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Small Towns, Big Cities: Rural and Urban Disparities Among Hospitalized Patients With COVID-19 in the Central Savannah River Area

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Background. There is a lack of data surrounding the impact of coronavirus disease 2019 (COVID-19) among rural and urban communities. This study aims to determine whether there are differences in epidemiologic characteristics and clinical outcomes among individuals with COVID-19 among these communities.

Methods. This was a retrospective analysis of 155 patients admitted to a single-center tertiary academic hospital located in Augusta, Georgia, with a large proportion of hospitalized patients transferred from or residing in rural and urban counties. Hospitalized adult patients were included in the study if they were admitted to AUMC between March 13, 2020, and June 25, 2020, and had a positive polymerase chain reaction test for severe acute respiratory syndrome coronavirus 2 regardless of the presence or absence of symptomatology. Demographics, admission data, and 30-day outcomes were examined overall and by geographical variation.

Results. Urban patients were more likely to be admitted to the general medical floor (P = .01), while rural patients were more likely to require an escalation in the level of care within 24 hours of admission (P = .02). In contrast, of the patients who were discharged or expired at day 30, there were no statistically significant differences in either total hospital length of stay or intensive care unit length of stay between the populations.

Conclusions. There may be many social determinants of health that limit a rural patient's ability to seek prompt medical care and contribute to decompensation within the first 24 hours of admission. This study provides insight into the differences in clinical course among patients admitted from different community settings and when accounting for comorbid conditions.

Keywords. COVID-19; disparities; hospitalized; rural; urban.

Coronavirus disease 2019 (COVID-19) was declared a public health emergency and international pandemic by the World Health Organization (WHO) in January 2020 [1]. Despite the plethora of research, there is still much to be understood about the epidemiology, symptomatology, clinical implications, and outcomes of COVID-19 among different populations. Much of the data published thus far highlight the epidemiology and outcomes of disease in urban cities. Little information exists on how COVID-19 has affected individuals from rural communities [2, 3].

The state of Georgia's experience with COVID-19 has been well documented nationally [4, 5], initially because of the sharp increase in cases, along with the numerous "hot spots" described in several rural South Georgia communities, and later on for being one of the first states to lift the shelter-in-place order. Georgia has a unique population with significant health disparities among its urban and rural populations [6]. In fact, this is the reason some refer to the state as being 2 Georgias: Metro Atlanta and "everywhere else." Augusta, Georgia, is located 2.5 hours east of Metro Atlanta and is home to Augusta University Medical Center (AUMC), a public academic medical center that cares for the surrounding urban and rural counties in what is called the Central Savannah River Area (CSRA). The CSRA includes 18 different counties in both Georgia and South Carolina with a total population of >700 000 [7]. During the COVID-19 pandemic, AUMC has taken care of individuals from varying population densities and demographics. The institution has also received a significant number of patient transfers from all over the states of Georgia and South Carolina in order to alleviate the medical

burden on smaller affiliate hospitals and other critical access hospitals.

Previous published work from Augusta University has described the geographical variations associated with COVID-19 incidence and mortality in Georgia using national and state data sets [6]. Their findings suggest that individuals in rural geographical regions, especially non-Hispanic Black American persons, have a higher mortality rate [6]. Evidence from the Centers for Disease Control and Prevention (CDC) indicates that age and the presence of comorbidities increase one's risk for severe COVID-19 disease [8]. As previously stated, there is a higher prevalence of comorbidities among individuals from rural counties when compared with those from urban counties [8]. Our study aims to evaluate the epidemiology, level of care, length of stay, and outcomes of individuals from different geographical regions requiring hospital admission at our institution.

METHODS

Study Design and Participants

Data for this study were obtained by reviewing the patient's electronic medical record (Cerner Power Chart). To be included in the retrospective analysis, patients had to be age 18 and above, be admitted to AUMC between March 13, 2020, and June 25, 2020, and have a positive severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) polymerase chain reaction (PCR) test regardless of the presence or absence of COVID-19 symptoms. Cases that were high clinical suspicion of COVID-19 but PCR negative were not included in the study. Data were collected using electronic data source forms and transferred to a data collection tool. No interventions were made on subjects included in the retrospective analysis. This study was approved by Augusta University's Institutional Review Board.

