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Should COVID-19 Patients > 75 Years be Ventilated? An Outcome Study

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ABSTRACT

Background: Elderly patients with COVID-19 disease are at increased risk for adverse outcomes. Current data regarding disease characteristics and outcomes in this population is limited.

Aim: To delineate the adverse factors associated with outcomes of COVID-19 patients ≥ 75 years of age.

Design: Retrospective cohort study.

Methods: Patients were classified into mild/moderate, severe/very severe, and critical disease (intubated) based on oxygen requirements. The primary outcome was in-hospital mortality.

Results: 355 patients aged ≥ 75 years hospitalized with COVID-19 between March 19th and April 25th, 2020 were included. Mean age was 84.3 years. One-third of the patients developed critical disease. Mean length of stay was 7.10 days. Vasopressors were required in 27%, with the highest frequency in the critical disease group (74.1%). Overall mortality was 57.2%, with a significant difference between severity groups (mild/moderate disease:17.4%, severe/very severe disease:71.3%, critical disease: 94.9%, $p < 0.001$). Increased age, dementia, and severe/very severe and critical disease groups were each significantly associated with increased odds for mortality while diarrhea was associated with decreased odds for mortality (OR:0.12, 95% CI:0.02-0.60, $p < 0.05$). None of the cardiovascular comorbidities were significantly associated with mortality.

Conclusion: Age and dementia are associated with increased odds for mortality in patients ≥ 75 years of age hospitalized with COVID-19. Those who require intubation have the greatest odds for mortality. Diarrhea as a presenting symptom was associated with lower odds for mortality.

INTRODUCTION

As of early January 2021, the coronavirus (SARS-CoV-2) pandemic remains a public health crisis, affecting more than 84 million people globally and 20 million in the United States (US) alone. ¹ Presentations range from an asymptomatic course to severe inflammatory reaction resulting in acute respiratory distress syndrome (ARDS) and multi-organ dysfunction. ²

Older age, obesity, and other comorbid conditions are associated with higher rates of COVID-19 mortality. ^{3,4} The Centers for Disease Control and Prevention (CDC) reports that although individuals older than age 65 comprise 17% of the total US population, they account for 31% of COVID-19 infections, 45% of hospitalizations, 53% of intensive care unit (ICU) admissions, and 80% of deaths. ⁵ Similarly, a report from the Chinese Center for Disease Control and Prevention evaluating more than 72,000 cases of COVID-19 reported an overall case fatality rate (CFR) of 2.3%. In contrast, the CFR was 8% in 70–79-year-olds and 14.8% in those ≥ 80 years old. ⁶ A Chinese study of 201 patients found that older age is associated with a greater risk of developing ARDS and of death. ⁷

Elderly patients may have one or more pre-existing medical conditions, which places them at increased risk for developing severe forms of COVID-19 and even of dying from the disease. Physiological changes that accompany aging, including altered immune response and multiple age-related comorbidities (e.g., dementia), are associated with poorer outcomes in older patients. ⁸

Very few studies have focused on the characteristics and outcomes of COVID-19 infection in the elderly in the US; hence, data in this regard are limited. This retrospective single-center study aims

to delineate the characteristics, risk factors, and outcomes among patients aged ≥ 75 years hospitalized with COVID-19.

METHODS

Study Setting

A single-center, retrospective, observational analysis was performed at Maimonides Medical Center, a 711-bed tertiary care teaching hospital in New York City. The Maimonides Medical Center Institutional Review Board approved the study, qualified it as minimal risk research, and waived the need for informed consent.

Patient Selection

We analyzed the clinical and demographic characteristics and outcomes of patients aged ≥ 75 years admitted to Maimonides Medical Center with COVID-19 between March 19th and April 25th, 2020. The method for diagnosis of SARS-CoV-2 infection was real-time reverse transcription-polymerase chain reaction (RT-PCR) testing of a nasopharyngeal sample. All patients included in this study presented to our emergency department (ED) with either symptoms suggestive of COVID-19 infection or had a history of exposure to a person with known COVID-19 infection. Those who presented with symptoms and had a positive result as outpatient, were re-tested in our emergency department to confirm COVID-19 infection. Patients who died within one day of being admitted or during their ED stay prior to being admitted were excluded. Patients seen in the ED or outpatient clinics that did not require hospitalization were also excluded.

Definition of Disease Severity

Disease severity was determined by the amount of oxygen supplementation required throughout the patient's hospital course. Mild disease severity was defined as an oxygen saturation level $>95\%$ on room air. Moderate disease severity was defined as requiring oxygen supplementation via nasal cannula at rates of up to 5 L/min to maintain an oxygen saturation level of $\geq 95\%$. Severe disease was defined as any patient with SARS-CoV-2 infection requiring oxygen supplementation via face mask at rates up to 10 L/min to maintain an oxygen saturation level of $\geq 95\%$. The disease was considered very severe when requiring oxygen supplementation via non-rebreather mask or high-flow nasal cannula (HFNC) to maintain an oxygen saturation level of $\geq 95\%$. The disease was deemed critical when intubation and mechanical ventilation were required.

