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The Influence of Hospital Urbanicity on Mortality in Patients With Acute Respiratory Failure: A National Cohort Retrospective Analysis

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BACKGROUND: The primary objective of this study was to employ a national database to evaluate the association of hospital urbanicity, urban versus rural, on mortality and length of hospital stay in patients hospitalized with acute respiratory failure. METHODS: We used the 2014 National Inpatient Sample database to evaluate the association of hospital urbanicity with (1) mortality and (2) prolonged hospital stay, defined as ≥ 75th percentile of the study population. We conducted a mixed-effects logistic regression analysis adjusting for sociodemographic variables and medical comorbidities. The random effect was hospital identification number (a unique value assigned in the NIS database for a specific institution). The odds ratio (OR), 95% CI, and *P* values were reported for each independent variable. RESULTS: The odds of inpatient mortality were significantly higher among urban teaching (OR 1.39, 95% CI 1.39–1.66, *P* < .001) and urban nonteaching hospitals (OR = 1.39, 95% CI 1.26–1.52, *P* < .001) compared to rural hospitals. The odds of prolonged hospital stay were significantly higher among urban teaching (OR = 1.82, 95% CI 1.66–2.0, *P* < .001) and urban nonteaching compared to rural hospitals (OR = 1.50, 95% CI 1.36–1.65, *P* < .001). CONCLUSIONS: This study supports the current body of literature that there are significant differences in patient populations among hospital type. Differences in health outcomes among different types of hospitals should be considered when designing policies to address health equity as these are unique populations with specific needs. *Key words: urban; rural; disparity; mortality; hospital length of stay; respiratory failure*. [Respir Care 2021;66(12):1789–1796. © 2021 Daedalus Enterprises]

Introduction

Increasing urbanization throughout the past century has shaped population demographics and influenced numerous aspects of population health. Currently, 84% of the United States population and 55% of the world population live in urban areas, which according to the United States Census Bureau are defined as areas with more than 50,000 people.[1-3] It is projected that by 2050, 89% of the United States population will reside in urban areas.[1,2,4]

The concept of urbanicity, the impact of living in an urban area at a given time, has come to increasing national attention over the past several decades as the body of data on urban versus rural health disparities has grown.[5] Collectively, numerous studies describe differences in essentially all aspects of urban versus rural population health, from access to primary and specialty care to prevalence of chronic diseases to management and outcomes of acute care in emergency and inpatient settings.[6,7] Although data from the United States Census

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Bureau show a significant increase in racial and ethnic diversity in the United States, the majority of urban communities is composed of racial and ethnic minorities.[2]

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Acute respiratory failure carries high morbidity and mortality.[8] The mortality rate adjusted for age and sex has increased 3.4% per year since 2017, and it continues to be one of the major causes of hospital admission.[9] A paucity of research exists on the epidemiology of this condition in regard to hospital urbanicity. The primary objective of this study was to employ a national database to evaluate the association of hospital urbanicity, urban versus rural, on mortality and length of hospital stay in patients hospitalized with acute respiratory failure.

QUICK LOOK

Current knowledge

The concept of urbanicity, the impact of living in an urban area at a given time, has come to increasing national attention over the past several decades as the body of data on urban versus rural health disparities has grown. Numerous studies describe differences in access to primary and specialty care to management and outcomes of acute care in emergency and inpatient settings.

What this paper contributes to our knowledge

Urban nonteaching and teaching hospitals had significantly higher odds of inpatient mortality and prolonged hospital stay compared to rural hospitals. This study provides a basis for identifying factors that influence geographic differences and provides a basis for allocating resources for patients with acute respiratory failure.

Methods

Because this was not considered human subjects research given the retrospective design of the study, the present project was exempt from the consent requirement by the institutional review board. Data were obtained from the publicly available data set the National (Nationwide) Inpatient Sample (NIS) database of the Healthcare Cost and Utilization Project (HCUP).[10,11] NIS is the largest multistate, all-payer, inpatient health care database in the United States and approximates a 20% stratified sample of medical records from United States hospitals. This study adheres to the Strengthening the Reporting of Observational Studies in Epidemiology guidelines.

