COVID-19 Experience in a Wisconsin Academic Medical Center

Julie M. Kolinski, MD; Sakthi K. Sundararajan, MD; Sheila Swartz, MD; Kavita V. Naik, MD; Navdeep Gupta, MD

ABSTRACT

Background: Several studies describing Coronavirus disease 2019 (COVID-19) have been reported; however, to our knowledge, no case series has been published from the Midwest.

Objective: To describe demographic characteristics and outcomes of patients admitted with COVID-19 to a Wisconsin academic medical center.

Methods: We performed a retrospective analysis of data obtained for COVID-19 patients admitted from March 14, 2020 through April 19, 2020.

Results: One hundred sixty-eight patients were admitted. Outcomes measured include time in the intensive care unit (53%), mechanical ventilation (18%), and death (19%). ICU patients had higher rates of diabetes, obesity, and higher inflammatory markers. The majority of patients admitted were African American (68%).

Conclusion: This case series highlights demographic similarities and differences, as well as outcomes, among COVID-19 patients in a Wisconsin Academic Medical Center compared to those reported in other geographic regions.

BACKGROUND

The novel coronavirus SARS-CoV-2 (COVID-19) was first detected in Wuhan, China at the end of 2019. Since its arrival in the United States, a plethora of research looking at the clinical characteristics, presentation, and outcomes of the disease has been published, including several meta-analyses.

One of the first case series involving patients hospitalized with COVID-19 in Seattle, Washington—the first epicenter of the disease in the US—reported a 50% mortality rate and a 75% rate of mechanical ventilation. This small cohort (n=24) had high rates of lymphopenia (75%) and diabetes as a comorbidity (58%).[1]

As COVID-19 has spread to more densely populated regions in the United States—most notably New York City, the opportunity to analyze larger amounts of data has arisen. A large case series comprised of 5700 cases of patients hospitalized with COVID-19 in the New York City area showed a 14.2% admission rate to intensive care units (ICU), as well as lower rates of mortality (21%) and mechanical ventilation (12.2%). Diabetes, hypertension, and obesity were reported as the most common comorbidities.[2]

In response to the surge in COVID-19 cases across the country and concerns about resource limitations, many hospital systems canceled elective surgeries, created surge plans for an expected influx of patients, and honed various new management plans.

In our institution, these efforts were implemented quickly and efficiently. This study aims to better understand the clinical characteristics and outcomes of COVID-19 in a medium-sized Midwestern hospital.

METHODS

We performed a retrospective analysis of patients ≥18 years old who were SARS-CoV-2 positive and admitted to Froedtert

Author Affiliations: Department of Pediatrics, Medical College of Wisconsin (MCW), Milwaukee, Wis (Kolinski, Swartz); Department of General Internal Medicine, MCW, Milwaukee, Wis (Kolinski Sundararajan, Swartz, Naik, Gupta).

Corresponding Author: Julie M. Kolinski, MD; Assistant Professor, Internal Medicine and Pediatrics, Medical College of Wisconsin, 999 N 92nd St, Suite 560, Milwaukee, WI 53226; phone 414.337.7179; email jkolinski@mcw.edu; ORCID ID 0000-0002-2826-533X.

(Froedtert) Memorial Lutheran Hospital between March 14 and April 19, 2020. Froedtert is a 600-bed academic medical center in Milwaukee, Wisconsin. The first patient was admitted on March 14, 2020. Of the 168 patients admitted, 8 were subsequently readmitted; however, only index admissions were included in this analysis. We compared baseline demographics, presenting subjective and objective data, and the clinical course of patients treated in the ICU and on the general floor. We also assessed the primary outcome of spending time in the ICU; secondary outcomes included mechanical ventilation and death. A subgroup analysis was performed on African American patients. Categorical data were expressed as n (%) and compared using Fisher's exact test. Continuous data were expressed as median with interquartile range (IQR) and compared using Mann-Whitney U test. This study was approved by the Medical College of Wisconsin Institutional Review Board.

