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Prognostic Markers of Geriatric Patients in the Intensive Care Unit with Acute Hypoxic Respiratory Failure Secondary to COVID-19

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ABSTRACT

Purpose: SARS-CoV-2 (COVID-19) has continued to be a public health emergency, affecting almost 450 million people worldwide, with a disproportionate significant disease burden in the elderly community. Our main purpose of this study was to provide population specific prognostic markers upon description of demographic factors, clinical characteristics, diagnostic variables, treatment characteristics and outcome variables in critically ill geriatric patients with acute hypoxic respiratory failure due to COVID-19 infection.

Methods: This is a retrospective chart review of 165 patients admitted to a single institution's medical and cardiovascular intensive care unit between the dates of March 01, 2020 and December 31, 2020. Inclusion criteria was patients age greater than or equal to 65 years, documented positive COVID-19 polymerase chain reaction test result and a diagnosis of acute hypoxic respiratory failure. Our primary end point evaluated the rate of mortality in relation to multiple variables during intensive care unit admission.

Results: Of 165 patients, 45 patients were excluded. Of the remaining 120 patients, 41 were females and 79 were males. Four independent risk factors are significantly associated with higher odds of mortality for the concerned population: presence of solid tumor (AOR: 0.002, 95% CI: <0.001, 0.31), maximum value of PaCO2 (AOR: 1.094, 95% CI: 1.029, 1.163), Charlson comorbidity index (AOR: 2.962, 95% CI: 1.59, 5.52), and use of diuretics (AOR: 0.015, 95% CI: <0.001, 0.49).

Conclusion: Certain factors were found to be poor prognostic markers during intensive care unit admission, which may predict a higher rate of mortality in those patient populations.

Abstract word count: 249

Keywords: Respiratory Insufficiency, SARS-CoV2, Geriatrics, Critical Care

STATEMENTS AND DECLARATIONS

The authors declare that they have no competing interests. There was no institutional funding in the production of this work.

INTRODUCTION

Since December 2019 when the first case of COVID-19 was documented, this virus has continued to be a public health emergency, affecting over half a billion people worldwide, with disproportionate significant disease burden in the elderly community.[1] According to the CDC, 75% of deaths due to coronavirus were in patients 65 years of age or greater.[2] It is believed that age related changes in the immune system associated with multiple comorbidities, elderly patients are at increased risk for COVID-19 complications.[3]

Past studies have shown that patients admitted to ICU were not only older, but had an increased number of comorbidities than those not admitted to ICU, suggesting both these factors are related to worse outcomes.[4] One study shows the most prevalent comorbidities are hypertension, diabetes, and cardiovascular disease.[5] Given the multitude of interventions and treatment factors associated with critical illness, a more comprehensive description of the clinical course of geriatric patients suffering from acute hypoxemic respiratory failure and acute respiratory distress syndrome (ARDS) has not yet been completed. As more information has emerged regarding interventions, treatment and prognostic markers, stratification to seemingly the most vulnerable population, the elderly, seems to be lacking as majority of the most up to date information about COVID-19 is generalized across all populations. With more research gathered over the nearly the last two years, further stratification towards at-risk populations would benefit developments in treating a still somewhat novel dangerous disease.

The purpose of this study is to provide a deep description of demographic factors, clinical characteristics, diagnostic variables, treatment characteristics and outcome variables in critically ill geriatric patients with acute hypoxic respiratory failure and ARDS due to COVID-19 infection to better stratify population specific prognostic markers.

MATERIALS AND METHODS

Study design, Setting and Population

This is a retrospective chart review of patients admitted to a single institution's medical and cardiovascular intensive care unit in Boca Raton, Florida between the dates of March 15, 2020 and December 31, 2020 with a positive COVID-19 polymerase chain reaction test result.

We categorized the patients based on ARDS status and the mortality outcome. Patients who had PaO2/FiO2 value between 200 and 300 fell into the 'Mild ARDS' group, who had value between 100 and 200 were

categorized into 'Moderate ARDS' group, and those who had value <100 were grouped into 'Severe ARDS' group. The remaining patients who were not intubated are classified into the 'Not requiring intubation' group.

