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Clinical Characteristics and Risk Factors for Death of Hospitalized Patients With COVID-19 in a Community Hospital: A Retrospective Cohort Study

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Abstract

Objective: To describe the clinical characteristics, outcomes, and risk factors for death of patients with coronavirus disease 2019 (COVID-19) in a community hospital setting.

Patients and Methods: This single-center retrospective cohort study included 313 adult patients with laboratory-confirmed COVID-19 admitted to a community hospital in Cook County, Illinois, from March 1, 2020, to May 25, 2020. Demographics, medical history, underlying comorbidities, symptoms, signs, laboratory findings, imaging studies, management, and progression to discharge or death data were collected and analyzed.

Results: Of 313 patients, the median age was 68 years (interquartile range, 59.0-78.5 years; range, 19-98 years), 182 (58.1%) were male, 119 (38%) were white, and 194 (62%) were admitted from a long-term care facility (LTCF). As of May 25, 2020, there were 212 (67.7%) survivors identified, whereas 101 (32.3%) nonsurvivors were identified. Multivariable Cox regression analysis showed increasing hazards of inpatient death associated with older age (hazard ratio [HR] 1.02; 95% CI, 1.01-1.04), LTCF residence (HR, 3.23; 95% CI, 1.68-6.20), and quick Sequential Organ Failure Assessment scores (HR, 2.59; 95% CI, 1.78-3.76).

Conclusion: In this single-center retrospective cohort study of 313 adult patients hospitalized with COVID-19 illness in a community hospital in Cook County, Illinois, older patients, LTCF residents, and patients with high quick Sequential Organ Failure Assessment scores were found to have worse clinical outcomes and increased risk of death.

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On December 31, 2019, the World Health Organization received a report of a cluster of cases of pneumonia of unknown etiology detected in Wuhan City, Hubei Province of China.[1] The pathogen was identified as a novel enveloped RNA betacoronavirus, different from both Middle East respiratory syndrome coronavirus and severe acute respiratory syndrome coronavirus, later designated severe acute respiratory syndrome coronavirus 2.[2] The disease that it causes was later named coronavirus disease 2019 (COVID-19).[3] This new disease rapidly spread globally, prompting the World Health Organization to declare it a pandemic on March 11, 2020. The United States has been, to date, the country with the highest incidence of the disease. As of June 2, 2020, there had been a total of 1,802,470 cases reported in the United States; in Cook County, Illinois, there had been 78,495 confirmed cases.[4,5]

After the emergence of this novel pathogen, several cohort and case series studies have described COVID-19 in populations overseas and large US academic centers.[6-17] Ecologic studies have found significant differences within the US territory regarding mortality patterns as a function of geographic location and population composition.[18] Also, detailed data on demographic characteristics, comorbidities, risk factors, and clinical outcomes from community hospitals are needed

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TABLE 1. Demographic and Clinical Characteristics of Patients With COVID-19[a,b]