RESULTS

Of the 168 patients admitted, 89 (53%) spent time in the ICU and 31 (18%) underwent mechanical ventilation (Table 1). The overall median age was 65 years (IQR 50-75), 55% were male, 68% were African American, and 77% were admitted from home. The most common comorbidities were hypertension (65%), obesity (48%), and diabetes (47%). Patients who spent time in the ICU were statistically more likely to have diabetes and/or obesity and have a higher white blood cell count, neutrophil to lymphocyte ratio (NLR), ferritin, lactate dehydrogenase, and C-reactive protein (CRP) on admission. The difference in day of illness at presentation between patients in the ICU and on the general floor was statistically insignificant. At the time of this analysis (April 20, 2020), 27% (n = 46) of patients were still admitted. Of those patients with dispositions (n = 122), 81% (n = 99) were discharged and 19% (n = 23) were deceased. African American patients also were analyzed separately (Table 2),

Table 1. Characteristics of Adult Patients With COVID-19 in a Midwest Academic Medical Center

	All Patients Treated N = 168	Adults Treated in ICU N = 89	Adults Treated on General Floor N = 79	*P* value
Age in years	65 (50-75)	63 (50-74)	66 (49-77)	0.956
Sex, male	93 (55%)	54 (60%)	40 (51%)	0.278
Race				
African American	114 (68%)	63 (71%)	51 (65%)	0.644
White	35 (21%)	16 (18%)	19 (24%)	0.644
Other	19 (11%)	10 (11%)	9 (11%)	0.644
Prior to admission location				
Home	130 (77%)	73 (82%)	57 (72%)	0.329
Skilled nursing facility	20 (12%)	9 (10%)	11 (14%)	0.329
Other (group home, assisted living, shelter)	18 (11%)	7 (8%)	11 (14%)	0.329
Comorbidities				
Asthma	27 (16%)	12 (13%)	15 (19%)	0.402
Cancer[a]	23 (14%)	9 (10%)	14 (18%)	0.181
Chronic kidney disease and/or dialysis	52 (31%)	29 (33%)	23 (29%)	0.738
COPD	21 (13%)	13 (15%)	8 (10%)	0.485
Coronary artery disease	24 (14%)	16 (18%)	8 (10%)	0.186
Dementia	20 (12%)	5 (6%)	15 (19%)	**0.009**
Diabetes mellitus	79 (47%)	51 (57%)	28 (35%)	**0.005**
Heart failure[b]	29 (17%)	15 (17%)	14 (18%)	1.000
Hypertension	110 (65%)	64 (72%)	46 (58%)	0.074
Obesity (BMI ≥ 30 kg/m^2)	80 (48%)	50 (56%)	30 (38%)	**0.021**
Presenting symptoms				
Fever (n=166)[c]	112 (67%)	57 (64%)	55 (70%)	0.621
Cough (n=165)	118 (70%)	69 (78%)	49 (62%)	**0.025**
Dyspnea (n=166)	109 (65%)	71 (80%)	38 (48%)	**<0.001**
Gastrointestinal[d] (n=163)	73 (43%)	38 (43%)	35 (44%)	0.876
Reported COVID-19 contact (n=106)	44 (26%)	25 (28%)	19 (24%)	0.434
Reported day of illness on admission (n=166)	6 (3-10)	7 (4-10)	5 (3-9)	0.067
Laboratory values on admission				
White blood cell count x109/L [Ref Range 3.9-11.2] (n = 168)	6.6 (5.15-8.95)	7.5 (5.6-9.5)	5.6 (4.4-7.6)	**<0.001**
Absolute lymphocyte count x109/L [0.9-3.2] (n=168)	0.96 (0.66-1.33)	0.96 (0.63-1.31)	0.94 (0.74-1.34)	0.554
Neutrophil:lymphocyte ratio (n=168)	4.96 (2.80-8.66)	6.32 (2.98-9.49)	4.02 (2.33 -7.40)	**0.011**
Ferritin, ng/mL [30-400] (n=148)	682 (294-1353)	834 (409-1793)	529 (231-1219)	**0.003**
LDH, U/L [113-225] (n=141)	329 (251-443)	381 (295-515)	277 (232-333)	**<0.001**
CRP, mg/dL [0-0.5] (n=148)	7.55 (2.75-13.65)	10.3 (5.60-17.93)	3.55 (1.50-10.55)	**<0.001**
Procalcitonin, ng/mL [≤0.08] (n=97)	0.26 (0.10-0.69)	0.29 (0.09-0.87)	0.17 (0.11-0.51)	0.251
Chest radiography findings (n=167)				
Clear	38 (23%)	8 (9%)	30 (38%)	**<0.001**
Unilateral infiltrates	36 (22%)	21 (24%)	15 (19%)	**<0.001**
Bilateral infiltrates	93 (56%)	59 (67%)	34 (43%)	**<0.001**
Clinical course				
Temperature ≥ 100.4 in first 24 hours	102 (61%)	59 (66%)	43 (54%)	0.154
Maximum O_2 delivery				
Simple nasal cannula	57 (34%)	16 (18%)	41 (52%)	
High-flow oxygen	36 (21%)	36 (40%)	NA	
Mechanical ventilation	31 (18%)	31 (35%)	NA	
ECMO	5 (3%)	5 (6%)	0	
Length of stay, discharged patients (n=99)	6 (3-9)	8 (7-11) (n=42)	4 (3-7) (n=57)	**<0.001**

Note: Values are n (%) or median (IQR as p25 – p75). Bold *P* values indicate <0.05.