Demographic variables include age, gender, sex, race, weight. Baseline comorbidities were those included in the Charlson Comorbidity Index[6]. Clinical variables were identified as sepsis, cardiogenic shock, pneumothorax, acute kidney injury requiring hemodialysis, atrial fibrillation, cardiac arrest, myocarditis, cerebral vascular incident, deep vein thrombosis, and acute limb ischemia. Lab variables obtained included complete blood counts, arterial blood gas, c-reactive protein (CRP), troponin, d-dimer, ferritin, procalcitonin, and bilirubin.

Treatment variables included all types of supplemental oxygenation, the mode of mechanical ventilation, proning, neuromuscular blockers, antivirals, antibiotics, steroids, plasma, diuretics, and vasopressors. Variables that were obtained at time of intubation as well as maximum and minimum levels included tidal volume, tidal volume in relation to ideal body weight, positive end-expiratory pressure (PEEP), respiratory rate, plateau pressure, driving pressure, and ventilatory ratio.

Outcome variables included length of ICU stay, length of hospital stay, discharge disposition, mortality, extubation, and tracheostomy.

Data Analysis

Statistical analyses were performed using SAS version 9.4 (SAS Institute Inc., Cary, NC). Descriptive statistics were calculated to understand demographics, comorbidities, lab variables, and patient outcomes, and were reported in terms of mean, percentages and standard deviation. $\chi 2$ tests were used for categorical variables (Fisher's exact when appropriate), while Kruskal-Wallis test was used for continuous variables. Multivariate logistic regression model was used to calculate odds ratios (ORs) and 95% confidence intervals (CIs) for all outcomes[7]. Backward selection was applied to construct the logistic model. Variables which were significant at $P < 0.05$ in the bivariate analysis and had ≥10 events were included in the final model. Statistical significance was set at $P < 0.05$ and all tests were 2 sided.

We attempted the following tree-based supervised machine learning methods to extract the most important features for predicting the outcomes of interest: simple decision tree and random forest (RF). A decision tree method is a tree-like model of decisions that can predict the best choice mathematically. We used an optimized version of the Classification and Regression Trees algorithm to develop the simple decision tree[8]. We used the Gini index as a

metric to identify the split point. The Gini index is the probability of a certain randomly selected feature that was classified incorrectly in the dataset. The weakness of the simple decision tree is its instability and a risk of overfitting, and thus RF was modeled to improve the prediction. RF is an ensemble classifier that combines multiple decision trees through majority voting[9].

RESULTS.

A total of 165 patient charts were reviewed, and 45 patients were excluded due to ICU admission not related to COVID-19 (Figure 1). Of the remaining 120 patients to be included in the analysis, 38 patients survived and 82 had mortality (32% vs 68%). There were 65 patients who were intubated (54%). Of those, 47 patients died; in those who were not intubated, 35 patients died (p=0.412). There were 51 patients who had a cardiac arrest, one of which survived (p= < 0.001). Out of the 12 patients who underwent tracheostomy insertion, 6 died (p=0.169). Also, 77 patients required vasopressors, 59 of which died (p=0.016). There were 46 patients who received COVID convalescent plasma, of which 30 died; however, of those who did not receive convalescent plasma, 22 lived and 52 died (p=0.706). There was no significant difference in mortality with steroid use, proning, or neuromuscular blockade (p = 0.718, 0.56, 0.901, respectively).

The baseline demographic characteristics and representativeness are shown in Table 1. The mean age of the study population was 71.61±11.65 years. Of our entire population of 120 patients, 41 were females and 79 were males. Complications that were observed during the ICU stay included pneumothorax, acute kidney injury requiring hemodialysis, atrial fibrillation, cardiac arrest, COVID myocarditis, cerebral vascular accident, pulmonary embolism, deep vein thrombosis, and acute limb ischemia. Of the 120 patients, 9 (8%) developed pneumothorax, 19 (16%) underwent hemodialysis, 44 (37%) experienced atrial fibrillation, 51 (43%) had cardiac arrest, 11 (9%) experienced COVID myocarditis, 8 (7%) had cerebral vascular accident, 4 (3%) had a known pulmonary embolism, 10 (8%) had a known deep vein thrombosis, and 3 (3%) had acute limb ischemia.