	Total (N=313)	Survivors (n=212 [67.7%])	Nonsurvivors (n=101 [32.3%])	*P* value[c]
Age (y)	68 (59-78.5)	66.5 (56-75)	74 (66-83)	<.001
Sex				
Male	182 (58.1)	117 (55.2)	65 (64.4)	.12
Female	131 (41.9)	95 (44.8)	36 (35.5)	
Ethnicity or race				
White (vs all other)	119 (38)	69 (32.5)	50 (49.5)	.004
Hispanic	47 (15)	34 (16)	13 (12.9)	
Black or African American	96 (30.7)	70 (33)	26 (25.7)	
Asian	26 (8.3)	18 (8.5)	8 (7.9)	
Arab	5 (1.6)	5 (2.4)	0 (0)	
Other	20 (6.4)	16 (7.5)	4 (4)	
Residence				<.001
Home	119 (38)	97 (46.8)	22 (21.8)	
LTCF	194 (62)	115 (54.2)	79 (78.2)	
Comorbidities				
Total number of comorbidities	3 (2-4)	3 (2-4)	3 (2-4)	.02
Two or more comorbidities	266 (85)	173 (81.6)	93 (92.1)	.01
Hypertension	222 (70.9)	143 (67.5)	79 (78.2)	.05
Cardiovascular	105 (33.5)	68 (32.1)	37 (36.6)	.43
Obesity	101 (32.3)	76 (35.8)	25 (24.8)	.05
Diabetes	140 (44.7)	93 (43.9)	47 (46.5)	.66
Chronic liver disease	9 (2.9)	7 (3.3)	2 (2.0)	.51
Malignant disease or mass	33 (10.5)	21 (9.9)	12 (11.9)	.60
Cerebrovascular	57 (18.2)	38 (17.9)	19 (18.8)	.85
Neurocognitive impairment	113 (36.1)	60 (28.3)	53 (52.5)	<.001
COPD or asthma	66 (21.1)	39 (18.4)	27 (26.7)	.09
ESRD	22 (7.0)	13 (6.1)	9 (8.9)	.37
DVT or PE	21 (6.7)	15 (7.1)	6 (5.9)	.71
HIV infection or immunodeficiency	6 (1.9)	4 (1.9)	2 (2)	.96
Smoking status				
Nonsmoker	184 (58.8)	126 (59.4)	58 (57.4)	.74
Former	85 (27.2)	48 (22.6)	37 (36.6)	.009
Current	38 (12.1)	35 (16.5)	3 (3.0)	<.001
Symptoms				
Fever	188 (60.1)	135 (63.7)	53 (52.5)	.06
Chills	31 (9.9)	26 (12.3)	5 (5.0)	.04
Fatigue or malaise	86 (27.5)	67 (31.6)	19 (18.8)	.02
Myalgias or body aches	46 (14.7)	38 (17.9)	8 (7.9)	.02
Cough	160 (51.1)	118 (55.7)	42 (41.6)	.02
Shortness of breath	210 (67.1)	132 (62.3)	78 (77.2)	.008
Sore throat	16 (5.1)	12 (5.7)	4 (4.0)	.52
Headache	28 (8.9)	26 (12.3)	2 (2.0)	.003
Anorexia	49 (15.7)	34 (16.0)	15 (14.9)	.79
Anosmia	11 (3.5)	8 (3.8)	3 (3.0)	.72
Abdominal pain	21 (6.7)	17 (8.0)	4 (4.0)	.18

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TABLE 1. Continued

	Total (N=313)	Survivors (n=212 [67.7%])	Nonsurvivors (n=101 [32.3%])	*P* value[c]
Symptoms, continued				
Diarrhea	43 (13.7)	37 (17.5)	5 (5.9)	.006
Nausea or vomiting	38 (12.1)	32 (15.1)	6 (5.9)	.02

[a]COPD = chronic obstructive pulmonary disease; COVID-19 = coronavirus disease 2019; DVT = deep venous thrombosis; ESRD = end-stage renal disease; HIV = human immunodeficiency virus; LTCF = long-term care facility; PE = pulmonary embolism.
[b]Categorical variables are presented as number (%). Continuous variables are presented as median (interquartile range).
[c]*P* values indicate differences between survivors and nonsurvivors. $P<.05$ was considered statistically significant.

to fully characterize the spectrum of the disease and to allow health care providers to prepare tailored interventions for their communities. For that reason, the objective of this study was to describe the clinical characteristics, outcomes, and risk factors for death of patients with COVID-19 hospitalized in a community hospital setting.

PATIENTS AND METHODS

Design and Participants

This retrospective cohort study included 313 hospitalized adult patients (18 years or older) with COVID-19 from Saint Francis Hospital, a 216-bed community hospital located in the North Shore Chicago area, Cook County, Illinois, who had been admitted from March 1, 2020, to May 25, 2020. A confirmed case of COVID-19 was defined by a positive result on a reverse transcriptase polymerase chain reaction assay of a specimen collected on a nasopharyngeal swab. Only patients with laboratory-confirmed illness were included.

Data Collection

Information collected included demographic data, medical history, underlying comorbidities, symptoms, signs, laboratory findings, imaging studies, treatment measures, survival to hospital discharge or data abstraction cutoff date (survivors), and in-hospital death or referral to hospice (nonsurvivors). Clinical outcomes were monitored up to May 25, 2020; this was the cutoff date for data abstraction. The study was approved by the Institutional Review Board of AMITA Health System (2020-0128-02). The Ethics Commission waived the requirement for informed consent, given that this research involves no more than minimal risk to participants.