Data Collection

Data collected included patient demographics, presenting symptoms, comorbidities, home medications, initial vital signs upon admission, pertinent laboratory results, treatment received for COVID-19, complications, and outcomes, including mortality and length of hospital stay (LOS).

Outcomes

The primary outcome was in-hospital mortality, described as death in hospital following the diagnosis of COVID-19. The secondary outcome was LOS.

Statistical Analysis

Descriptive statistics of mean and standard deviation were used to describe continuous variables, whereas frequencies and percentages were used to describe categorical variables. Skewed variables were log-transformed. Troponin had values of 0; therefore, 0.01 was added to all values,

which were then log-transformed. Analysis of variance compared continuous variables and Pearson's chi-square test compared categorical variables, except when the expected cell size was <5, in which case the Fisher's exact test was performed. Univariate logistic regression was conducted for the outcome variable of mortality. Any variable that was statistically significant in the univariate analysis for mortality was included in the multivariate analysis. Univariate linear regression was conducted for the outcome variable of LOS. Any variable that was statistically significant in the univariate analysis for LOS was included in the multivariate analysis. All *p*-values were two-tailed. The alpha level for significance was set at $p < 0.05$. IBM SPSS Statistics v. 26 (IBM, Armonk, NY) and Stata SE v. 15 (Stata, College Station, TX) were used for statistical analyses.

RESULTS

Baseline Characteristics

There were 355 patients included in the study. The mean age was 84.3 years, and almost half were female. Two-thirds were Caucasian and 7.6% were Hispanic. Hypertension (78.6%), diabetes mellitus (33.8%), heart failure (26.2%), and coronary artery disease (26.2%) were the most common comorbidities. There were 15.8% that were obese. Shortness of breath (58.9%), fever (49.9%), and cough (41.1%) were the most common presenting symptoms. Table 1 shows the baseline characteristics.

Management

Table 2 shows management and outcome variables. There were 33% that were intubated and 27% required vasopressors, with the highest frequency for vasopressors in the critical disease severity

group (74%). There were 10.1% that received hemodialysis and 9.9% received blood transfusions. More than two-thirds received hydroxychloroquine (69.9%) and/or azithromycin (72.7%). Prophylactic antibiotics were administered to 76.1%.

Complications

There were 10.1% diagnosed with bacteremia/fungemia, while <1% had either a cerebrovascular accident or deep venous thrombosis. No statistical difference was found in the occurrence of deep vein thrombosis/pulmonary embolism or cerebrovascular accident based on disease severity. Bacteremia/fungemia were seen more often in patients with critical disease severity (19.8%).

Mortality and LOS

The overall mortality rate was 57.2%, with a significant difference between severity groups. Patients with mild/moderate disease had mortality of 17.4%, those with severe/very severe disease had mortality of 71.3%, and those with critical disease had the highest mortality of 94.9% ($p<0.001$). The mean LOS was 7.10 days. This varied from 4.77 days in patients with mild/moderate disease, 5.92 days for those with severe/very severe disease, to 9.1 days for those with critical disease ($p<0.001$).

Dementia and Disease Outcomes

Table 3 shows comparisons between patients with and without dementia. Those with dementia were older, had less diabetes, more severe/very severe disease, and less critical disease (i.e., intubated). Those with dementia had a greater percentage for mortality than those without dementia ($p=0.003$). There was no difference for LOS between those with and without dementia.

Both severe/very severe disease ($p < 0.001$) and critical disease ($p < 0.001$) were each significantly associated with increased odds for mortality. Critical disease was significantly associated with increased LOS.

Predictors of LOS

Table 4 shows linear regression analyses for LOS. In the multivariate analysis, female gender, cough, severe/very severe disease, hemodialysis, blood transfusion, steroid use, prophylactic anticoagulation, therapeutic anticoagulation, vitamin C, tocilizumab, and antibiotics for suspected bacterial infection were each significantly associated with increased LOS. None of the comorbidities, vital signs, laboratory values, and complication variables were significantly associated with LOS.

Predictors of Mortality

Table 5 shows logistic regression analyses for mortality. In the multivariate analysis, increased age, dementia, severe/very severe and critical disease were each significantly associated with increased odds for mortality. Conversely, diarrhea was significantly associated with decreased odds for mortality. None of the vital signs, laboratory values, treatment management, and complication variables were significantly associated with mortality.