Our primary outcome of interest was inpatient mortality, defined as death during the inpatient stay. The secondary outcome was hospital length of stay (d), with a range of 0–308 d.[12] These variables are collected by NIS HCUP as a dichotomous variable (mortality) and a continuous variable (hospital stay).[12] We defined prolonged length of hospital stay as $\geq$ 75th percentile of the study population and, therefore, dichotomized the variable at the 75th percentile. Supplemental Figure 1 shows the distribution of hospital stay. Hospitalizations of patients with an age of 18-y old or greater in 2014 with a diagnosis of respiratory failure and mechanical ventilation were included. HCUP NIS utilizes International Classification of Disease, Ninth Revision (ICD-9) to characterize patient populations, and therefore, variable transformation was not utilized. To define the study population, acute respiratory failure, we used the following ICD-9 codes: 518.81 (acute respiratory failure), 518.82 (acute respiratory insufficiency), 518.84 (acute and chronic respiratory failure), 518.52 (other pulmonary insufficiency not specified elsewhere following surgery), 518.51 (acute respiratory failure following surgery), and 518.53 (acute and chronic respiratory failure following surgery). Mechanical ventilation was defined with the following ICD-9 procedure codes of 96.70 (continuous invasive mechanical ventilation of unspecified duration), 96.71 (continuous invasive mechanical ventilation of $<$ 96 h), 96.72 (continuous invasive mechanical ventilation for more than 96 h), and 96.04 (endotracheal intubation).

Sociodemographic and hospital variables included in our study were collected, stored, and managed by NIS. NIS collects data pertaining to race, age, income quartiles, insurance type, sex, hospital division, and hospital control. The aforementioned variables are collected as categorical variables, and therefore, no transformation of sociodemographic or hospital level was applied to the data. Please see NIS data elements for further details on income quartiles and sociodemographic and hospital level data (https://www.hcup-us.ahrq.gov/db/nation/nis/nisdde.jsp). We included comorbidities that were the most prevalent ($>$ 1%) in the NIS database. We used ICD-9 codes to identify medical history for each case. The use of these ICD-9 codes has been used in prior studies.[13] Study inclusion required that all patients carry a concomitant ICD-9 code of respiratory failure and mechanical ventilation. Sociodemographic (race, age, income quartile, insurance status, and sex) and hospital variables (hospital division: New England [Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut]; Middle Atlantic [New York, Pennsylvania, New Jersey]; East North Central [Wisconsin, Michigan, Illinois, Indiana, Ohio]; West North Central [Missouri, North Dakota, South Dakota, Nebraska, Kansas, Minnesota, Iowa]; South Atlantic [Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida]; East South Central

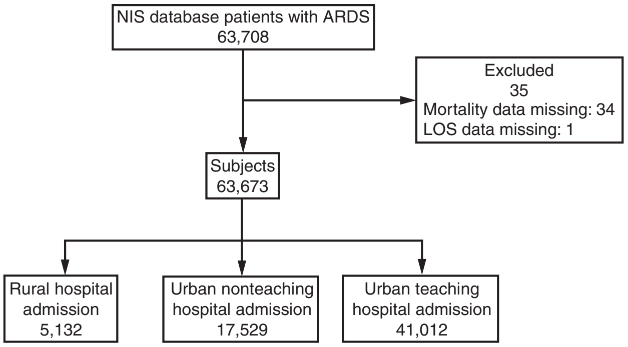

Fig. 1. Flow chart. NIS = National Inpatient Sample, LOS = length of stay.