Statistical Analyses

Descriptive statistics were used to summarize the data; categorical variables were described as frequency rates and percentages, and continuous variables were described using median and interquartile range (IQR) values. We used the Mann-Whitney *U* test, χ^2 test, or Fisher exact test to compare differences between survivors and nonsurvivors when appropriate. Cox proportional hazards (PH) regression model was conducted to examine the relationship between independent variables and mortality, in which hazard ratios (HRs) were used to quantify the associations. Schoenfeld residuals were used to test the PH assumption of Cox models statistically. A two-sided α of less than .05 was considered statistically significant. All statistical analyses were performed using SPSS version 23.0 (IBM Corp). Additional details regarding data collection, interrater agreement and reliability, missing values, nonproportionality test, and definitions are provided in the Supplement (available online at http://mcpiqojournal.org).

RESULTS

Demographic and Presenting Characteristics

At the cutoff date, we identified 323 patients with the diagnosis of COVID-19 admitted to AMITA Health Saint Francis Hospital. Of those, 4 patients with no evidence of a positive response to reverse transcriptase polymerase chain reaction and 6 patients who were incidentally found to be positive with no

TABLE 2. Presentation Vital Signs, Laboratory Results, and Imaging Studies of Patients With COVID-19[a,b,c]

	Total (N=313)	Survivors (n=212 [67.7%])	Nonsurvivors (n=101 [32.3%])	*P* value[d]
Signs[e]				
Altered mental status	137 (43.8)	64 (30.2)	73 (72.3)	<.001
Temperature (°C)	37.8 (37-38.7)	37.8 (36.9-38.6)	37.8 (37.1-38.7)	.93
Lowest O_2 (%)	93 (88-95)	93 (89.25-96.0)	92 (86.0-95.0)	.001
Systolic blood pressure (mm Hg)	123 (104-140.5)	128.5 (80-109)	107 (89-107)	<.001
Heart rate (beats/min)	96 (80-110)	95 (80-109)	98 (79-98)	.22
Respiratory rate	22 (20-28)	21 (20-26)	26 (20-32)	<.001
Laboratory[e]	Reference values			
White blood cell count ($\times 10^9$/L)	4.0-11.0	8.1 (5.6-11.5)	7.7 (5.1-10.3)	9.2 (6.4-13.0)	.001
Lymphocyte count ($\times 10^9$/L)	0.6-3.4	0.9 (0.6-1.3)	0.9 (0.7-1.4)	0.8 (0.5-1.3)	.03
Hemoglobin (g/dL)	12.0-15.3	12.9 (11.3-14.1)	12.8 (11.3-14.1)	12.9 (11.35-14.2)	.76
Platelets ($\times 10^9$/L)	150-450	209 (166.5-275.5)	208 (169-271)	210 (161-285)	.71
Serum sodium (mmol/L)	133-144	136 (132-140)	135 (132-139)	138 (133-149)	<.001
Serum creatinine (mg/dL)	0.6-1.3	1.24 (0.89-2.01)	1.13 (0.85-1.62)	1.61 (1.0-2.96)	<.001
Blood urea nitrogen (mg/dL)	7-25	27 (16-46)	22 (14-35)	37 (25-71)	<.001
Aspartate aminotransferase (U/L)	13-39	35 (24-56.5)	32.5 (23-52)	40 (27-71)	<.001
Alanine aminotransferase (U/L)	7-52	25 (16-41.5)	24 (15-37.7)	27 (16-47)	<.001
Alkaline phosphatase (U/L)	35-104	62 (50-81.5)	63.5 (50-81)	59 (50-84)	.44
Total bilirubin (mg/dL)	0.0-1.0	0.5 (0.4-0.7)	0.50 (0.4-0.7)	0.55 (0.4-0.8)	<.001
Lactate dehydrogenase (U/L)	140-271	288 (203-426)	280 (200-397)	361(217-481)	<.001
Ferritin (ng/mL)	11-307	479 (184-1021)	412 (164-950)	722 (287-1367)	<.001
Lactic acid (mmol/L)	0.7-2.0	1.8 (1.2-2.5)	1.7 (1.1-2.2)	2 (1.3-3.1)	<.001
Procalcitonin (ng/mL)	0.20-0.49	1.05 (0.33-3.53)	0.87 (0.28-2.99)	1.67 (0.44-4.67)	<.001
D-dimer (ng/mL)	0-622	1418 (756-5589)	1193 (677-3292)	2449 (1029-7878)	<.001
C-reactive protein (mg/dL)	<1.0	10.5 (4.8-16.9)	9.25 (3.7-15.6)	13. 9 (7.7-20.9)	<.001
Creatine kinase (U/L)	30-223	226 (87.5-1010.6)	192 (78-845)	293 (109-1522)	<.001
High-sensitivity troponin (pg/mL)	0-20	31 (11-94)	20 (8-78)	52 (20-154)	<.001
Imaging[e]				
No parenchymal findings	NA	48 (15.3)	39 (18.4)	9 (8.9)	.03
Unilateral opacities	NA	73 (23.3)	51 (24.1)	22 (21.8)	.65
Bilateral opacities	NA	153 (48.9)	98 (46.2)	55 (54.5)	.17
Diffuse opacities	NA	39 (12.5)	24 (11.3)	15 (14.9)	.37