From the logistic regression analysis, we observe that, after accounting for covariates, four independent risk factors are significantly associated with higher odds of mortality for the concerned population: presence of solid tumor (AOR: 0.002, 95% CI: <0.001, 0.31), maximum value of PaCO2 (AOR: 1.094, 95% CI: 1.029, 1.163), higher Charlson comorbidity index (AOR: 2.962, 95% CI: 1.59, 5.52), and use of Diuretics (AOR: 0.015, 95% CI: <0.001, 0.49). The logistic regression has a c-index of 0.932, which is substantially good.

Fig. 2 presents a simple decision tree model for classifying patients into expired or not. From the decision tree, it is apparent that history of cardiac arrest is the biggest predictor for mortality. Charlson comorbidity index and pre-operative C-reactive protein are the next two influential predictors of mortality according to this decision tree.

The importance matrix plot for the RF method is shown in Fig. 3 and reveals that the top 5 most important variables contributing to the model were temperature, maximum value of pre-operative C-reactive protein, maximum value of pre-operative ferritin, age, and Charlson comorbidity index. Although decision trees are prone to overfitting, the feature importance graph from RF shows that 2 of the 5 most influential variables were in the top nodes of decision tree analysis.

Table 2 shows the population characteristics broken down into ARDS status and mortality and hospice. Table 3 shows the baseline characteristics divided into ARDS status and mortality and hospice. Table 4 and 5 both show the clinical prognostic variables that were researched broken down into ARDS status and mortality and hospice.

DISCUSSION

In our single-center retrospective study involving patients that were admitted to the ICU for acute hypoxic respiratory failure during the dates of 3/15/2020 to 12/30/2020, it was found that only a few prognostic factors influenced survival or mortality. Cardiac arrest and higher Charlson comorbidity index was noted to be the most significant prognostic factors resulting in mortality.

It was to our surprise that the mortality rate among those intubated was not statistically significant. However, it has been shown in prior research, which is in alignment with our results, that mechanical ventilation does not necessarily result in increased mortality[10]. Most of the research that has been performed observes early versus late invasive ventilation, instead of the overall in-hospital mortality rate of mechanical ventilation. It is predicted that in the United States, mortality of intubated patients ranges between 23-67%[11]. Ultimately, due to the versatility of the disease process, it is difficult to predict the course each patient will undergo. Certain patients will recover after many weeks of mechanical ventilation, and some will deteriorate very quickly despite all efforts.

It was our original goal of the study to look at patients aged 65 years and older. Once all the data was compiled, we realized that in order to have a greater power which would reach statistical significance, we would be

required to encompass those aged 50 years and older. However, our average age was 71 years of age. Therefore, this data can still be generalized to the elderly population who are admitted to the intensive care unit with COVID-19.

Overall, from the results of our study, it can be concluded that patients in the intensive care unit who are diagnosed with COVID-19 induced acute hypoxic respiratory failure who have a baseline elevated Charlson comorbidity index or experience cardiac arrest, will ultimately have higher mortality risk. We hope that from these results of this study, that goals of care discussions with patient's families will be easier to establish and comprehend.

Our study has several limitations. First, the sample size was very limited given inclusion criteria and duration. Had the duration been longer, we would have a stronger power. Second, our study only includes one hospital, which limits the generalizability. Third, given the retrospective nature of the study, we are unable to control the methods of measures for diagnosis.

TAKE HOME MESSAGE

There are four scenarios in which patients admitted to the intensive care unit with COVID-19 induced acute hypoxic respiratory failure result in higher odds of mortality, which include patients with a high Charlson comorbidity index, are currently diagnosed with a solid tumor, experience cardiac arrest in the ICU, or have elevated PaCO2 levels on ABG. These patients should be closely monitored and early goals of care discussions with both the patient and their families should established.

DECLARATIONS

ACKNOWLEDGEMENTS

Not Applicable.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Ethics approval was acquired following the hospital research committee review of the research protocol and plan.

