13.12% |
| XR chest | 1037 | 74.77% |
| XR fluoroscopy | 2 | 0.14% |
| XR ankle, femur, fingers, hand, knee | 1 | 0.07% |
| CT abdomen | 23 | 1.66% |
| CT angio neck | 3 | 0.22% |
| CT angio pulmonary | 13 | 0.94% |
| CT chest | 10 | 0.72% |
| CT head/brain | 35 | 2.52% |
| CT neck | 3 | 0.22% |
| CT pelvis | 2 | 0.14% |
| CT spine | 3 | 0.22% |
| CT angio chest, angio head, angio UE, cerebral perfusion, femur, multiphase liver, sinus | 1 | 0.07% |
| US abdomen | 19 | 1.37% |
| US lower extremity venous system | 14 | 1.01% |
| US retroperitoneal | 2 | 0.14% |
| US upper extremity venous | 5 | 0.36% |
| US chest, duplex hemodialysis access flow LVE, renal, thoracotomasis | 1 | 0.07% |
| MRI brain | 7 | 0.50% |
| MRI abdomen, MRCP, pelvis, spine | 1 | 0.07% |
| MRA head, neck | 1 | 0.07% |
| IR gastrostomy tube placement | 2 | 0.14% |
| NM hepatobiliary, myocardial perfusion | 1 | 0.07% |
| RF speech | 1 | 0.05% |

XR: X-ray, CT: Computed Tomography, Angio: Angiography, UE: Upper Extremity, US: Ultrasound, LVE: Left Upper Extremity, MRI: Magnetic Resonance Imaging, MRA: Magnetic Resonance Angiography, MRCP: Magnetic Resonance Cholangiopancreatography, IR: Interventional Radiology, NM: Nuclear Medicine, RF: Radiographic Fluoroscopy.

a One study per imaging type.
imaging requirement based on large sample size. The means are back transformed into log means for these values, and all the $p$ values are adjusted. Age is a confounder.

There were no statistically significant differences between Hispanic and non-Hispanic patients for the weekly CXRs in four clinical outcome sub-groups: ED management (0.16 ± 0.05 vs. 0.14 ± 0.08, p:0.79), inpatient management (non-ICU) (1.31 ± 0.11 vs. 1.46 ± 0.16, p:0.43), ICU admission without invasive ventilation (1.4 ± 0.17 vs. 1.35 ± 0.26, p:0.86), and ICU admission and ventilator support (3.29 ± 0.22 vs. 3.59 ± 0.37, p:0.38), respectively. When comparing all weekly imaging studies between Hispanic and non-Hispanic patients, there were no statistically significant differences in the same four sub-groups: ED management (0.2 ± 0.06 vs. 0.14 ± 0.08, p:0.56); inpatient management (non-ICU) (1.48 ± 0.11 vs. 1.66 ± 0.17, p:0.38); ICU admission without invasive ventilation (1.62 ± 0.18 vs. 1.99 ± 0.31, p:0.28), and ICU admission and ventilator support (4.27 ± 0.24 vs. 4.89 ± 0.42, p:0.1), respectively (Table 4). We did not compare any other imaging study types since the numbers were too small for accurate analysis.

We examined the clinical outcomes between Hispanic and non-Hispanic patients. Adjusted Rate Ratios (RR) were calculated: 0.7 ± 0.19, p:0.19 for ED management; 1.1 ± 0.22, p:0.64 for requiring inpatient management (non-ICU); 1.12 ± 0.41, p:0.76 for requiring ICU admission without invasive ventilation; 1.25 ± 0.37, p:0.46 for requiring ICU admission and ventilator support; and 1.85 ± 0.72, p:0.11 for death. Similar results were found in ICU patients with adjusted RR of 2.31 ± 1.17, P:0.01 and 1.03 ± 0.32, P:0.91 for death and ventilator support, respectively. There were no statistically significant differences in clinical outcomes between Hispanic and Non-Hispanic patients (Table 5). Kaplan-Meier curves were parallel between Hispanic and non-Hispanic groups. Supremum test and Schoenfeld residual plots further confirmed proportional hazard assumption was met. As shown in Fig. 1, there was no statistically significant difference in time to death; however, in the subgroup analysis with ICU patients only, Hispanics had a greater length of stay for non-Hispanic patients in both clinical outcomes (Table 4).