[a]COVID-19 = coronavirus disease 2019; NA = not applicable.
[b]SI conversion factors: To convert alanine aminotransferase, alkaline phosphatase, aspartate aminotransferase, creatine kinase, and lactate dehydrogenase to μkat/L, multiply by 0.0167. To convert serum creatinine to mmol/L, multiply by 0.0259.
[c]Categorical variables are presented as number (%). Continuous variables are presented as median (interquartile range).
[d]*P* values indicate differences between survivors and nonsurvivors. *P*<.05 was considered statistically significant.
[e]Admission vital signs, laboratory results, and imaging studies were selected to be included on the basis of previous characterizations of patients with COVID-19.

symptoms were excluded. Hence, a total of 313 patients were included in the final analysis (Table 1). The median age was 68 years (IQR, 59.0-78.5 years; range, 19-98 years), 182 (58.1%) were male, 119 (38%) were white, and 194 (62%) were admitted from a long-term care facility (LTCF).

Among the 313 patients, 298 (95.2%) had at least one underlying condition. The most common comorbidities were hypertension (222 [70.9%]), diabetes (140 [44.7%]), neurocognitive impairment (113 [36.1%]), cardiovascular disease (105 [33.5%)]), and obesity (101 [32.3%]). Furthermore, 123 (39.3%) of

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TABLE 3. Severity, Complications, and Interventions Among Patients With COVID-19[a,b]

	Total (N=313)	Survivors (n=212 [67.7%])	Nonsurvivors (n=101 [32.3%])	*P* value[c]
Severity				
qSOFA score	1 (1-2)	1 (0-1)	2 (1-2)	<.001
NIH severity				
Mild illness	17 (5.4)	17 (8.0)	0	
Moderate illness	49 (15.6)	40 (18.9)	9 (8.9)	.02
Severe illness	247 (78.9)	155 (73.1)	92 (91.1)	<.001
Complications				
Respiratory failure	214 (68.4)	128 (60.4)	86 (85.1)	<.001
Sepsis	110 (35.1)	46 (21.7)	64 (63.4)	<.001
Septic shock	62 (19.8)	21 (9.9)	41 (64.1)	<.001
ARDS	49 (15.7)	27 (12.7)	22 (21.8)	.04
Acute kidney injury	120 (38.2)	68 (32.1)	52 (51.5)	.001
Acute cardiac injury	76 (24.3)	42 (19.8)	34 (33,7)	.008
Rhabdomyolysis	67 (21.4)	38 (17.9)	29 (28.7)	.03
Coinfection	45 (14.4)	22 (10.4)	23 (22.8)	.003
Interventions				
Azithromycin	149 (47.6)	108 (59.9)	41 (40.6)	.09
Hydroxychloroquine	65 (20.8)	43 (20.3)	22 (21.8)	.76
Steroids	133 (42.5)	82 (38.7)	51 (50.5)	.05
Colchicine	52 (16.6)	36 (17.0)	16 (15.8)	.80
Tocilizumab	27 (8.6)	20 (9.4)	7 (6.9)	.45
Antibiotics	282 (90.1)	191 (90.1)	91 (90.1)	.99
Anticoagulation				
None	21 (6.7)	8 (3.8)	13 (12.9)	.002
Prophylactic enoxaparin	94 (30)	75 (35.4)	19 (18.8)	.002
Prophylactic heparin	81 (25.9)	51 (24.1)	30 (29.7)	.29
Therapeutic enoxaparin	59 (18.8)	41 (19.3)	18 (17.8)	.75
Heparin infusion	32 (19.2)	14 (6.6)	18 (17.8)	.002
Oral anticoagulation	25 (8.0)	22 (10.4)	3 (3.0)	.02
Fondaparinux	1 (0.3)	1 (0.5)	0 (0.0)	.48
Maximal respiratory support in the ED				
None	101 (32.3)	84 (39.6)	17 (16.8)	<.001
Nasal cannula	132 (42.2)	93 (43.9)	39 (38.6)	.37
High flow	25 (8.0)	11 (5.2)	14 (13.9)	.008
Non-rebreather mask	19 (6.1)	6 (2.8)	13 (12.9)	<.001
Humidified high-flow system	7 (2.2)	4 (1.9)	3 (3.0)	.54
NIMV	4 (1.3)	1 (0.5)	3 (3.0)	.06
IMV	25 (8.0)	13 (6.1)	12 (11.9)	.07
ICU admission	98 (31.3)	50 (23.6)	48 (47.5)	<.001
Intubation	61 (19.5)	32 (15.1)	29 (28.7)	.004
Prone position	54 (17.3)	32 (15.1)	22 (21.8)	.14
Neuromuscular blockers	36 (11.5)	18 (8.5)	18 (17.8)	.01
Vasopressors	55 (17.6)	27 (12.7)	28 (27.7)	.001
New-onset RRT	10 (3.2)	3 (1.4)	7 (6.9)	.009