Statistical Analysis

We obtained data on patients' county of residence using the address recorded on their medical record. Patients were classified into urban and rural counties based on the classification rules of the US Census Bureau (county populations of ≥50 000 are classified as urban) [9–13]. If the county population was <50 000, then it was considered a rural county. Quantitative variables (age, length of stay, etc.) were summarized using mean (SD) and median (interquartile range), and comparisons were done using the nonparametric Wilcoxon rank-sum test (2 groups) and Kruskal-Wallis analysis of variance test (multiple groups). For categorical variables, absolute and relative abundances within groups were reported. Comparisons between different groups were done using the Fisher exact, and P values were reported. All computations were done using R (version 3.6.1).

RESULTS

This analysis included the first 155 patients admitted to AUMC with a positive SARS-CoV-2 PCR assay between March 13, 2020, and June 25, 2020. Table 1 depicts the general characteristics of the individuals included in the chart review. The median age was 62 years, with a majority of the patients being age 45 years or older (77.42%), African American persons (58.82%), and insured via Medicare and/or Medicaid (54.84%). The 1 Asian patient was removed from comparisons involving race but was included for analysis of the other variables. Of the hospitalized patients, 62 (40.00%) were from a rural county. More

Table 1. Baseline Characteristics

	No. (%)
Total subjects	155 (100)
Demographics	
Mean age (SD), y	59.85 (17.93)
Median age (IQR), y	62 (22.5)
Age (by category)	
18–29 y	9 (5.81)
30–44 y	26 (16.77)
45–64 y	55 (35.48)
65+ y	65 (41.94)
Gender	
Male	74 (47.74)
Female	81 (52.26)
Race or ethnicity	
African American	90 (58.82)
Male	49 (54.44)
Female	41 (45.56)
Age, median (IQR), y	61 (22.75)
White	52 (33.99)
Male	19 (36.54)
Female	33 (63.46)
Age, median (IQR), y	66 (27.25)
Hispanic	10 (6.54)
Male	5 (50)
Female	5 (50)
Age, median (IQR), y	41 (18.25)
Asian	1 (0.65)
Insurance	
Commercial	39 (25.16)
Medicare/Medicaid	85 (54.84)
Self-pay	23 (14.84)
Others	8 (5.16)
County type	
Rural	62 (40)
Urban	93 (60)
Exposure risk history	
Nursing home resident	41 (26.45)
Health care worker	6 (3.87)
Incarcerated	8 (5.16)

"Others" insurance includes GA Correctional Health, VA and Workman's Compensation. Race data were obtained using available data in the specified patient demographic. The EMR included Hispanic as a race, although it is generally referred to as an ethnicity. A county was considered rural if the population was <50 000 people.

Abbreviations: EMR, electronic medical record; IQR, interquartile range.

than one-quarter (26.45%) of patients admitted to AUMC were nursing home residents (Table 1).

The most common comorbidities were hypertension (107, 69.03%), diabetes mellitus (59, 37.06%), coronary artery disease/congestive heart failure (45, 29.03%), obesity (body mass index 30–39; 55, 35.48%), underlying chronic lung disease (28, 18.06%), and chronic kidney disease of any stage (24, 15.48%) (Table 2). Of the patients admitted, the majority (90.97%) had at least 1 comorbidity present, with African American persons having an average of 2.93 comorbidities and Whites having an average of 2.71 comorbidities. There was a significant difference in the number of comorbidities among African American persons and Hispanic persons as well as between White persons and Hispanic persons. There was no significant difference in the number of comorbidities when comparing rural and urban individuals.

In analyzing admission data, 92 (59.35%) individuals were initially admitted to the general medical floor, 14 (9.03%) were initially admitted to the general medical floor but required transfer to the intensive care unit (ICU) within 24 hours, and 48 (30.97%) were initially directly admitted to the ICU. There was a significant difference among ages (4-way comparison, $P = .01$) in those admitted to the floor and those admitted to the ICU. In a 3-way comparison, race/ethnicity was not found to be significant among different levels of care on admission, but there was a difference among rural and urban individuals ($P = .01$). Urban individuals were more likely to be admitted to the floor, while rural individuals were more likely to require escalation of medical care within 24 hours of admission (Table 3).

Table 4 evaluates the 30-day outcomes among the hospitalized population. Of the 155 patients, 78 (50.32%) were discharged home, and 33 (21.29%) were discharged to a skilled nursing facility or long-term acute care center. Seven patients (4.52%) required rehospitalization, and 14 remained hospitalized at day 30 (Table 4). There were no statistically significant differences in discharge disposition, readmissions, total hospital length of stay, ICU length of stay, or mortality rates among rural and urban individuals. Among the 22 (14.19%) expired patients, there were no statistically significant differences in age, number of comorbidities, length of stay, or ICU length of stay among rural and urban individuals (Tables 4 and 5).