Written, informed consent was waived given the nature of the study.

CONSENT FOR PUBLICATION

Not applicable.

AVAILABILITY OF DATA AND MATERIALS

The datasets used in the production of this study are available from the corresponding author on reasonable request.

COMPETING INTERESTS

The authors declare that they have no competing interests.

FUNDING

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FOOTNOTES

Not applicable

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FIGURE LEGENDS

Table I. Shown are the demographic and clinical characteristics of the participating patients.

Table II. The population characteristics are broken down into ARDS status as well as mortality and hospice.

Table III. The baseline characteristics are divided into ARDS status as well as mortality and hospice.

Table IV. The clinical prognostic variables that were researched have been broken down into ARDS status.

Table V. The clinical prognostic variables that were researched have been broken down into mortality and hospice.

Figure I. Figure 1 shows how our patients were chosen. First we received all the charts of patients who were in the intensive care unit from 3/15/2020 until 12/30/2020. Then we removed all patients who were not admitted for COVID-19 related acute hypoxic respiratory failure.

Figure II. Simple decision tree model illustrating the classification of patients expired (and not expired). Each box has the following components: selected variables for classification, Gini index, number of samples classified to the box according to the previous variable, the average number of patients for each classification, and the majority of classes at the split node. Blue
and orange represents the expired and non-expired class, respectively, and the color densities increase when the Gini indexes decrease. Abbreviations: cardiacarrstyn, cardiac arrest yes vs no; charlson_index, Charlson comorbidity index; crp, C-reactive protein; pao2_fio2min, minimum value of ratio of PaO2 and FiO2; heartratemax, maximum value of heart rate.

Figure III. Importance matrix plot of the RF model. This importance matrix plot depicts the importance of each covariate in the final model. Abbreviations: temp, temperature; crpmax, maximum value of C-reactive protein; ferritinmax, maximum value of ferritin; age, age; harlson_index, Charlson comorbidity index; map, mean arterial pressure; leukocytesmax, maximum value of leukocytes; paco3_max, maximum value of PaCO3; leukocytes, preoperative value of leukocytes; ibw, ideal body weight.

FOOTNOTES
TABLES & FIGURES

Table I. Demographic and Clinical Characteristics of the Patients

Characteristic	Survived	Did Not Survive
Female sex – no. (%)	13 (32)	28 (68)
Race		

Caucasian	31 (33)	63 (67)
African American	1 (20)	4 (80)
Asian	2 (29)	5 (71)
Hispanic	4 (33)	8 (64)
Other	0 (0)	2 (100)
Body-mass Index	28 +/- 4	28 +/- 4
Comorbidities – no. (%)		
Asthma	36 (32)	76 (68)
Interstitial Lung Disease	38 (33)	77 (67)
Hypertension	13 (31)	29 (69)
ESRD	37 (32)	80 (68)
Myocardial Infarction	5 (36)	9 (64)
Peripheral Arterial Disease	0 (0)	11 (100)
Cerebral Vascular Accident	0 (0)	14 (100)
Dementia	3 (16)	16 (84)
COPD	3 (16)	16 (84)
Connective Tissue Disease	0 (0)	1 (100)
Peptic Ulcer Disease	1 (6)	16 (94)

Diabetes Mellitus Type 2	8 (20)	32 (80)
Hemiplegia	0 (0)	2 (100)
CKD Stage III or above	2 (15)	11 (85)
Solid Tumor	2 (29)	5 (71)
Leukemia	0 (0)	2 (100)
AIDS	1 (50)	1 (50)

Table II. Population characteristics

		Grouped by ARDS status						Grouped by mortality and hospice		
		Overall	Mild ARDS	Moderate ARDS	Not requiring intubation	Severe ARDS	P-Value	No	Yes	P-Value
Age, n (%)		120	14	33	16	57		38	82	
	< 50 years	7 (5.8)	1 (7.1)	1 (3.0)	1 (6.2)	4 (7.0)	0.522	5 (13.2)	2 (2.4)	0.010
	50-59 years	12 (10.0)		5 (15.2)	2 (12.5)	5 (8.8)		6 (15.8)	6 (7.3)	
	60-69 years	23 (19.2)	4 (28.6)	6 (18.2)	4 (25.0)	9 (15.8)		10 (26.3)	13 (15.9)	
	70-79 years	35 (29.2)	3 (21.4)	6 (18.2)	3 (18.8)	23 (40.4)		10 (26.3)	25 (30.5)	
	> 80 years	43 (35.8)	6 (42.9)	15 (45.5)	6 (37.5)	16 (28.1)		7 (18.4)	36 (43.9)	