When evaluating the maximum length of stay (days), there was no statistically significant difference in the mean between Hispanic and non-Hispanic patients requiring ED management (1.69 ± 0.19 vs. 1.43 ± 0.28, p:0.45) or ICU admission with ventilator support (29.66 ± 0.84 vs. 26.43 ± 1.24, p:0.04). However, there was a statistically significant difference for the patients requiring inpatient management (non-ICU) (8.16 ± 0.31 vs. 9.72 ± 0.5, $p < 0.01$) and ICU admission without invasive ventilation (10.39 ± 0.57 vs. 13.45 ± 1.13, $p < 0.01$), with a greater length of stay for non-Hispanic patients in both clinical outcomes (Table 4).

5. Discussion

Ethnic minorities have been disproportionately affected by COVID-19, as confirmed with our study cohort of 247 (77.6%) Hispanic and 84 (22.4%) non-Hispanic patients. Mean age was 53.2 years (standard deviation, 16.7 years) for all patients, 50.8 years (standard deviation, 14.6 years) for Hispanic patients, and 60.3 years (standard deviation, 20.3 years) for non-Hispanic patients (Table 1). Similar to CDC reports, Hispanic COVID-19 patients in this study were significantly younger than non-Hispanic patients.

In our cohort, the most common initial presentations were cough, shortness of breath, fever, and myalgia, followed by chills, fatigue, throat pain, diarrhea, and loss of taste. These findings are consistent with well-recognized respiratory and gastrointestinal signs and symptoms in COVID-19 patients. At least one underlying medical condition or comorbidity was identified in the majority 286 (86.4%) of our patients ($n = 331$). Preexisting comorbidities were seen in 210 (85%) Hispanics patients ($n = 247$), and in 76 (90%) non-Hispanic patients ($n = 84$). The most frequent comorbidities were obesity, diabetes, and hypertension, with obesity (44.53%) foremost in Hispanic patients and hypertension (57.14%) in non-Hispanic patients (Table 1). Our results validate prior work and confirm obesity may play a major role in a higher incidence of COVID-19 in the Hispanic population.

The primary outcome compared imaging utilization between Hispanic and non-Hispanic COVID-19 patients in the ED and hospital setting. Table 3 illustrates a wide range of imaging studies used to monitor these patients, reflecting the many different disease manifestations and complications associated with COVID-19. As expected, with the lung being the primary organ involved, CXR was most frequently obtained in both cohorts. CXR is a critical tool in evaluating