DISCUSSION

More than half of all hospitals in the United States are rural hospitals [14]. Frequently understaffed and limited, these institutions serve populations that tend to be older and have less access to care, increased poverty, and numerous comorbidities [15–17]. These characteristics present unique challenges, such as health care disparities and low levels of physician follow-up, which impact rural communities in general but have been augmented during the pandemic [18].

Table 2. Medical History

Comorbidities	No. (%)
Coronary artery disease/congestive heart failure	45 (29.03)
Arrythmias	19 (12.26)
Hypertension	107 (69.03)
Diabetes mellitus	59 (38.06)
Obesity	
BMI 30–39 kg/m^2	55 (35.48)
BMI ≥40 kg/m^2	16 (10.32)
Sickle cell disease	3 (1.94)
Connective tissue disease	4 (2.58)
Rheumatoid arthritis	2 (1.29)
Systemic lupus erythematosus	2 (1.29)
Taking hydroxychloroquine	3 (1.94)
Active malignancy on treatment	7 (4.52)
Solid organ transplant	2 (1.29)
Current smoker	6 (3.87)
Lung disease	28 (18.06)
Chronic obstructive pulmonary disease	18 (11.61)
Asthma	7 (4.52)
Interstitial lung disease	2 (1.29)
Liver disease	4 (2.58)
Chronic kidney disease (any stage)	24 (15.48)
HIV	1 (0.65)
Cerebrovascular accident	23 (14.84)
Pulmonary embolism	5 (3.23)
Deep vein thrombosis	6 (3.87)
Pregnant	7 (4.52)
No. of comorbidities	No. (%)
0	14 (9.03)
1	23 (14.84)
2	31 (20.00)
3	40 (25.81)
4	29 (18.71)
5+	18 (11.61)
Average comorbidities by race and ethnicity	Mean (SD)
African American	2.93 (1.61)
White	2.71 (1.56)
Hispanic	1.40 (1.58)
Comparison of comorbidities between races	P Value
African American vs White	.53
African American vs Hispanic	.00
White vs Hispanic	.02
Three-way comparison	.02
Average comorbidities by county type	Mean (SD)
Rural	2.81 (1.48)
Urban	2.68 (1.75)
Comparison of comorbidities by county type	P Value
Two-way comparison	.49

Abbreviation: BMI, body mass index.

Many publications highlight general COVID-19 epidemiologic characteristics, as well as racial disparities [2, 3, 19–25]. However, there are few studies describing the disparities seen between urban and rural settings [2, 19]. One recent study reviewed preliminary outcomes comparing cohorts that received different COVID-19 treatments in a rural hospital [26]. To our knowledge, this is the first study to compare rural and urban

Table 3. Demographics Based on Level of Care Upon Admission

	Admitted to Floor	Admitted to Floor Then Transferred to ICU Within 24 Hours	Admitted to ICU
Total subjects, No. (%)	92 (59.35)	14 (9.03)	48 (30.97)
Age group			
18–29 y	8 (88.99)	0 (0.00)	1 (11.11)
30–44 y	21 (80.77)	2 (7.69)	3 (11.54)
45–64 y	29 (52.73)	5 (9.09)	21 (38.18)
65+ y	34 (52.31)	7 (10.77)	23 (35.38)
P value	.01	.97	.04
Race			
African American	51 (56.67)	9 (10.00)	30 (33.33)
White	33 (63.46)	3 (5.77)	15 (28.85)
Hispanic	7 (70.00)	2 (20.00)	1 (10.00)
P value	.62	.25	.34
County type			
Rural	29 (46.77)	10 (16.13)	23 (37.10)
Urban	63 (67.74)	4 (4.30)	25 (26.88)
P value	.01	.02	.22
No. of comorbidities			
0	11 (78.57)	0 (0.00)	3 (21.43)
1	19 (82.61)	3 (13.04)	1 (4.35)
2	18 (58.06)	4 (12.90)	9 (29.03)
3	23 (57.50)	1 (2.50)	15 (37.50)
4	15 (51.72)	4 (13.79)	10 (34.48)
5+	6 (33.33)	2 (11.11)	10 (55.56)
P value	.02	.30	.01

Abbreviation: ICU, intensive care unit.

individuals admitted to the same hospital setting with a positive SARS-CoV-2 test, following the same medical therapeutic guidelines for all patients. This study provides valuable insight into the differences among individuals from varying geographical backgrounds in patients receiving similar COVID-19 treatments based on established hospital protocols with guidance from the National Institutes of Health and CDC COVID-19 treatment recommendations [27, 28]. Throughout the duration of the study, patients may have received azithromycin, hydroxychloroquine, remdesivir, tocilizumab, convalescent plasma, dexamethasone, or any combination of the aforementioned therapeutics based on AUMC's hospital protocols.