Gender, n (%)										
	Female	41 (34.2)	5 (35.7)	13 (39.4)	8 (50.0)	15 (26.3)	0.288	13 (34.2)	28 (34.1)	0.841
	Male	79 (65.8)	9 (64.3)	20 (60.6)	8 (50.0)	42 (73.7)		25 (65.8)	54 (65.9)	
Race, n (%)										
	Caucasian/White	94 (78.3)	11 (78.6)	24 (72.7)	13 (81.2)	46 (80.7)	0.619	31 (81.6)	63 (76.8)	0.851
	African American/Black	5 (4.2)		2 (6.1)	2 (12.5)	1 (1.8)		1 (2.6)	4 (4.9)	
	Asian	7 (5.8)	1 (7.1)	3 (9.1)		3 (5.3)		2 (5.3)	5 (6.1)	
	Hispanic	12 (10.0)	1 (7.1)	4 (12.1)	1 (6.2)	6 (10.5)		4 (10.5)	8 (9.8)	
	Other	2 (1.7)	1 (7.1)			1 (1.8)			2 (2.4)	
BMI, median [Q1,Q3]		28.0 [25.0,33.0]	27.0 [24.7,32.8]	27.0 [24.5,33.0]	26.5 [22.8,28.5]	29.0 [25.0,34.0]	0.256	28.0 [25.0,33.0]	28.0 [25.0,33.0]	0.839

Table III. Baseline Characteristics

	Grouped by ARDS status						Grouped by mortality and hospice		
							No	Yes	P-Value
	Overall	Mild ARDS	Moderate ARDS	Not requiring intubation	Severe ARDS	P-Value			
	120	14	33	16	57		38	82	
Obesity, n (%) No	75 (62.5)	10 (71.4)	20 (60.6)	13 (81.2)	32 (56.1)	0.271	23 (60.5)	52 (63.4)	0.919

	Yes	45 (37.5)	4 (28.6)	13 (39.4)	3 (18.8)	25 (43.9)		15 (39.5)	30 (36.6)	
Asthma, n (%)	No	8 (6.7)	1 (7.1)	1 (3.0)	2 (12.5)	4 (7.0)	0.661	2 (5.3)	6 (7.3)	1.000
	Yes	112 (93.3)	13 (92.9)	32 (97.0)	14 (87.5)	53 (93.0)		36 (94.7)	76 (92.7)	
Interstitial Lung Disease, n (%)	No	5 (4.2)				5 (8.8)	0.124		5 (6.1)	0.178
	Yes	115 (95.8)	14 (100.0)	33 (100.0)	16 (100.0)	52 (91.2)		38 (100.0)	77 (93.9)	
Hypertension, n (%)	No	78 (65.0)	10 (71.4)	23 (69.7)	9 (56.2)	36 (63.2)	0.754	25 (65.8)	53 (64.6)	0.934
	Yes	42 (35.0)	4 (28.6)	10 (30.3)	7 (43.8)	21 (36.8)		13 (34.2)	29 (35.4)	
End-stage renal disease, n (%)	No	3 (2.5)	1 (7.1)	1 (3.0)	1 (6.2)		0.300	1 (2.6)	2 (2.4)	1.000
	Yes	117 (97.5)	13 (92.9)	32 (97.0)	15 (93.8)	57 (100.0)		37 (97.4)	80 (97.6)	
Prior myocardial infarction, n (%)	No	106 (88.3)	13 (92.9)	27 (81.8)	13 (81.2)	53 (93.0)	0.307	33 (86.8)	73 (89.0)	0.764
	Yes	14 (11.7)	1 (7.1)	6 (18.2)	3 (18.8)	4 (7.0)		5 (13.2)	9 (11.0)	
Congestive heart failure, n (%)	No	102 (85.0)	9 (64.3)	30 (90.9)	15 (93.8)	48 (84.2)	0.086	35 (92.1)	67 (81.7)	0.227
	Yes	18 (15.0)	5 (35.7)	3 (9.1)	1 (6.2)	9 (15.8)		3 (7.9)	15 (18.3)	
Peripheral arterial disease, n (%)	No	109 (90.8)	12 (85.7)	33 (100.0)	14 (87.5)	50 (87.7)	0.199	38 (100.0)	71 (86.6)	0.016
	Yes	11 (9.2)	2 (14.3)		2 (12.5)	7 (12.3)			11 (13.4)	
Cerebrovascular disease, n (%)	No	106 (88.3)	12 (85.7)	28 (84.8)	16 (100.0)	50 (87.7)	0.455	38 (100.0)	68 (82.9)	0.005
	Yes	14 (11.7)	2 (14.3)	5 (15.2)		7 (12.3)			14 (17.1)	
Dementia, n (%)	No	101 (84.2)	11 (78.6)	27 (81.8)	14 (87.5)	49 (86.0)	0.864	35 (92.1)	66 (80.5)	0.176
	Yes	19 (15.8)	3 (21.4)	6 (18.2)	2 (12.5)	8 (14.0)		3 (7.9)	16 (19.5)	