Abbreviations: COPD, chronic obstructive pulmonary disease; CRP, C-reactive protein; BMI, body mass index; ECMO, extracorporeal membrane oxygenation; LDH, lactate dehydrogenase.

SI conversion factors: To convert LDH to µkat/L, multiple by 0.0167; C-reactive protein to mg/L, multiple by 10.

[a] Current and history of cancer included.

[b] Any form of heart failure included: systolic, diastolic, and/or both.

[c] (n=xx) notes the number of data points available to account for missing data.

[d] Gastrointestinal symptoms included nausea, vomiting, diarrhea, and abdominal pain.

Table 2. Select Characteristics of African American COVID-19 Patients

	African American Patients N=114	Caucasian and Other Patients N=54	*P* value
Age in years	66 (52-75)	62 (49-77)	0.879
Sex, Male	65 (57%)	28 (52%)	0.619
Comorbidities			
Chronic kidney disease and/or dialysis	43 (38%)	9 (17%)	**0.007**
Dementia	16 (14%)	4 (7%)	0.308
Diabetes mellitus	66 (58%)	13 (24%)	**<0.001**
Heart Failure[a]	22 (19%)	7 (13%)	0.385
Hypertension	83 (73%)	27 (50%)	**0.005**
Obesity (BMI ≥ 30 kg/m^2)	55 (48%)	25 (46%)	0.869
Laboratory values on admission			
White Blood Cell Count x10^9/L [Ref Range 3.9-11.2] (n=168)[b]	6.9 (4.9-9.3)	6 (5.3-8)	0.189
Absolute Lymphocyte Count x10^9/L [0.9-3.2] (n=168)	0.96 (0.69-1.34)	0.96 (0.64-1.32)	0.873
Neutrophil:Lymphocyte Ratio (n=168)	5.30 (2.81-8.75)	4.22 (2.77-8.38)	0.512
Ferritin, ng/mL [30-400] (n=148)	686 (268-1541)	621 (297-1336)	0.599
LDH, U/L [113-225] (n=141)	332 (248-458)	325 (257-443)	0.841
CRP, mg/dL [0-0.5] (n=148)	9.2 (3.4-15)	5.6 (2.4-10.3)	**0.041**
Procalcitonin, ng/mL [≤0.08] (n=97)	0.30 (0.11-0.69)	0.15 (0.07-0.51)	**0.037**
Clinical Course			
Spent any time in ICU	63 (55%)	26 (48%)	0.412
Mechanical ventilation	19 (17%)	12 (22%)	0.400
Length of stay, discharged patients (n=99)	7 (4-9) (n=73)	4 (3-7) (n=26)	**0.043**

Note: Values are n (%) or median (IQR as p25 – p75). Bold *P* values indicate <0.05.
Abbreviations: COPD, chronic obstructive pulmonary disease; CRP, C-reactive protein; BMI, body mass index; ECMO, extracorporeal membrane oxygenation; LDH, lactate dehydrogenase.
SI conversion factors: To convert LDH to µkat/L, multiple by 0.0167; C-reactive protein to mg/L, multiple by 10
[a]Any form of heart failure included: systolic, diastolic, and/or both.
[b](n=xx) notes the number of data points available to account for missing data.

with results showing similar rates of ICU stays, mechanical ventilation, and deaths. Of those African American patients with dispositions (n = 92), 18% (n= 17) were deceased compared to 19% (n = 6) of the rest of the patients. African American patients were statistically more likely to have chronic kidney disease or dialysis dependency, hypertension, diabetes, higher CRP and procalcitonin levels, and a longer length of stay.