DISCUSSION

The current COVID-19 pandemic has affected the older population most severely. To our knowledge, this study represents the largest US analysis focusing on elderly patients hospitalized with COVID-19. Our findings indicate that even in very elderly patients that older age is associated

with increased mortality. This corroborates previous studies that suggest that advancing age is a risk factor for increased mortality in COVID-19 infection.⁹⁻¹²

The overall mortality in our cohort was 57.2%. However, this percentage significantly varied among disease severity levels where mild to moderate disease had mortality of 17.4% while critical disease had mortality of 94.9%. Other studies report COVID-19 mortality rates for older patients ranging from 20% to 97%.^{9, 11, 13} This broad variation in mortality rates depends significantly on admission criteria, disease severity and age cutoffs of the patients included in the individual studies. As our study included only inpatients, we anticipated higher mortality rates than other studies that included outpatients or patients who were seen in the emergency department and discharged. Intubated patients (critical disease group) in our study had the highest mortality rate. The mortality rate was similar to the 97% mortality rate found in the subgroup of older COVID-19 patients who required intubation in another study.¹³ This was likely due to a more severe disease process in these patients leading to severe respiratory distress rather than intubation itself and its complications. Hence, the decision to intubate in this elderly population should be individualized based on the overall clinical picture as would be done in non-COVID patients.

Cardiovascular comorbidities are associated with worse outcomes in COVID-19 patients.^{9, 14-18} As expected in a study focused on older patients, a higher percentage of hypertension, atrial fibrillation, coronary artery disease, heart failure, and cerebrovascular disease were found in our study as compared to reports that included younger patients.^{13, 19} However, we did not find any association for any of these comorbidities with mortality.

COVID-19 patients with dementia had a higher mortality rate than those patients without dementia. This contrasts with a study on elderly patients hospitalized with COVID-19 that included 44% of patients with dementia. Although there was a numerically higher mortality in patients with dementia (27% vs 20%), this was not statistically significant.²⁰ In a report from Italy of 627 COVID-19 patients admitted to a geriatric service, patients with dementia had a mortality rate of 62% as compared to 26% in those without the disease.²¹ However, there was a difference in age between the groups of 13.7 years which was statistically significant and could have accounted for the difference in mortality. Interestingly, even though our study showed dementia to be associated with higher mortality, less patients with dementia were in the critical disease severity group. This could possibly be explained by a higher proportion of demented patients undergoing palliative care and refusing aggressive interventions that would include intubation.

In our cohort, obesity was not associated with mortality. In contrast, a recent study in general population found that obesity was associated with higher mortality.¹⁰ It is possible that effect of obesity differs by age group where the elderly that are obese are not associated with mortality.

Studies report the incidence rate of diarrhea in COVID-19 patients to range from 2–50%.²²⁻²⁴ We found diarrhea as a presenting symptom in 6.8% of patients, and its presence was associated with decreased mortality. In a previous study by our group, diarrhea was associated with lower mortality in COVID-19 patients with high oxygen requirements.²⁵ In contrast, another report found COVID-19 patients with diarrhea, nausea, and vomiting to be more likely to develop ARDS requiring mechanical ventilation as compared to patients without gastrointestinal symptoms.²⁶

Our study has some limitations. First, we did not collect data on certain atypical symptoms, such as delirium and altered mental status, which may be particularly relevant in the older population. Second, we have no follow-up data on discharged patients to determine post-discharge mortality and readmission rates. However, our focus was to characterize hospitalized patients and determine their outcomes. Third, we did not include information regarding goals of care, which is of paramount importance in the very elderly, especially with a disease process as lethal as COVID-19. Although our study is one of the largest analyses to date focusing on the very elderly, further research is needed in this population to address these topics.

CONCLUSION

Age and dementia are important risk factors for mortality in patients ≥ 75 years of age hospitalized with COVID-19. Patients who require intubation have the greatest odds for dying. Patients who reported diarrhea as a presenting symptom had lower mortality than those who did not. Furthermore, although cardiovascular comorbidities are more frequent in the older population, these comorbidities were not associated with mortality in our study.

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Table 1: Baseline characteristics

| Variable | M (SD) or Frequency (%) Whole Sample (n=355) | M (SD) or Frequency (%) Mild/ moderate (n=144) | M (SD) or Frequency (%) Severe/ Very severe (n=94) | M (SD) or Frequency (%) Critical (n=117) | p-value |
|---------------------------------|--|--|--|--|----------------|
| <i>Demographics</i> | | | | | |
| Age (years) | 84.3 (6.51) | 84.2 (6.54) | 85.8 (6.69) | 83.2 (6.15) | 0.02 |
| Female gender | 164 (46.2) | 69 (47.9) | 46 (48.9) | 49 (41.9) | 0.51 |
| Race | | | | | 0.41 |
| White | 239 (67.3) | 99 (68.8) | 58 (61.7) | 82 (70.1) | |
| Black | 45 (12.7) | 21 (14.6) | 13 (13.8) | 11 (9.4) | |
| Asian | 41 (11.5) | 12 (8.3) | 16 (17.0) | 13 (11.1) | |
| Other | 30 (8.5) | 12 (8.3) | 7 (7.4) | 11 (9.4) | |
| Ethnicity | | | | | 0.35 |
| Non-Hispanic | 323 (91.0) | 131 (91.0) | 88 (93.6) | 104 (88.9) | |
| Hispanic | 27 (7.6) | 12 (8.3) | 6 (6.4) | 9 (7.7) | |
| Unknown | 5 (1.4) | 1 (0.7) | 0 (0.0) | 4 (3.4) | |
| <i>Comorbidities</i> | | | | | |
| Obesity | 56 (15.8) | 16 (14.2) | 12 (14.6) | 28 (26.4) | 0.04 |
| Smoking | | | | | 0.52 |
| Never | 94 (26.5) | 38 (26.4) | 20 (21.3) | 36 (31.0) | |
| Active | 6 (1.7) | 4 (2.8) | 0 (0.0) | 2 (1.7) | |
| Former | 30 (8.5) | 12 (8.3) | 8 (8.5) | 10 (8.6) | |
| Unknown | 225 (63.4) | 90 (62.5) | 66 (70.2) | 69 (59.0) | |
| Hypertension | 279 (78.6) | 108 (75.5) | 74 (78.7) | 97 (82.9) | 0.35 |
| Diabetes mellitus | 120 (33.8) | 49 (34.3) | 30 (31.9) | 41 (35.0) | 0.89 |
| Cerebrovascular accident | 37 (10.4) | 9 (6.3) | 13 (13.8) | 15 (12.8) | 0.11 |
| Atrial fibrillation | 78 (22.0) | 25 (17.5) | 23 (24.5) | 30 (25.6) | 0.23 |