[a]ARDS = acute respiratory distress syndrome; COVID-19 = coronavirus disease 2019; ED = emergency department; ICU = intensive care unit; IMV = invasive mechanical ventilation; NIH = National Institutes of Health; NIMV = noninvasive mechanical ventilation; qSOFA = quick Sequential Organ Failure Assessment; RRT = renal replacement therapy

[b]Categorical variables are presented as number (%).

[c]*P* values indicate differences between survivors and nonsurvivors. *P*<.05 was considered statistically significant.

the patients were reported to be either former smokers or current smokers. The most common symptoms on presentation were shortness of breath (210 [67.1%]), fever (188 [56.9%]), cough (160 [51.1%]), altered mental status (137 [43.8%]), and fatigue or malaise (86 [27.5%]; Table 1).

In this population of patients, nonsurvivors were significantly older and were more likely to be men, white, and LTCF residents. A considerably higher proportion of nonsurvivors had 2 or more comorbidities compared with survivors. Survivors were more likely to report influenza-like illness symptoms, including chills, fatigue or malaise, myalgia or body aches, cough, headache, diarrhea, and nausea or vomiting. On the other hand, nonsurvivors were more likely to present with shortness of breath (Table 1).

Vital Signs, Laboratory Findings, and Imaging Features on Presentation

Initial vital signs, laboratory findings, and imaging features are presented in Table 2. Missing values were present only for laboratory findings. Rates of missing values are provided in the Missing Values section of the Supplement (available online at http://mcpiqojournal.org).

On presentation, nonsurvivors were more likely to be found with altered mental status, with a lower nadir in oxygen saturation and blood pressure and higher respiratory rates. The temperature and heart rate did not differ significantly between groups. Regarding laboratory findings, numerous differences were observed between survivors and nonsurvivors, including higher white blood cell count, lower absolute lymphocyte count, higher liver function test values (except for alkaline phosphatase), and more elevated inflammatory markers (ie, lactate dehydrogenase, ferritin, procalcitonin, D-dimer, C-reactive protein) and end-organ damage markers (lactic acid, serum creatinine, creatine kinase, and high-sensitivity troponin). Compared with nonsurvivors, survivors were more likely to present with no parenchymal findings on chest radiographs. However, there was no difference in the presence of unilateral, bilateral, or diffuse opacities (Table 2).

Illness Severity, End-Organ Damage, and Interventions

Table 3 shows the severity of illness, rates of complications or end-organ damage, and frequency of interventions. Of the 313 patients, 247 (78.9%) met the National Institutes of Health criteria for severe illness. This proportion was higher among nonsurvivors compared with survivors. The median quick Sequential Organ Failure Assessment (qSOFA) score was significantly higher in nonsurvivors than in survivors. Respiratory failure was the most common complication (214 [68.4%]), followed by acute kidney injury (120 [38.2%]) and sepsis (110 [35.1%]). Nonsurvivors had statistically higher rates of complications or end-organ damage compared with survivors (Table 3).