[Kentucky, Tennessee, Mississippi, Alabama]; West South Central [Oklahoma, Texas, Arkansas, Louisiana]; Mountain [Idaho, Montana, Wyoming, Nevada, Utah, Colorado, Arizona, New Mexico]; and Pacific [Alaska, Washington, Oregon, California, Hawaii]) and hospital control (government and privately owned) were included in the study. Figure 1 shows the study inclusion. The following covariates based on their ICD-9 codes were collected: pneumonia (480.x–488.x), pancreatitis (577.x), aspiration pneumonia (507.x), sepsis (995.x), diabetes mellitus (250.x), hypertension (401.x), dyslipidemia (272.x), chronic kidney disease (585.x), pulmonary disease (chronic bronchitis, bronchiectasis, emphysema, and asthma; 490.x–493.x), obstructive sleep apnea (327.x), extremely obese (body mass index > 40; V85.x), congestive heart failure (428.x), atrial fibrillation (427.x), bleeding disorder (coagulation disorder; 286.x), alcohol use (303.x and 305.x), and tobacco use (305.x).

The primary covariate was hospital urbanicity, categorized as rural, urban nonteaching, or urban teaching hospitals. HCUP NIS collects and stores this data element as HOSP_LOCTEACH, and therefore, variable transformation was not required. According to HCUP NIS, the rural versus urban classification was determined by the Core-Based Statistical Areas (CBSA) of the United States Census Bureau.[12] Hospitals located in counties with a metropolitan CBSA were defined as urban, whereas hospitals with a micropolitan CBSA were classified as rural. A hospital is determined to be a teaching hospital if the hospital has one or more Accreditation Council for Graduate Medical Education–approved residency programs, is a member of the Council of Teaching Hospitals, or has a ratio of full-time equivalent interns and residents to beds of 0.25 or higher.[12]

Statistical Analysis

R, a software environment for statistical computing (R version 4.2), was used to perform all statistical analyses. Cases with missing data for outcomes of interest mortality ($n = 34$) and hospital stay ($n = 1$) were removed from the analysis. Unknown data were present for the following variable: race, income quartile, payer, and sex. We coded unknown data (unknown) and included these subjects in the study. The missing-indicator method is a well-recognized and described method for handling missing data described as early as 1986 by Miettinen.[14] The missing-indicator method approach is an attractive alternative to other methods as all available information remains in the analysis to maintain statistical power.[15]

For unadjusted analyses, the *P* for the comparisons between cohorts was derived from the Pearson chi-square and analysis of variance. To assess the association of hospital urbanicity with inpatient mortality, we performed a mixed-effects logistic regression analysis adjusting for sociodemographic variables and medical comorbidities. The variables included in the regression model were insurance type, hospital division and control, race, age, income, and comorbidities (ie, pneumonia, pancreatitis, diabetes mellitus, hypertension, dyslipidemia, chronic kidney disease, chronic bronchitis, obstructive sleep apnea, body mass index, heart failure, atrial fibrillation, bleeding disorder, tobacco use, and alcohol use). The primary exposure variable (hospital urbanicity) was split into 3 cohorts: rural hospital, nonteaching urban hospital, and teaching urban hospital. The reference variable for this analysis was rural hospital. The random effect was hospital identification number (a unique value assigned in the NIS database for a specific institution). Utilizing this data element allowed us to account for clustered observations within hospitals.[16] The odds ratio (OR), 95% confidence interval (CI), and *P* were reported for the hospital urbanicity.

Results

There were 63,708 subjects with acute respiratory failure requiring mechanical ventilation in the database. After excluding 35 patients with missing data, our final sample included 63,672 subjects. Table 1 outlines the distribution of subjects and hospital characteristics. Rural, urban nonteaching, and urban teaching hospitals had 5,132 (8.1%), 17,529 (27.5%), and 41,012 (64.4%) subjects, respectively. The overall rural, urban nonteaching, and urban teaching mortality rates were 26.8%, 19.7%, 26.0%, and 28.1%, respectively. Among subjects with respiratory failure requiring mechanical ventilation, there were statistically significant differences in all demographic (race, age, income, primary insurance type, and gender) and hospital (division, control) variables between rural and urban hospitals. Compared to urban hospitals, rural hospitals had a higher prevalence of pneumonia, hypertension, pulmonary disease, and tobacco use ($P < .05$). Compared to rural hospitals, urban hospitals had a higher prevalence of pancreatitis, aspiration pneumonia, sepsis, diabetes mellitus, dyslipidemia, chronic kidney disease, atrial fibrillation, and bleeding disorder ($P < .05$).