| | | | | | |
|--|---------------|---------------|---------------|---------------|--------|
| Heart failure | 93 (26.2) | 35 (26.1) | 25 (28.1) | 33 (30.6) | 0.75 |
| Chronic obstructive pulmonary disease | 34 (9.6) | 14 (9.8) | 11 (11.7) | 9 (7.7) | 0.61 |
| Asthma | 14 (3.9) | 4 (2.8) | 5 (5.3) | 5 (4.3) | 0.62 |
| Deep vein thrombosis/pulmonary embolism | 17 (4.8) | 7 (4.9) | 4 (4.3) | 6 (5.1) | 0.77 |
| Chronic kidney disease | 25 (7.0) | 9 (6.3) | 6 (6.4) | 10 (8.5) | 0.75 |
| Coronary artery disease | 93 (26.2) | 41 (28.7) | 21 (22.3) | 31 (26.5) | 0.56 |
| Cancer | | | | | 0.01 |
| No | 316 (89.0) | 123 (86.0) | 84 (89.4) | 109 (93.2) | |
| Active treatment | 17 (4.8) | 11 (7.7) | 6 (6.4) | 0 (0.0) | |
| Past 5 years | 21 (5.9) | 9 (6.3) | 4 (4.3) | 8 (6.8) | |
| Dementia | 88 (24.8) | 27 (18.9) | 39 (41.5) | 22 (18.8) | <0.001 |
| <i>Presenting symptoms</i> | | | | | |
| Fever | 177 (49.9) | 64 (45.1) | 52 (55.3) | 61 (52.1) | 0.27 |
| Cough | 146 (41.1) | 57 (40.1) | 34 (36.2) | 55 (47.4) | 0.24 |
| Anosmia | 1 (0.3) | 0 (0.0) | 0 (0.0) | 1 (0.9) | 0.60 |
| Ageusia | 3 (0.8) | 1 (0.7) | 2 (2.1) | 0 (0.0) | 0.27 |
| Myalgia | 34 (9.6) | 15 (10.6) | 4 (4.3) | 15 (12.8) | 0.10 |
| Nausea | 16 (4.5) | 9 (6.3) | 4 (4.3) | 3 (2.6) | 0.34 |
| Vomiting | 14 (3.9) | 9 (6.4) | 4 (4.3) | 1 (0.9) | 0.06 |
| Diarrhea | 24 (6.8) | 10 (7.0) | 9 (9.6) | 5 (4.3) | 0.31 |
| Shortness of breath | 209 (58.9) | 59 (41.5) | 65 (69.1) | 85 (72.6) | <0.001 |
| Chest pain | 18 (5.1) | 8 (5.6) | 6 (6.4) | 4 (3.4) | 0.56 |
| <i>Vital signs</i> | | | | | |
| Systolic blood pressure [mmHg] | 129.6 (24.68) | 129.9 (22.53) | 129.0 (24.62) | 129.6 (27.30) | 0.96 |
| Diastolic blood pressure [mmHg] | 73.7 (19.07) | 74.0 (16.82) | 74.0 (19.90) | 73.0 (21.00) | 0.90 |
| Heart rate [per minute] | 93.8 (21.68) | 91.1 (20.39) | 95.4 (19.86) | 95.9 (24.27) | 0.15 |
| Oxygen saturation | 91.7 (8.08) | 94.3 (5.47) | 89.6 (9.52) | 90.3 (8.67) | <0.001 |

| | | | | | |
|--------------------------------------|-------------|-------------|-------------|-------------|--------|
| Respiratory rate [per minute] | 24.7 (7.19) | 21.4 (4.00) | 26.3 (7.82) | 27.3 (8.14) | <0.001 |
|--------------------------------------|-------------|-------------|-------------|-------------|--------|