The most common interventions included the use of antibiotics (other than azithromycin, 282 [90.1%]) azithromycin (149 [47.6%]) and intravenous steroids (133 [42.5%]). Among the 313 patients, 292 (93.3%) received either prophylactic or therapeutic anticoagulation, including oral anticoagulants. On presentation, more survivors required no oxygen support compared with nonsurvivors. A total of 98 (31.3%) patients required intensive care unit admission, and nonsurvivors required higher rates of critical care compared with survivors. In addition, higher rates of nonsurvivors required intubation, vasopressors, neuromuscular blockers, and new renal replacement therapy (Table 3).

Survival Outcomes

Until May 25, 2020 (Table 4), 14 (4.5%) patients remained active in the hospital (11 in the ICU and 3 on the general medical ward), 189 (60.4%) patients had been discharged home, 8 (2.6%) patients had been discharged to long-term acute care hospitals, and 1 (0.3%) patient had been transferred to a tertiary center for extracorporeal membrane oxygenation. Of 313 patients, 212 (67.7%) patients were discharged home or to other health care facilities; 101 (32.3%) patients had died or had been discharged to hospice (88 and 13 patients, respectively).

The median time from symptom onset to admission was 2 days (IQR, 1.0-7.0 days). This time was significantly shorter in nonsurvivors compared with survivors. The median length of hospital stay (time from admission to event) was 7 days (IQR, 4.0-11-0 days). The median time from admission to event in survivors (ie, discharge or last follow-up) was

TABLE 4. Clinical Outcomes of Patients With COVID-19[a,b]

Outcomes	Total (N=313)	Survivors (n=212 [67.7%])	Nonsurvivors (n=101 [32.3%])	*P* value[c]
Active patients	14 (4.5)	NA	NA	NA
Discharge disposition				
Home or LTCF	189 (60.4)	NA	NA	NA
Long-term acute care hospitals	8 (2.6)	NA	NA	NA
Transferred for ECMO	1 (0.3)	NA	NA	NA
Died	88 (28.1)	NA	NA	NA
Hospice	13 (4.2)	NA	NA	NA
Time from illness onset to admission (d)	2 (1-7)	3 (1-7)	2 (1-5)	.04
Time from illness onset to ICU admission (d)	4 (1-8)	5 (2-9.25)	3 (1-7.75)	.09
Hospital length of stay (d)	7 (4-11)	6 (4-10)	7 (3-12)	.46
Time from illness onset to outcome (d)	10 (7-16)	9 (7.0-16.75)	10 (6.5-16.0)	.89

[a]COVID-19 = coronavirus disease 2019; ECMO = extracorporeal membrane oxygenation = ICU, intensive care unit; LTCF = long-term care facility; NA = not applicable.
[b]Categorical variables are presented as number (%). Continuous variables are presented as median (interquartile range).
[c]*P* values indicate differences between survivors and nonsurvivors. *P*<.05 was considered statistically significant.

6 days (4.0-10.0 days), whereas the median time to event in nonsurvivors (ie, death or transition to hospice) was 7 days (3.0-12.0 days).

Risk Factors for Inpatient Death

Independent predictors for death in the cohort are shown in Table 5. In the bivariable analysis, older age, white ethnicity, LTCF residence, hypertension, neurocognitive impairment, altered mental status, low blood pressure, high respiratory rate, elevated qSOFA scores, high white blood cell count, and increased concentrations of sodium, blood urea nitrogen, lactic acid, and procalcitonin were associated with increased risk of inpatient death in this cohort. Elevated lactate dehydrogenase (HR, 1.001; *P*=.04), D-dimer (HR, 1.000007; *P*<.001), creatine kinase (HR, 1.000032; *P*=.049), and high-sensitivity troponin (HR, 1.001; *P*=.006) also showed a significant association with increased risk of death. For sensitivity analysis of unmeasured confounders, we calculated the E-value (with the lower confidence limit) described by VanderWeele and Ding[19] and Mathur et al[20] for the predictors with stronger associations, LTCF residence and elevated qSOFA score. The E-value is defined as the minimum strength of association on the risk ratio scale that an unmeasured confounder would need to have with both the exposure and the outcome, conditional on the measured covariates, to explain away a specific exposure-outcome association fully. The higher the E-value, the stronger the confounder associations must be to explain away the effect. For LTCF residence, the E-value for the point estimate (HR, 7.35) was 6.97 and 3.45 for the CI lower limit (2.79). Then, an unmeasured confounder associated with LTCF residence and inpatient death in patients with COVID-19 in this population by an HR of 3.45-fold each could explain away the lower confidence limit, but weaker confounding could not. For qSOFA, the E-value for the estimate (HR, 2.90) was 3.56 and 2.57 for the CI lower limit (1.97).