DISCUSSION

This case series reports a higher rate of ICU stays (53%) compared to case series in California (30%) and New York (14%); a lower mechanical ventilation rate (18%) than California (29.2%), but similar to New York (12.2%); and a similar overall mortality rate (19%) versus California (15.6%) and New York (21%).[2,3] The higher ICU stay rate in our study may be largely due to learnings from previous case series about the importance of early intervention, rather than a greater degree of illness in patients on presentation. Due to this guidance, in addition to considering the overall clinical picture of the patient, our institution's ICU criteria included a sustained respiratory rate of ≥24 or the need for nasal cannula respiratory support ≥ 6 liters of oxygen. Early use of high flow nasal cannula and proning while awake was instituted. Overall, this led to more conservative management of patients with a lower threshold for ICU transfer than was typically the case for other respiratory illnesses at our institution. As previously noted, this did not prompt a higher mechanical ventilation rate; instead, rates of ventilation were lower than other series reported, which suggests that earlier ICU management is perhaps protective, although our study was not powered to assess this outcome. Comorbidities affecting outcomes, including diabetes, obesity, and hypertension, were noted to agree with prior studies.[3] The NLR—a biomarker of systemic inflammation that has shown prognostic utility in COVID-19—was higher in our patients who spent time in the ICU (6.32 vs 4.02, $P = 0.011$), which is consistent with severe cases reported from Wuhan, China (5.5 vs 3.2, $P < 0.0001$).[4,5]

Day of illness at presentation is also reported in this study. It became evident early on that our providers should take care to note what day of illness a COVID-19 patient was on at presentation.[6] This allowed providers to monitor for decompensation during what has been described as the cytokine storm syndrome, occurring during the second phase of the COVID-19 illness.[7] Both groups analyzed had a similar day of illness on presentation, although this metric was asked more specifically later in the study as more information about its importance was disseminated to providers.

Unlike previous studies, this case series is unique in its predominance of hospitalized patients who are African American (68%). The racial and ethnic breakdown of the Milwaukee region is approximately 39% African American,[8] and our hospital's fiscal year 2019 admissions were 30% African American. Critical illness defined as ICU stay or mechanical ventilation was the same for African American patients compared to others; however, the rates of comorbidities were higher, which likely played a role in the increased admission rate. Interestingly, the length of stay for African American patients was nearly double that of non-African American patients. This may be due, in part, to their higher rates of comorbidities but also suggests that there may be differences in their clinical course that warrant further investigation. Overall, this racial disparity requires further analysis with a larger data set.

Limitations of this data include the fact that Wisconsin is early in its pandemic, and these patients were treated at a single hospital with all final outcomes not yet established.

CONCLUSION

This report highlights the experience of a Midwest Academic Medical Center in the first month of the COVID-19 pandemic and highlights demographic similarities and differences compared to patients in other geographic regions.

Funding/Support: None declared.

Financial Disclosures: None declared.

REFERENCES

1. Bhatraju PK, Ghassemieh BJ, Nichols M, et al. Covid-19 in critically ill patients in the Seattle region - case series. *N Engl J Med*. 2020;382(21):2012-2022. doi:10.1056/NEJMoa2004500

2. Richardson S, Hirsch JS, Narasimhan M, et al. Presenting characteristics, comorbidities, and outcomes among 5700 patients hospitalized with COVID-19 in the New York City area. *JAMA*. 2020;323(20):2052-2059. doi:10.1001/jama.2020.6775

3. Myers LC, Parodi SM, Escobar GJ, Liu VX. Characteristics of hospitalized adults with COVID-19 in an integrated health care system in California. *JAMA*. 2020;323(21):2195-2198. doi:10.1001/jama.2020.7202

4. Zahorec R. Ratio of neutrophil to lymphocyte counts--rapid and simple parameter of systemic inflammation and stress in critically ill. *Bratisl Lek Listy*. 2001;102(1):5-14.

5. Qin C, Zhou L, Hu Z, et al. Dysregulation of immune response in patients with COVID-19 in Wuhan, China. *Clin Infect Dis*. Published online March 12, 2020. doi:10.1093/cid/ciaa248

6. Zhou F, Yu T, Du R, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. *Lancet*. 2020;395(10229):1054-1062. doi:10.1016/S0140-6736(20)30566-3

7. Mehta P, McAuley DF, Brown M, et al; HLH Across Specialty Collaboration, UK. COVID-19: consider cytokine storm syndromes and immunosuppression. *Lancet*. 2020;395(10229):1033-1034. doi:10.1016/S0140-6736(20)30628-0

8. QuickFacts, Milwaukee city, Wisconsin. United States Census Bureau. Published July 1, 2019. Accessed April 30, 2020. www.census.gov/quickfacts/milwaukeecitywisconsin

advancing the art & science of medicine in the midwest

WMJ

WMJ (ISSN 1098-1861) is published through a collaboration between The Medical College of Wisconsin and The University of Wisconsin School of Medicine and Public Health. The mission of *WMJ* is to provide an opportunity to publish original research, case reports, review articles, and essays about current medical and public health issues.

Visit www.wmjonline.org to learn more.