The results of our study suggest that among hospitalized individuals in the CSRA, there are no significant differences between the number of comorbidities. However, patients from rural communities were more likely to require an escalation of medical care, resulting in transfer to the ICU within 24 hours after hospital admission. This is particularly useful knowledge as it may help predict which individuals may be at higher risk of early decompensation. Further research should attempt to identify "novel" or "unique" predictors of severity or rapid decompensation that can account for the difference in morbidity between rural- and urban-residing COVID-19 populations.

Limitations

The limitations present in this study are similar to most retrospective chart reviews in that data could only be obtained and utilized from what was documented in the electronic medical record. This analysis included patients who had laboratory-confirmed testing, regardless of symptomatology. There were 12 subjects who did not possess the classic symptomatology associated with COVID-19 disease but were included in the study due to their positive laboratory testing. The data in this analysis were collected from the first 155 patients who were hospitalized at our facility. Most of these admissions predated the consistent use of dexamethasone and remdesivir and other therapeutic drugs as

Table 4. Day 30 Dispositions

	Total, No. (%)	Rural, No. (%)	Urban, No. (%)	P Value
Discharged to home	78 (50.32)	33 (53.23)	45 (48.39)	.62
Discharged to SNF/LTAC	33 (21.29)	11 (17.74)	22 (23.66)	.43
Rehospitalized	7 (4.52)	3 (4.84)	4 (4.30)	1
Still hospitalized, not in ICU	7 (4.52)	4 (6.45)	3 (3.23)	.44
In ICU—not intubated	3 (1.94)	1 (1.61)	2 (2.15)	1
In ICU—intubated	4 (2.58)	3 (4.84)	1 (1.08)	.30
Expired	22 (14.19)	7 (11.29)	15 (16.13)	.48

Abbreviations: ICU, intensive care unit; LTAC, long-term acute care facility; SNF, skilled nursing facility.

Table 5. Characteristics of Discharged and Expired Patients

	Rural		Urban		
Discharged Patients	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)	P Value
Total hospital LOS (n = 111)	11.32 (8.18)	8.5 (10.00)	9.61 (8.24)	7 (11.50)	.10
ICU LOS (n = 73)	5.36 (7.67)	0 (9.25)	3.51 (6.84)	0 (2.50)	.12
Expired Patients (n = 22)	Mean (SD)	Median (IQR)	Mean (SD)	Median (IQR)	P Value
Age	67.86 (8.86)	67 (7.00)	69 (18.81)	66 (24.00)	.94
No. of comorbidities	3.00 (1.41)	3 (1.00)	3.4 (2.06)	3 (1.50)	.97
Total hospital LOS	9.71 (8.12)	7 (6.00)	9.47 (6.89)	8 (3.00)	.92
ICU LOS	7.71 (7.30)	5 (8.00)	6.07 (8.28)	3 (6.50)	.41

Total hospital LOS (n = 111) includes the 78 discharged home plus 33 discharged to skilled nursing facilities or long-term acute care facilities. ICU LOS (n = 73) signifies that only 73 of the 111 patients discharged required ICU-level care at some point in their hospital stay.

Abbreviations: ICU, intensive care unit; IQR, interquartile range; LOS, length of stay.

well as vaccines, which could have impacted the outcome data in the early months of the pandemic. Social determinants of health that were not identified in this study may have also impacted patients' clinical outcomes. As this was a single-center study, the results may not be generalizable to other rural communities.

CONCLUSIONS

The COVID-19 pandemic continues to highlight disparities among certain populations. Many of the studies published thus far have been from large urban metropolitan areas [2, 3, 19]. However, patients in rural Georgia communities tend to be older and less educated and to have more comorbidities and disabilities than patients from urban Georgia communities [6, 8]. Our results suggest that special care and medical vigilance should be given to patients from rural communities as they may be more likely to rapidly decompensate within the first 24 hours of admission. An escalation of COVID-19 research targeting rural communities is certainly necessary to better understand the specific impact, pathogenesis, and outcomes of COVID-19 disease in these communities.

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