Note: M=mean, SD=standard deviation. Sample size for continuous variables less than 355 are: Systolic blood pressure (n=353), Diastolic blood pressure (n=353), Heart rate (n=352), Oxygen saturation (n=351), and Respiratory rate (n=353). Sample size for categorical variables missing are: Obesity (n=54), Hypertension (n=1), Diabetes mellitus (n=1), Cerebrovascular accident (n=1), Atrial fibrillation (n=1), Heart failure (n=24), Chronic obstructive pulmonary disease (n=1), Chronic kidney disease (n=2), Asthma (n=1), Deep vein thrombosis/pulmonary embolism (n=2), Coronary artery disease (n=1), Cancer (n=1), Dementia (n=1), Fever (n=2), Cough (n=3), Anosmia (n=3), Ageusia (n=2), Myalgia (n=3), Nausea (n=2), Vomiting (n=3), Diarrhea (n=2), Shortness of breath (n=2), and Chest pain (n=2).

Table 2: Management and Outcomes

| Variable | M (SD) or Frequency (%) Whole Sample (n=355) | M (SD) or Frequency (%) Mild/moderate (n=144) | M (SD) or Frequency (%) Severe/Very severe (n=94) | M (SD) or Frequency (%) Critical (n=117) | p-value |
|--------------------------------------|---|--|--|---|----------------|
| <i>Laboratory values</i> | | | | | |
| White blood cell K/UL | 9.4 (5.81) | 8.6 (5.24) | 10.0 (9.67) | 9.7 (5.39) | 0.01 |
| Lymphocyte count K/UL | 12.5 (9.96) | 13.8 (10.82) | 11.5 (9.84) | 11.9 (8.84) | 0.17 |
| Platelets K/UL | 208.5 (95.49) | 216.7 (97.85) | 214.4 (101.93) | 194.2 (86.28) | 0.10 |
| Hemoglobin g/dL | 12.3 (2.21) | 12.1 (2.21) | 12.1 (2.30) | 12.5 (2.12) | 0.23 |
| Serum sodium mmol/L | 139.3 (8.87) | 137.7 (7.49) | 142.6 (10.00) | 138.7 (8.80) | <0.001 |
| Creatinine mg/dL | 1.83 (1.78) | 1.6 (1.38) | 1.9 (1.70) | 2.1 (2.18) | 0.02 |
| C-reactive protein mg/dL (highest) | 18.5 (10.88) | 13.2 (8.71) | 20.7 (10.87) | 22.4 (10.81) | <0.001 |
| Ferritin ng/mL (highest) | 1,107.9 (1,369.00) | 863.3 (1,026.64) | 944.5 (1,126.15) | 1,478.8 (1,724.85) | 0.01 |
| D-dimer ng/mL (highest) | 5,810.0 (10,920.07) | 3,257.2 (7,377.53) | 7,812.1 (14,399.90) | 6,933.7 (10,855.24) | 0.02 |
| Lactate dehydrogenase IU/L (highest) | 561.8 (546.16) | 403.9 (166.42) | 501.6 (240.44) | 762.9 (825.58) | <0.001 |
| Glomerular filtration rate | 44.2 (17.78) | 47.6 (16.44) | 41.5 (17.94) | 42.3 (18.63) | 0.02 |
| Troponin ng/mL (highest) | 1.0 (5.82) | 0.3 (1.62) | 1.0 (6.35) | 1.6 (7.99) | <0.001 |
| Procalcitonin ng/mL (highest) [mean] | 3.2 (6.90) | 2.7 (7.61) | 2.0 (2.50) | 4.7 (8.10) | 0.002 |
| Alanine transaminase IU/L [mean] | 38.6 (63.12) | 30.4 (35.16) | 36.9 (53.06) | 49.9 (89.91) | 0.15 |
| Aspartate transaminase IU/L | 69.5 (111.85) | 52.6 (54.04) | 66.1 (69.88) | 92.3 (171.89) | 0.001 |
| <i>Intubation</i> | 117 (33.0) | 0 (0.0) | 0 (0.0) | 117 (100.0) | --- |
| <i>Treatment management</i> | | | | | |
| Vasopressor | 96 (27.0) | 4 (2.9) | 6 (6.4) | 86 (74.1) | <0.001 |
| Hemodialysis | 36 (10.1) | 6 (4.3) | 5 (5.4) | 25 (21.4) | <0.001 |
| ECMO support | 1 (0.3) | 0 (0.0) | 0 (0.0) | 1 (0.9) | 0.61 |
| Blood transfusion | 35 (9.9) | 7 (5.1) | 4 (4.3) | 24 (20.5) | <0.001 |
| Hydroxychloroquine | 248 (69.9) | 76 (54.3) | 68 (72.3) | 104 (88.9) | <0.001 |
| Azithromycin | 258 (72.7) | 82 (59.0) | 73 (77.7) | 103 (88.0) | <0.001 |
| Ritonavir/lopinavir | 1 (0.3) | 0 (0.0) | 0 (0.0) | 1 (0.9) | 0.60 |
| Steroids | 60 (16.9) | 8 (5.8) | 10 (10.6) | 42 (36.2) | <0.001 |