Table 1. Study Characteristics

	Study Population ($N = 63,673$)	Hospital Urbanicity			P
		Rural ($n = 5,132$)	Urban Nonteaching ($n = 17,529$)	Urban Teaching ($n = 41,012$)	
Race					< .001
White	42,073 (66.1)	4,127 (80.4)	12,524 (71.4)	25,422 (62.0)	
Black	10,202 (16.0)	426 (8.3)	2,210 (12.6)	7,566 (18.4)	
Hispanic	4,844 (7.6)	109 (2.1)	1,384 (7.9)	3,351 (8.2)	
Asian or Pacific Islander	1,163 (1.8)	33 (0.6)	358 (2.0)	772 (1.9)	
Native American	496 (0.8)	72 (1.4)	130 (0.7)	294 (0.7)	
Other	1,741 (2.7)	84 (1.6)	449 (2.6)	1,208 (2.9)	
Unknown	3,154 (5.0)	281 (5.5)	474 (2.7)	2,399 (5.8)	
Age, y					< .001
18–49	13,811 (21.7)	990 (19.3)	3,591 (20.5)	9,230 (22.5)	
50–64	20,032 (31.5)	1,726 (33.6)	5,295 (30.2)	13,011 (31.7)	
65–79	20,904 (32.8)	1,799 (35.1)	6,033 (34.4)	13,072 (31.9)	
> 80	8,926 (14.0)	617 (12.0)	2,610 (14.9)	5,699 (13.9)	
Income Quartile					< .001
1	22,049 (34.6)	2,825 (55.0)	5,135 (29.3)	14,089 (34.4)	
2	17,800 (28.0)	1,703 (33.2)	5,215 (29.8)	10,882 (26.5)	
3	12,970 (20.4)	398 (7.8)	3,934 (22.4)	8,638 (21.1)	
4	9,327 (14.6)	62 (1.2)	2,920 (16.7)	6,345 (15.5)	
Unknown	1,527 (2.4)	144 (2.8)	325 (1.9)	1,058 (2.6)	
Payer					< .001
Medicare	36,447 (57.2)	3,155 (61.5)	10,446 (59.6)	22,846 (55.7)	
Medicaid	10,242 (16.1)	850 (16.6)	2,515 (14.3)	6,877 (16.8)	
Private insurance	10,913 (17.1)	670 (13.1)	2,932 (16.7)	7,311 (17.8)	
Self-pay	3,894 (6.1)	287 (5.6)	1,008 (5.8)	2,599 (6.3)	
No charge	311 (0.5)	8 (0.2)	97 (0.6)	206 (0.5)	
Other	1,755 (2.8)	157 (3.1)	506 (2.9)	1,092 (2.7)	
Unknown	111 (0.2)	5 (0.1)	25 (0.1)	81 (0.2)	
Sex					< .001
Male	3,2883 (51.6)	2,483 (48.4)	9,002 (51.4)	21,398 (52.2)	
Female	30,781 (48.3)	2,649 (51.6)	8,527 (48.6)	19,605 (47.8)	
Unknown	9 (0)	0 (0)	0 (0)	9 (0)	
Hospital Division					< .001
New England	2,590 (4.1)	160 (3.1)	505 (2.9)	1,925 (4.7)	
Middle Atlantic	8,071 (12.7)	329 (6.4)	1,436 (8.2)	6,306 (15.4)	
East North Central	9,051 (14.2)	719 (14.0)	2,245 (12.8)	6,087 (14.8)	
West North Central	3,972 (6.2)	454 (8.8)	965 (5.5)	2,553 (6.2)	
South Atlantic	14,602 (22.9)	1,076 (21.0)	4,692 (26.8)	8,834 (21.5)	
East South Central	6,254 (9.8)	1,325 (25.8)	1,470 (8.4)	3,459 (8.4)	
West South Central	8,615 (13.5)	619 (12.1)	2,183 (12.5)	5,813 (14.2)	
Mountain	4,150 (6.5)	205 (4.0)	1,483 (8.5)	2,462 (6.0)	
Pacific	6,368 (10.0)	245 (4.8)	2,550 (14.5)	3,573 (8.7)	
Hospital Control					< .001
Government, nonfederal	7,895 (12.4)	947 (18.5)	1,784 (10.2)	5,164 (12.6)	
Private, not profit	45,222 (71.0)	3,275 (63.8)	11,083 (63.2)	30,864 (75.3)	
Private, invest-own	10,556 (16.6)	910 (17.7)	4,662 (26.6)	4,984 (12.2)	
Pneumonia	21,975 (34.5)	2,062 (40.2)	6,229 (35.5)	13,684 (33.4)	< .001
Pancreatitis	1,062 (1.7)	65 (1.3)	280 (1.6)	717 (1.7)	.03
Aspiration pneumonia	11,346 (17.8)	801 (15.6)	3,394 (19.4)	7,151 (17.4)	< .001
Sepsis	16,493 (25.9)	1,046 (20.4)	4,527 (25.8)	10,920 (26.6)	< .001
Diabetes mellitus	20,648 (32.4)	1,662 (32.4)	5,782 (33.0)	13,204 (32.2)	.17
Hypertension	25,109 (39.4)	2,119 (41.3)	6,793 (38.8)	16,197 (39.5)	.004