| Table 4 | Overall application of imaging studies per ethnicity and admission status. |
| --- | --- | --- | --- |
| Label | Category | Hispanic (Mean ± SE)$^a$ | Non-Hispanic (Mean ± SE)$^a$ | Adjusted $p^b$ |
| Number of chest X-rays per week per patient$^c$ | ED management (discharged home) | 0.16 ± 0.05 | 0.14 ± 0.08 | 0.79 |
| Number of chest X-rays per week per patient$^c$ | Requiring inpatient management (non-ICU) | 1.31 ± 0.11 | 1.46 ± 0.16 | 0.43 |
| Number of chest X-rays per week per patient$^c$ | Requiring ICU admission without invasive ventilation | 1.4 ± 0.17 | 1.35 ± 0.26 | 0.86 |
| Number of chest X-rays per week per patient$^c$ | Requiring ICU admission and ventilator support | 3.29 ± 0.22 | 2.59 ± 0.37 | 0.38 |
| Number of all imaging studies per week per patient$^c$ | ED management (discharged home) | 0.2 ± 0.05 | 0.14 ± 0.08 | 0.56 |
| Number of all imaging studies per week per patient$^c$ | Requiring inpatient management (non-ICU) | 1.48 ± 0.11 | 1.66 ± 0.17 | 0.38 |
| Number of all imaging studies per week per patient$^c$ | Requiring ICU admission without invasive ventilation | 1.62 ± 0.18 | 1.99 ± 0.31 | 0.28 |
| Number of all imaging studies per week per patient$^c$ | Requiring ICU admission and ventilator support | 4.27 ± 0.24 | 4.89 ± 0.42 | 0.1 |
| Length of stay$^d$ | ED management (discharged home) | 1.69 ± 0.19 | 1.43 ± 0.28 | 0.45 |
| Length of stay$^d$ | Requiring inpatient management (non-ICU) | 8.16 ± 0.31 | 9.72 ± 0.5 | <0.01 |
| Length of stay$^d$ | Requiring ICU admission without invasive ventilation | 10.39 ± 0.57 | 13.45 ± 1.13 | <0.01 |
| Length of stay$^d$ | Requiring ICU admission and ventilator support | 29.66 ± 0.84 | 26.43 ± 1.24 | 0.04 |

ED: Emergency department, ICU: Intensive Care Unit.

$^a$ Point estimate was conducted at equal prevalence rate of combabilities and complications associated with COVID-19.

$^b$ Adjusted p value from multi-variate Poisson regression using log transformation. Data driven covariates selection was conducted by Elastic-Net to filter the important predictor for each outcome.

$^c$ Adjusted by hyperlipidemia, dyslipidemia, stroke including cerebrovascular events, cardiac history, length of stay, age and sex.

$^d$ Adjusted by hypertension, thrombotic complications, chronic kidney disease including End Stage Renal Disease, Intestinal Lung Disease, age and sex.
for ICU admission without invasive ventilation; 1.25 ± 0.37, P:0.46 for ICU admission and ventilator support; 1.85 ± 0.72, P:0.11 for death. These findings are similar to prior reports.24,25 We did observe differences in the death outcome between the two cohorts, but our small sample size did not detect any statistically significant difference.

When evaluating the maximum length of stay by comparing the mean after log transformation, there was a statistically significant difference between Hispanic and non-Hispanic patients in the settings of ICU admission without invasive ventilation (10.39 ± 0.57 vs. 13.45 ± 1.13, p < 0.01) and inpatient management (non-ICU) (8.16 ± 0.31 vs. 9.72 ± 0.5, p < 0.01), respectively (Table 4). In these two subcohorts, non-Hispanic patients were older and had more comorbidities, which may have contributed to their longer length of stay. However, the length of stay for the most critically ill patients in the ICU requiring ventilators was longer in Hispanic than non-Hispanic patients, with a p-value of 0.04.

There are several limitations to this study. First, the study time-period is relatively limited during this ongoing pandemic, with rapidly evolving diagnostic and treatment guidelines. Second, while this is a single institution experience that may not accurately represent other hospital settings, our healthcare system does include a tertiary/quaternary medical center, a County hospital, and a satellite community hospital with a diverse patient population. Third, our cohort size is small and may not accurately depict the Hispanic population at large. For certain comparisons (i.e., death rate), we did observe a discrepancy with an adjusted RR of 1.85, but this was not statistically significant (p = 0.11). Our study is under-powered with a small effect size. Still, we are confident in concluding that there were no detectable, large differences between Hispanic and non-Hispanic populations in our data.