| | | | | | |
|---|------------|------------|------------|-------------|--------|
| Prophylactic anticoagulation | 232 (65.4) | 84 (60.4) | 64 (68.8) | 84 (73.0) | 0.09 |
| Therapeutic anticoagulation | 90 (25.4) | 28 (20.1) | 25 (26.9) | 37 (31.6) | 0.11 |
| Convalescent plasma | 7 (2.0) | 1 (0.7) | 1 (1.1) | 5 (4.3) | 0.14 |
| Remdesivir | 7 (2.0) | 0 (0.0) | 0 (0.0) | 7 (6.0) | <0.001 |
| Vitamin C | 350 (98.6) | 42 (30.2) | 36 (38.3) | 53 (45.3) | 0.045 |
| Zinc | 105 (29.6) | 37 (26.6) | 25 (26.6) | 43 (36.8) | 0.15 |
| Tocilizumab | 11 (3.1) | 0 (0.0) | 2 (2.1) | 9 (7.7) | 0.001 |
| Antibiotics for suspected bacterial infection | 270 (76.1) | 82 (59.0) | 78 (83.0) | 110 (94.0) | <0.001 |
| Complications | | | | | |
| Deep vein thrombosis/pulmonary embolism | 2 (0.6) | 1 (0.8) | 1 (0.5) | 0 (0.7) | 0.73 |
| Cerebrovascular accident | 3 (0.8) | 1 (1.2) | 1 (0.8) | 1 (1.0) | 1.00 |
| Bacteremia/fungemia | 36 (10.1) | 5 (3.6) | 8 (8.6) | 23 (19.8) | <0.001 |
| Outcomes | | | | | |
| Mortality | 203 (57.2) | 25 (17.4) | 67 (71.3) | 111 (94.9) | <0.001 |
| Length of stay (days) | 7.8 (7.10) | 5.6 (4.77) | 7.7 (5.92) | 10.6 (9.14) | <0.001 |

Note: M=mean, SD=standard deviation. Sample size for continuous variables less than 355 are: White blood cell (n=351), Lymphocyte (n=317), Platelet (n=345), Hemoglobin (n=347), Serum sodium (n=350) Creatinine (n=347), Ferritin (n=287), D-dimer (n=156), Lactate dehydrogenase (n=298), Glomerular filtration rate-admission (n=346), Troponin (n=325), Procalcitonin (n=270), Alanine transaminase-admission (n=313), and Aspartate transaminase-admission (n=313). Sample size for categorical variables missing are: Vasopressor (n=6), Hemodialysis (n=6), Ecmo support (n=6), Blood transfusion (n=6), Hydroxychloroquine (n=4), Azithromycin (n=5), Ritonavir/lopinavir (n=6), Steroids (n=6), Prophylactic anticoagulation (n=8), Therapeutic anticoagulation (n=6), Convalescent plasma (n=5), Remdesivir (n=5), Vitamin C (n=5), Zinc (n=5), Antibiotics for suspected bacterial infection (n=5), Diagnosis of deep vein thrombosis/pulmonary embolism (n=2), Diagnosis of cerebrovascular accident (n=7), and Diagnosis of bacteremia/fungemia (n=9). Comparison between groups reports percentages only for cases analyzed and does not include missing cases. Prophylactic anticoagulation included Lovenox 40 mg (n=34, 9.6%) Lovenox 60 mg (n=73, 20.6%), Heparin (n=71, 20.0%), and Low dose apixaban (n=54, 15.2%). Therapeutic anticoagulation included Lovenox (n=46, 13.0%), Heparin drip (n=6, 1.7%), DOAC (n=35, 9.9%), and Coumadin (n=3, 0.8%). Laboratory values are on admission unless otherwise specified.