(Continued)

Table 1. Continued

	Study Population (N = 63,673)	Hospital Urbanicity			P
		Rural (n = 5,132)	Urban Nonteaching (n = 17,529)	Urban Teaching (n = 41,012)	
Dyslipidemia	17,113 (26.9)	1,402 (27.3)	4,849 (27.7)	10,862 (26.5)	.01
Chronic kidney disease	13,473 (21.2)	902 (17.6)	3,918 (22.4)	8,653 (21.1)	< .001
Pulmonary disease	19,037 (29.9)	1,972 (38.4)	5,556 (31.7)	11,509 (28.1)	< .001
Obstructive sleep apnea	6,847 (10.8)	509 (9.9)	1,874 (10.7)	4,464 (10.9)	.10
Extremely obese	5,255 (8.3)	436 (8.5)	1,420 (8.1)	3,399 (8.3)	.61
Congestive heart failure	20,841 (32.7)	1,767 (34.4)	6,019 (34.3)	13,055 (31.8)	< .001
Atrial fibrillation	12,870 (20.2)	998 (19.4)	3,741 (21.3)	8,131 (19.8)	< .001
Bleeding disorder	2,263 (3.6)	97 (1.9)	574 (3.3)	1,592 (3.9)	< .001
Alcohol use	6,705 (10.5)	451 (8.8)	1,799 (10.3)	4,455 (10.9)	< .001
Tobacco use	14,093 (22.1)	1,543 (30.1)	3,986 (22.7)	8,564 (20.9)	< .001
Mortality	17,077 (26.8)	1,011 (19.7)	4,549 (26.0)	11,517 (28.1)	< .001
LOS, d mean (SD)	8.70 (9.18)	7.09 (6.80)	8.35 (8.36)	9.05 (9.72)	< .001
†Extended LOS	18,238 (28.6)	1,109 (21.6)	4,789 (27.3)	12,340 (30.1)	< .001

Data are reported as n (%) unless otherwise indicated.
LOS = length of hospital stay
† Extended LOS = hospital stay defined as > 75th percentile of cohort
P corresponds to Pearson chi-square for categorical variables and analysis of variance for continuous variables