Given the observed clinical characteristics of this population of patients and on the basis of previously reported cohorts, we selected older age, LTCF residence status, body mass index, number of comorbidities, hypertension, neurocognitive impairment, lactic acid, and qSOFA score to fit into the multivariable Cox PH regression model.[21] LTCF residence and qSOFA remained reliable predictors for inpatient death in this population of patients (Table 5; E-value for LTCF residence, 3.88 [CI lower limit, 2.22]; E-value for qSOFA, 3.25 [2.34]).

DISCUSSION

As of May 25, 2020, of the 313 adult patients with COVID-19 admitted in a community hospital in Cook County, Illinois, 198 (63.3%) had been discharged from the hospital, whereas 88 (28.1%) had died and 13 (4.2%) had been transitioned to hospice. Nonsurvivors were more likely to be older, white,

TABLE 5. Bivariable and Multivariable Cox Regression of Factors Associated With Inpatient Death[a]

Clinical characteristics	Bivariable HR (95% CI)	*P* value[b]	Multivariable HR (95% CI)	*P* value[b]
Age	1.036 (1.020-1.052)	<.001	1.02 (1.01-1.04)	.002
White (vs all other)	1.58 (1.064-2.34)	.023		
Latino (vs all other)	0.57 (0.31-1.03)	.064		
Black or African American (vs all other)	0.94 (0.60-1.47)	.796		
LTCF residence	7.35 (2.79-19.36)	<.001	3.23 (1.68-6.20)	<.001
Body mass index	0.96 (0.93-0.99)	.014	1.01 (0.98-1.04)	.39
Number of comorbidities	1.16 (1.02-1.31	.018		
Hypertension	1.84 (1.14-2.96)	.011	1.2 (0.75-2.09)	.37
Neurocognitive impairment	3.21 (2.10-4.89)	<.001	1.48 (0.90-2.43)	.115
Smoking				
Never smoker (reference)				
Former smoker	1.11 (0.73-1.69)	.596		
Current smoker	0.19 (0.06-0.63)	.006		
Altered mental status	4.22 (2.71-6.55)	<.001		
Systolic blood pressure (low)	1.02 (1.01-1.04)	<.001		
Respiratory rate	1.022 (1.004-1.04)	.015		
qSOFA score	2.90 (1.97-4.26)	.034	2.59 (1.78-3.76)	<.001
White blood cell count	1.041 (1.003-1.080)	.032		
Sodium	1.033 (1.018-1.049)	<.001		
Blood urea nitrogen	1.017 (1.01-1.025)	<.001		
Lactate dehydrogenase	1.21 (1.07-1.37)	.002	1.02 (0.90-1.16)	.67
Procalcitonin	1.01 (1.004-1.03)	.012		

[a]HR = hazard ratio; ICU = intensive care unit; LTCF = long-term care facility; qSOFA, = quick Sequential Organ Failure Assessment.
[b]*P*<.05 was considered statistically significant.

and LTCF residents. In addition, nonsurvivors overall had more underlying conditions, in particular higher rates of hypertension, neurocognitive impairment, and obesity. These risk factors are similar to previously described US cohorts.[10,11,13-16]

Respiratory failure, acute kidney injury, and sepsis were the most common complications observed. Nonsurvivors had statistically higher rates of complications or end-organ damage compared with survivors. Remarkably, our population of patients showed higher rates of some nonpulmonary complications compared with other cohorts. Initial Chinese studies reported acute kidney injury in 0.5% to 15% of the patients, whereas 38.2% of our patients presented with acute kidney injury.[6-9,22] Acute cardiac injury and septic shock were seen in 7.2% to 17% and in 1.1% to 20% of these patients.[6-9,22] In contrast, in our cohort, 24.3% of the patients developed acute cardiac injury, and 19.8% developed septic shock. The rates of respiratory failure were higher in our patients (68.4% vs 54% in China).[23] Still, the rate of acute respiratory distress syndrome was similar (3.4% to 31% in Chinese reports vs 15.7% in our population).[6-9] Compared with other US cohorts, the rates of acute kidney injury were higher (38.2% vs 22.2%),[14] whereas the rates of septic shock were lower (19.8% vs 27.5% to 32.6%).[11,15]