Table 3: Dementia analysis

| Variable | No Dementia M (SD) or Frequency (%) (n=266) | Yes Dementia M (SD) or Frequency (%) (n=88) | p-value | Dementia Mortality Multivariate OR (95% CI) (n=88) | Dementia LOS Multivariate B (SE) (n=88) |
|---|--|--|----------------|---|--|
| <i>Demographics</i> | | | | | |
| Age (years) | 83.1 (6.26) | 87.9 (5.96) | <0.001 | 1.03 (0.94, 1.13) | <0.001 (0.01) |
| Female gender | 117 (44.0) | 47 (53.4) | 0.12 | --- | --- |
| <i>Comorbidities</i> | | | | | |
| Obesity | 45 (20.1) | 11 (14.3) | 0.26 | --- | --- |
| Hypertension | 211 (79.3) | 68 (77.3) | 0.68 | --- | --- |
| Diabetes mellitus | 100 (37.6) | 20 (22.7) | 0.01 | 2.68 (0.68, 10.58) | -0.04 (0.09) |
| Heart failure | 72 (28.9) | 21 (25.6) | 0.56 | --- | --- |
| <i>Disease severity</i> | | | | | |
| Care-group | | | <0.001 | | |
| Mild/moderate | 116 (43.6) | 27 (30.7) | | 1.00 | Reference |
| Severe/very severe | 55 (20.7) | 39 (44.3) | | 9.81 (2.93, 32.80)*** | 0.05 (0.09) |
| Critical | 95 (35.7) | 22 (25.0) | | 53.71 (5.87, 491.38)*** | 0.24 (0.10)* |
| <i>Complications</i> | | | | | |
| Deep vein thrombosis/ pulmonary embolism | 1 (0.4) | 1 (1.2) | 0.44 | --- | --- |
| Cerebrovascular accident | 1 (0.4) | 2 (2.3) | 0.16 | --- | --- |
| Bacteremia/ fungemia | 25 (9.6) | 11 (12.8) | 0.40 | --- | --- |
| <i>Outcomes</i> | | | | | |
| Mortality | 140 (52.6) | 62 (70.5) | 0.003 | | |
| LOS (days) | 7.9 (7.49) | 7.6 (5.83) | 0.58 | | |

Note: LOS=length of stay, M=mean, SD=standard deviation, OR=odds ratio, CI=confidence interval, B=unstandardized beta, SE=standard error. *p<0.05, **p<0.01, ***p<0.001

Table 4: Linear Regression for Hospital Length of Stay

| Variable | Univariate B (SE) | Multivariate B (SE) | Multivariate No Mortality B (SE) | Multivariate Yes Mortality B (SE) |
|---|------------------------------|--------------------------------|---|--|
| <i>Demographics</i> | | | | |
| Age (years) | -0.01 (0.003)* | -0.002 (0.003) | --- | --- |
| Female gender | 0.08 (0.04)# | 0.08 (0.04)* | 0.16 (0.06)** | 0.03 (0.05) |
| <i>Presenting Symptoms</i> | | | | |
| Cough | 0.09 (0.04)* | 0.08 (0.04)* | 0.02 (0.06) | 0.08 (0.05) |
| Shortness of breath | 0.12 (0.04)** | -0.06 (0.04) | --- | --- |
| <i>Laboratory values</i> | | | | |
| C-reactive protein mg/dL | 0.01 (0.002)** | --- | --- | --- |
| Ferritin ng/mL (highest) | 0.12 (0.05)* | --- | --- | --- |
| <i>Disease severity</i> | | | | |
| Mild/moderate | Reference | Reference | Reference | Reference |
| Severe/very severe | 0.17 (0.05)** | 0.11 (0.05)* | 0.27 (0.07)*** | 0.05 (0.08) |
| Critical | 0.27 (0.05)*** | 0.10 (0.06) | 0.13 (0.19) | 0.07 (0.08) |
| <i>Treatment management</i> | | | | |
| Vasopressor | 0.22 (0.05)** | -0.12 (0.06) | --- | --- |
| Hemodialysis | 0.27 (0.07)*** | 0.15 (0.07)* | 0.02 (0.16) | 0.14 (0.07)* |
| Blood transfusion | 0.41 (0.07)*** | 0.24 (0.07)*** | 0.33 (0.13)* | 0.26 (0.07)*** |
| Hydroxychloroquine | 0.22 (0.05)*** | 0.08 (0.06) | --- | --- |
| Azithromycin | 0.19 (0.05)*** | | --- | --- |
| Steroids | 0.33 (0.05)*** | 0.18 (0.05)** | 0.13 (0.12) | 0.17 (0.06)** |
| Prophylactic anticoagulation | 0.14 (0.04)** | 0.18 (0.05)*** | 0.26 (0.07)*** | 0.18 (0.06)** |
| Therapeutic anticoagulation | 0.17 (0.05)*** | 0.23 (0.05)*** | 0.33 (0.09)*** | 0.18 (0.06)** |
| Convalescent plasma | 0.33 (0.15)* | -0.18 (0.14) | --- | --- |
| Remdesivir | 0.47 (0.15)** | 0.12 (0.13) | --- | --- |
| Vitamin C | 0.28 (0.04)*** | 0.12 (0.05)* | 0.16 (0.06)* | 0.15 (0.05)** |
| Zinc | 0.27 (0.04)*** | 0.09 (0.05) | --- | --- |
| Tocilizumab | 0.43 (0.12)*** | 0.25 (0.11)* | 0.41 (0.34) | 0.19 (0.11) |
| Antibiotics for suspected bacterial infection | 0.31 (0.05)*** | 0.12 (0.05)* | 0.13 (0.06)* | 0.08 (0.07) |
| <i>Complications</i> | | | | |
| Bacteremia/fungemia | 0.30 (0.07)*** | 0.10 (0.06) | --- | --- |

Note: B=unstandardized beta, SE=standard error. Multivariate whole sample analysis included 334 patients due to missing data. Multivariate no mortality subsample included 145 patients.