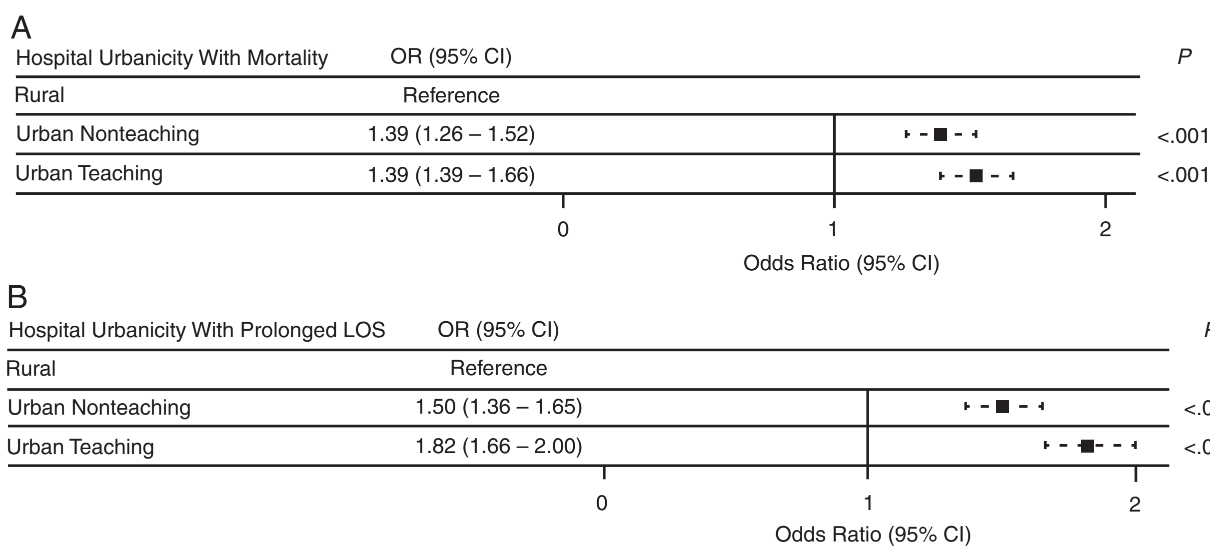

Fig. 2. Results of the mixed-effects multivariable logistic regression analysis. LOS = length of stay.

Figure 2 lists the results of the mixed-effects multivariable logistic regression analysis. The odds of inpatient mortality were statistically significantly higher among urban teaching hospitals (OR = 1.52, 95% CI 1.39–1.66, P < .001) and urban nonteaching hospitals (OR = 1.39, 95% CI 1.26–1.52, P < .001) compared to rural hospitals (Fig. 2A). The odds of prolonged hospital stay were significantly higher among urban teaching (OR = 1.82, 95% CI 1.66–2.00, P < .001) and urban nonteaching hospitals (OR = 1.50, 95% CI 1.36–1.65, P < .001) compared to rural hospitals (Fig. 2B). Figure 3 illustrates the prevalence of geographic region among all urban teaching hospitals. In order of decreasing prevalence, the prevalence of urban nonteaching hospitals is as follows: South Atlantic (21.5%), Middle Atlantic (15.4%), East North Central (14.8%), West South Central (14.2%), Pacific (8.7%), East South Central (8.4%), West North Central (6.2%), Mountain (6.0%), and New England (4.7%).

Discussion

Our primary aim was to highlight differences with respect to inpatient mortality and hospital stay among urban