The case-fatality rate (32.3%) was also two to three times higher than for other US cohorts. Nevertheless, the overall rates of patients requiring critical care were similar (31.3%) to those observed in hospitalized patients from New York City (12.2% to 33.1%), California (8.7% to 30%), and Georgia (39%).[11,13-17]

We hypothesize that the differences in severity and rates of complications and in-hospital death observed in our patients compared with other US and overseas cohorts are related to a worse baseline clinical status. More than 20 long-term care facilities surround our community hospital, vastly dominating the population of patients we

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serve, and the residents generally have a higher disease burden. Up to 95% (298/313) of the patients admitted with COVID-19 had at least one underlying condition, 266 (85%) had two or more comorbidities, and the median number among the entire cohort was 3 medical conditions. Even though there was no specific COVID-19 admission policy, given the surge of cases and the limited resources, mostly only patients requiring respiratory support were admitted. In addition, many patients with advance directives or goals of care were soon established on admission, with 46% (144/313) of the patients having do not resuscitate orders at the cutoff date of data abstraction and LTFC residents being more likely to have this order (58.8% vs 25.2%; $P<.001$).

Bivariable Cox regression showed an increased risk of inpatient death associated with older age, white ethnicity, LTCF residence, higher number of comorbidities, hypertension, and neurocognitive impairment. Initial abnormal vital signs and laboratory values, including altered mental status, hypotension, tachypnea, qSOFA scores, white blood cell count, and levels of sodium, blood urea nitrogen, lactic acid, procalcitonin, lactate dehydrogenase, D-dimer, creatine kinase, and high-sensitivity troponin, were also associated with increased risk of death. Other studies have found similar risk factors.[22-27]

In the multivariable Cox regression, we identified LTCF residence and elevated qSOFA scores as strong independent predictors for death. LTCF residents had a probability of 76.3% of dying sooner than patients admitted from home (when Probability = HR / [1+ HR])[28]; in the same manner, patients with high qSOFA scores had a probability of 72.1% of sooner death compared with those with lower scores. We noted an inverse association between current smoker status and risk of death; nevertheless, most of the hospitalized patients in this cohort already presented with severe disease; hence, smoking as a risk factor for worse clinical outcomes cannot be disregarded. In the same way, other apparent risk factors associated with death observed in previous studies, such as obesity, diabetes, chronic obstructive pulmonary disease, and cardiovascular disease, that were not found in this cohort should not be overlooked. The fact that the baseline functional status of our local population seems to be worse compared with other communities also has to be taken into account.

This study has several limitations. First, because of the retrospective study design, not all laboratory tests were done in all patients. Some markers previously described, such as interleukin 6, were excluded from the analysis, given high rates of missing values. Second, this study was conducted at a single-center hospital, probably introducing selection bias and limiting the extrapolation of the findings. Third, a large proportion of patients were admitted with severe disease, limiting the capacity of our models to assess the relationship between independent variables and death compared with patients with mild disease. The possibility of extrapolating our results with populations with better baseline functional status is limited. Fourth, readmissions were not considered for analysis; therefore, discharged patients, along with active patients, were right censored at the cutoff date for data abstraction, which may have introduced bias in the survival analysis.

CONCLUSION

In this single-center retrospective cohort study of 313 adult patients hospitalized with COVID-19 in a community hospital in Cook County, Illinois, older patients, LTCF residents, and high qSOFA scores were found to have worse clinical outcomes and increased risk of death.

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SUPPLEMENTAL ONLINE MATERIAL

Supplemental material can be found online at http://mcpiqojournal.org. Supplemental material attached to journal articles has not been edited, and the authors take responsibility for the accuracy of all data.

Abbreviations and Acronyms: **COVID-19** = coronavirus disease 2019; **HR** = hazard ratio; **IQR** = interquartile range; **LTCF** = long-term care facility; **PH** = proportional hazards; **qSOFA** = quick Sequential Organ Failure Assessment

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