Multivariate mortality subsample included 196 patients. C-reactive protein and Ferritin were not included in the multivariate analysis due to missing data. For brevity purposes, many variables not statistically significant in the univariate analyses are not shown in the table.

Multivariate whole sample adjusted R Square=0.38. Multivariate no mortality subsample adjusted R Square=0.40. Multivariate mortality subsample adjusted R Square=0.33.

#p=0.05, *p<0.05, **p<0.01, ***p<0.001.

Laboratory values are on admission unless otherwise specified

Table 5: Logistic Regression for Mortality Among Elderly COVID-19 Patients

| Variable | Univariate OR (95% CI) | Multivariate OR (95% CI) |
|---|-----------------------------------|-------------------------------------|
| <i>Demographics</i> | | |
| Age (years) | 1.05 (1.02, 1.09)** | 1.10 (1.02, 1.18)* |
| <i>Comorbidities</i> | | |
| Hypertension | 1.83 (1.09, 3.05)* | 1.83 (0.74, 4.56) |
| Cerebrovascular accident | 2.56 (1.17, 5.59)* | 1.13 (0.31, 4.15) |
| Heart failure | 1.75 (1.06, 2.88)* | 2.36 (0.97, 5.74) |
| Dementia | 2.15 (1.28, 3.60)** | 3.02 (1.19, 7.63)* |
| <i>Presenting symptoms</i> | | |
| Diarrhea | 0.28 (0.11, 0.70)** | 0.12 (0.02, 0.60)* |
| Shortness of breath | 3.12 (2.01, 4.86)*** | 1.77 (0.76, 4.12) |
| <i>Vital signs</i> | | |
| Oxygen saturation | 0.94 (0.91, 0.97)*** | 0.97 (0.92, 1.01) |
| Respiratory rate [per minute] | 772.43 (73.79, 8,085.45)*** | 1.02 (0.96, 1.09) |
| <i>Laboratory values</i> | | |
| White blood cell K/UL | 3.30 (1.29, 8.44)* | 3.44 (0.64, 18.54) |
| Serum sodium mmol/L | 1.03 (1.002, 1.05)* | 0.96 (0.91, 1.01) |
| C-reactive protein mg/dL (highest) | 1.08 (1.05, 1.11)*** | --- |
| Ferritin ng/mL (highest) | 1.75 (1.04, 2.93)* | --- |
| D-dimer ng/mL (highest) | 2.36 (1.37, 4.08)** | --- |
| Lactate dehydrogenase IU/L (highest) | 36.60 (9.79, 136.92)*** | --- |
| Glomerular filtration rate (admission) | 0.98 (0.97, 0.996)* | 1.00 (0.97, 1.03) |
| Troponin ng/mL (highest) | 3.17 (2.00, 5.02)*** | 1.46 (0.63, 3.38) |
| Aspartate transaminase IU/L | 1.005 (1.001, 1.01)* | --- |
| <i>Disease severity</i> | | |
| Care-group | | |
| Mild/moderate | 1.00 | 1.00 |
| Severe/very severe | 11.81 (6.35, 21.98)*** | 11.00 (4.12, 29.36)*** |
| Critical | 88.06 (34.82, 222.70)*** | 54.25 (11.84, 248.44)*** |
| <i>Treatment management</i> | | |
| Vasopressor | 24.44 (9.60, 62.19)*** | 5.10 (0.82, 31.54) |
| Hemodialysis | 3.49 (1.48, 8.19)** | 5.78 (0.85, 39.16) |
| Blood transfusion | 2.32 (1.06, 5.12)* | 0.60 (0.11, 3.14) |
| Hydroxychloroquine | 4.26 (2.61, 6.95)*** | 1.85 (0.61, 5.60) |
| Azithromycin | 3.50 (2.12, 5.77)*** | 1.33 (0.42, 4.26) |
| Steroids | 4.07 (2.04, 8.15)*** | 0.62 (0.17, 2.30) |
| Prophylactic anticoagulation | 1.75 (1.12, 2.75)* | 1.58 (0.64, 3.91) |
| Therapeutic anticoagulation | 1.62 (0.98, 2.66) | --- |
| Vitamin C | 1.59 (1.02, 2.48)* | 1.07 (0.45, 2.58) |
| Antibiotics for suspected bacterial infection | 3.26 (1.93, 5.49)*** | 0.55 (0.20, 1.50) |

| <i>Complications</i> | | |
|-----------------------------|---------------------|-------------------|
| Bacteremia/fungemia | 3.46 (1.47, 8.13)** | 0.72 (0.17, 3.08) |

Note: OR=odds ratio, CI=confidence interval. Multivariate analysis included 289 patients due to missing data. C-reactive protein, Ferritin, D-dimer, Lactate dehydrogenase, and Aspartate transaminase at admission were not included in the multivariate analysis due to missing data. For brevity purposes, many variables not statistically significant in the univariate analyses are not shown in the table.

*p<0.05, **p<0.01, ***p<0.001

Laboratory values are on admission unless otherwise specified.