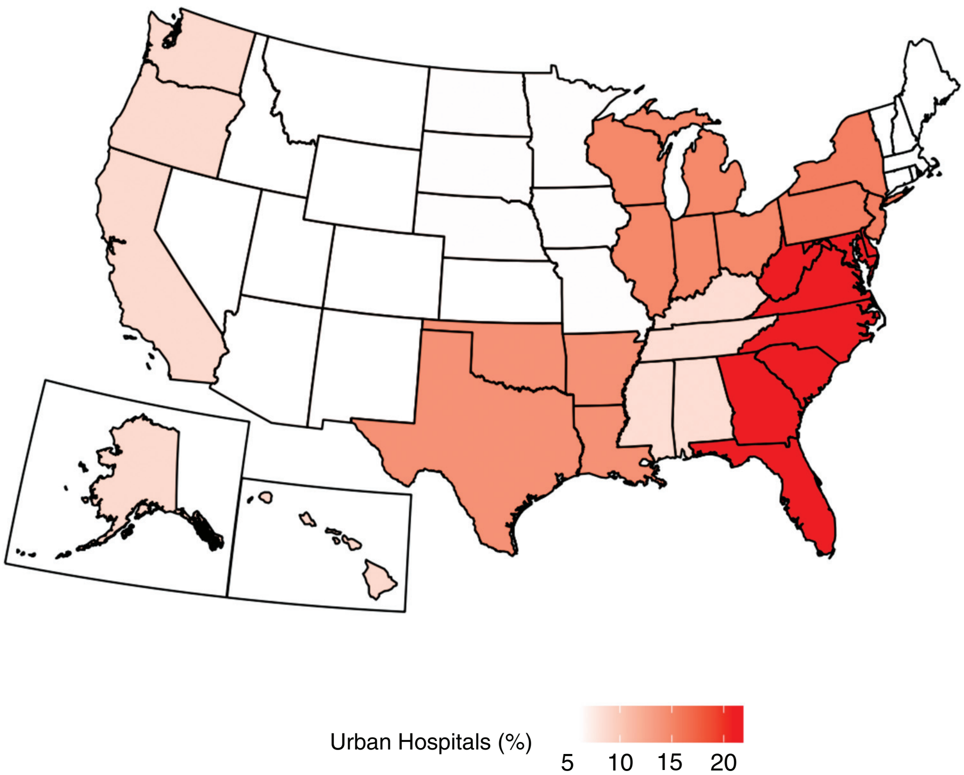

Fig. 3. Prevalence of each geographic region among all urban teaching hospitals.

and rural hospitals in patients with respiratory failure necessitating mechanical ventilation. Our main finding was that the odds of mortality and prolonged hospital stay in patients with respiratory failure were higher in both urban nonteaching and teaching compared to rural hospitals. Notably, far fewer patients with respiratory failure were treated at rural versus urban teaching or urban nonteaching hospitals. This study agrees with current literature, which suggests drastic differences in patient populations; as such, practical risk stratification protocols should be employed that may allow for appropriate allocation of resources.

Factors underlying urban versus rural hospital differences are not completely identified or understood. Several studies have shown poorer health outcomes among rural compared to urban hospitals for cardiovascular and renal disease, whereas other studies have shown higher morbidity and mortality in urban locations.[17-22] Similarly, we showed higher mortality among urban versus rural hospitals following acute respiratory failure. One important explanation is the differences in the underlying etiology responsible for respiratory failure requiring ventilation.

Although urban nonteaching and teaching hospitals are generally thought to be equipped with subspeciality care and advanced technology, these hospitals may be located in communities that harbor mistrust in the medical community due to centuries of mistreatment.[23,24] This alone may lead to delays in clinical presentation and worse outcomes. Other possibilities include environmental pollution and poor air quality in urban areas that may predispose patients who live in urban areas to more severe disease. Another possibility as to why mortality may be higher at urban versus rural hospitals is that perhaps critically ill patients with respiratory failure are being transferred out of rural hospitals, which may lack the financial security or physical resources to manage respiratory failure and associated comorbidities. More now than ever, we have seen this especially during the COVID-19 pandemic where smaller regional hospitals become easily overwhelmed and transfer patients to relief health care facilities that have extra resources and are more equipped to care for a larger number of medically complex patients.