In our healthcare system, in a densely populated metropolitan area, which serves a large Hispanic community, we did not find a significant difference between Hispanic and non-Hispanic COVID-19 patients regarding imaging utilization or clinical outcomes in the ED or hospital setting. Our study highlights that while COVID-19 is more prevalent in the Hispanic population, once patients were evaluated in the ED or admitted to the hospital, the Hispanic patients received comparable medical care in imaging utilization with non-Hispanic patients. Moreover, there was no statistically significant difference in clinical outcomes, including mortality rate. Future work should perhaps focus on reducing the social inequities outside of the hospital (densely crowded households, limited healthcare access, and lack of health insurance), all of which contribute to higher rates of COVID-19 in the Hispanic communities.9

Table 5
Clinical outcome by ethnicity.

| Clinical outcome                                  | Hispanic (Rate ± SE) | Non-Hispanic (Rate ± SE) | Adjusted rate ratio |
|--------------------------------------------------|----------------------|--------------------------|---------------------|
| ED management (discharged home)                  | 5.2% ± 0.7%          | 7.9% ± 0.7%              | 1.2 ± 0.19          |
| Inpatient management (non-ICU)                   | 110.7 ± 1.1%         | 158.1 ± 1.2%             | 1.5 ± 0.22          |
| ICU admission without invasive ventilation       | 12.9% ± 5.4%         | 11.6% ± 5.3%             | 1.1 ± 0.06          |
| Ventilator support among all hospitalized patients| 25.3% ± 5.1%         | 20.3% ± 5.1%             | 1.2 ± 0.07          |
| Ventilator support among ICU                     | 62.8% ± 6.0%         | 60.7% ± 6.0%             | 1.0 ± 0.03          |
| Patients only                                     | 10.3 ± 5.3%          | 15.6 ± 5.3%              | 0.7 ± 0.11          |
| Death for all hospitalized patients              | 18.4% ± 10%          | 10% ± 3.5%               | 1.5 ± 0.12          |
| Death for ICU patients                            | 30.7% ± 13.3%        | 13.3% ± 13.3%            | 2.3 ± 1.17          |

ED: Emergency department, ICU: Intensive Care Unit.

* Point estimate was conducted at equal prevalence rate of combabilities and sex for both ethnic groups and at age 65, exponential function was used to produce back transformed adjusted prevalence rate and standard error.

* Adjusted prevalence rate ratio and p value from multi-variante Poisson regression using log transformation. Data driven covariates selection was conducted by Elastic-Net to filter the important predictor for each outcome.

* Adjusted by hypertension, neurological disorder including dementia or Alzheimer’s Disease or subdural hematoma or schizophrenia, chronic kidney disease including End Stage Renal Disease, cardiac history, age and sex.

* Adjusted by stroke including cerebrovascular events, thyroid disorder, age and sex.

* Adjusted by hypertension, Diabetes Mellitus, age and sex.

* Adjusted by stroke including cerebrovascular events, thyroid disorder, age and sex. Based on total admitted patients (non-ICU inpatients and ICU patients).

* Adjusted by stroke including cerebrovascular event, thyroid disorder, age and sex. Based on ICU patients only.

* Adjusted by immunocompromised, thrombus, stroke including cerebrovascular events, neurological disorder including dementia or Alzheimer’s Disease, subdural hematoma, schizophrenia, age and sex.

* Adjusted by immunocompromised, Diabetes Mellitus, neurological disorder include dementia or Alzheimer’s Disease, age and sex.

COVID patients, as it is ubiquitous, rapid, and portable.26,27 Chest computed tomography (CT) is more effective than CXR in the early detection of COVID-19, with a low rate of misdiagnosing COVID-19.30-32 However, CT is more costly, has a markedly higher radiation dose, and is not as accessible as CXR. At our institution, physicians follow the American College of Radiology (ACR) recommendations and use CXR as the first line and chest CT sparingly, mainly reserved for hospitalized patients with specific clinical indications.13

Our results showed no statistically significant differences in the utilization of CXRs obtained per week per patient between Hispanics and non-Hispanics in the ED and all hospital subcohorts. In addition, no statistically significant difference was found in the total number of imaging studies per week per patient in all subcohorts (Table 4). These findings are especially significant given that outside of the hospital, Hispanic patients are disproportionately affected by COVID-19.19