The Centers for Disease Control and Prevention defines racism as a system consisting of structures and policies that assigns value and determines opportunity based on the way people look.[25] The Federal Housing Administration, established in 1934, perpetuated racial segregation primarily through "redlining," refusing to insure mortgages in Black communities and dissuading housing developers from selling homes to Black buyers.[26] In the 1950s, "blockbusters" purchased homes at lower prices in predominately White communities and resold to Black buyers for substantially higher prices.[26] Throughout the 20th century, other practices such as exclusionary zoning laws, racial steering, urban renewal following the 1949 Housing Act, and interstate construction through predominately black communities all contributed to urbanicity.[27,28] These practices, initially intended to encourage racial segregation, are now associated with a higher density of tobacco and alcohol retailers and fewer health-promoting resources.[29,30] It is these practices and policies that have shaped urban communities and the health consequences of living in these communities, and recent data from the Pew Research Center suggest urban communities continue to have the highest percentage of minorities.[31] We believe it is not the urbanicity that leads to inequality but rather centuries of racial covenants and structural inequalities that encouraged segregation and consequently poorer health outcomes among ethnic minorities.[32,33]

We also observed stark differences in hospital urbanicity represented in the Southeastern United States, where among urban teaching hospitals > 20% are below the Mason-Dixon line. Perhaps these data are confounded by the greater prevalence of southern states among urban hospitals, where southern states consistently rank among the worst in the United States for health and wellness according to America's Health Rankings annual reports.[34] Additionally, in South Carolina, only 66% of the population lives in urban areas (whereas the national average is 84%), yet these southern states have among the highest percentage of urban hospitals. The discrepancy between people who live rurally but may need to present to an urban hospital during a health crisis may lead to a time delay and worsening of clinical condition upon presentation to the hospital. Parcha and colleagues[9] evaluated trends and geographic differences in acute respiratory failure and showed that the adjusted acute respiratory failure mortality rate was highest for males, non-Hispanic Blacks, those living in nonmetropolitan areas, and in southern states. These differences pre-COVID shed light into the current geographic distribution of COVID-19. It is clear that these hospitals face unique challenges. Therefore, we must further define the need and gaps in clinical care and appropriately risk stratify and develop policies/interventions to improve health outcomes.

The literature suggests rural hospitals are underfunded and understaffed when compared to urban counterparts. In a recent comparison of nursing resources among large urban, small urban, and rural hospitals, rural hospitals had the lowest number of nurses with the largest amount of patient burden per nurse than large urban and small urban hospitals. Furthermore, the degree of baccalaureate credentialing among the nursing staff was lower overall for rural hospitals than for large urban or small urban hospitals.[35] However, urban areas are densely populated with minorities, who face a different set of health care challenges. This has profound implications for the difficulties that these hospitals face and calls into question the need for policy reform and resource reallocation in health care. New strategies and revisions to current public health and fiscal policies would be beneficial to bridge the rural-urban gap, specifically by targeting the resource deficit for rural hospitals and health prevention in urban communities.

There is a paucity of literature examining hospital stay in patients with respiratory failure, although one can surmise that a variety of factors may contribute to this observed difference. First, aforementioned differences in mortality rates may suggest that urban patients have worse clinical disease on presentation than rural patients, necessitating longer average periods of stay. Second, there may be differences in hospital discharge policies between urban and rural hospitals such that rural hospitals are generally able to discharge patients at earlier time points to rehabilitation and acute care facility following extubation compared to discharge policies at urban hospitals.

Whereas we do provide possible explanations for the observed differences among urbanicity cohorts, given the limitations of the study, the results should be interpreted with caution. Here we use NIS, an administrative database that uses billing codes to collect and store patient health information. As these codes were originally intended for billing, they do not capture the severity of disease, provider experience, specific or doses of medications, etiology of respiratory failure, ventilation management protocol, laboratory and microbiology data, and time spent on ventilator. With the use of NIS, we were unable to ascertain the number of patients who were transfers from outside hospitals, which could help to clarify the observed differences in hospital stay among urbanicity cohorts. Moreover, the database does not collect socioeconomic data beyond income and race. Given the retrospective nature of the data, we were only able to measure association and not causation. Such type of study may help drive hypothesis aimed to improve disparities between rural and urban hospitals.

Conclusions

We showed that the odds of mortality were significantly higher at urban teaching and nonteaching compared to rural hospitals. It is clear from the current literature that differences in urban versus rural hospitals should be considered when designing policies to address health equity, as these are unique populations with specific needs.

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