For our secondary outcome, we compared clinical outcomes for Hispanic and non-Hispanic patients, categorized from least to most critically ill as: ED management and discharge; inpatient management (non-ICU); ICU admission without invasive ventilation; ICU admission and ventilator support; and death (Table 5). Contrary to what was expected, Hispanic patients seen in the ED and/or admitted to the hospital had a similar critical illness likelihood as non-Hispanic patients. We found no statistically significant differences between Hispanic and non-Hispanic patients in all clinical outcomes and mortality. Adjusted rate ratios were calculated as 0.7 ± 0.19, P:0.19 for ED management; 1.1 ± 0.22, P:0.64 for inpatient management (non-ICU); 1.12 ± 0.41, P:0.76 for ICU admission without invasive ventilation; 1.25 ± 0.37, P:0.46 for ICU admission and ventilator support; 1.85 ± 0.72, P:0.11 for death. These findings are similar to prior reports.24,25 We did observe differences in the death outcome between the two cohorts, but our small sample size did not detect any statistically significant difference.

When evaluating the maximum length of stay by comparing the mean after log transformation, there was a statistically significant difference between Hispanic and non-Hispanic patients in the settings of ICU admission without invasive ventilation (10.39 ± 0.57 vs. 13.45 ± 1.13, p < 0.01) and inpatient management (non-ICU) (8.16 ± 0.31 vs. 9.72 ± 0.5, p < 0.01), respectively (Table 4). In these two subcohorts, non-Hispanic patients were older and had more comorbidities, which may have contributed to their longer length of stay. However, the length of stay for the most critically ill patients in the ICU requiring ventilators was longer in Hispanic than non-Hispanic patients, with a p-value of 0.04.

There are several limitations to this study. First, the study time-period is relatively limited during this ongoing pandemic, with rapidly evolving diagnostic and treatment guidelines. Second, while this is a single institution experience that may not accurately represent other hospital settings, our healthcare system does include a tertiary/quaternary medical center, a County hospital, and a satellite community hospital with a diverse patient population. Third, our cohort size is small and may not accurately depict the Hispanic population at large. For certain comparisons (i.e., death rate), we did observe a discrepancy with an adjusted RR of 1.85, but this was not statistically significant (p = 0.11). Our study is under-powered with a small effect size. Still, we are confident in concluding that there were no detectable, large differences between Hispanic and non-Hispanic populations in our data.

In our healthcare system, in a densely populated metropolitan area, which serves a large Hispanic community, we did not find a significant difference between Hispanic and non-Hispanic COVID-19 patients regarding imaging utilization or clinical outcomes in the ED or hospital setting. Our study highlights that while COVID-19 is more prevalent in the Hispanic population, once patients were evaluated in the ED or admitted to the hospital, the Hispanic patients received comparable medical care in imaging utilization with non-Hispanic patients. Moreover, there was no statistically significant difference in clinical outcomes, including mortality rate. Future work should perhaps focus on reducing the social inequities outside of the hospital (densely crowded households, limited healthcare access, and lack of health insurance), all of which contribute to higher rates of COVID-19 in the Hispanic communities.9

Author contributions

BD obtained IRB approval. LHL, XL, SYC, BD, DS, and MY reviewed the study documents. LHL, BD, SYC, XL, and MY provided input for all aspects. SYC and XL performed the statistical analysis. LHL, BD, and DS drafted the manuscript and references with support from XL, MY, and SYC. LHL, MY, SYC, and BD conceived the idea. The consultant and advisor was AG. All authors provided edits to the manuscript before submission.

The authors declare that they had full access to all of the data in this study. The authors take complete responsibility for the integrity of the data and the data analysis accuracy.

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Disclosures

None.
Declaration of competing interest

None.

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