COPD, n (%)	No	101 (84.2)	10 (71.4)	29 (87.9)	14 (87.5)	48 (84.2)	0.536	35 (92.1)	66 (80.5)	0.176
	Yes	19 (15.8)	4 (28.6)	4 (12.1)	2 (12.5)	9 (15.8)		3 (7.9)	16 (19.5)	
Connective tissue disease, n (%)	No	119 (99.2)	14 (100.0)	32 (97.0)	16 (100.0)	57 (100.0)	0.447	38 (100.0)	81 (98.8)	1.000
	Yes	1 (0.8)		1 (3.0)					1 (1.2)	
Peptic ulcer, n (%)	No	103 (85.8)	10 (71.4)	27 (81.8)	14 (87.5)	52 (91.2)	0.238	37 (97.4)	66 (80.5)	0.029
	Yes	17 (14.2)	4 (28.6)	6 (18.2)	2 (12.5)	5 (8.8)		1 (2.6)	16 (19.5)	
Liver disease, n (%)	No	118 (98.3)	14 (100.0)	33 (100.0)	15 (93.8)	56 (98.2)	0.265	37 (97.4)	81 (98.8)	0.269
	Mild	1 (0.8)			1 (6.2)			1 (2.6)		
	Moderate to severe	1 (0.8)				1 (1.8)			1 (1.2)	
Diabetes, n (%)	No	80 (66.7)	8 (57.1)	19 (57.6)	14 (87.5)	39 (68.4)	0.326	30 (78.9)	50 (61.0)	0.100
	without complications	36 (30.0)	6 (42.9)	13 (39.4)	2 (12.5)	15 (26.3)		8 (21.1)	28 (34.1)	
	with chronic complications or end-organ damage	4 (3.3)		1 (3.0)		3 (5.3)			4 (4.9)	
Hemiplegia, n (%)	No	118 (98.3)	13 (92.9)	33 (100.0)	16 (100.0)	56 (98.2)	0.335	38 (100.0)	80 (97.6)	1.000
	Yes	2 (1.7)	1 (7.1)			1 (1.8)			2 (2.4)	
Moderate to severe chronic kidney disease, n (%)	No	107 (89.2)	10 (71.4)	30 (90.9)	14 (87.5)	53 (93.0)	0.135	36 (94.7)	71 (86.6)	0.223
	Yes	13 (10.8)	4 (28.6)	3 (9.1)	2 (12.5)	4 (7.0)		2 (5.3)	11 (13.4)	
Solid tumor, n (%)	No	113 (94.2)	11 (78.6)	32 (97.0)	14 (87.5)	56 (98.2)	0.004	36 (94.7)	77 (93.9)	0.365
	Localized	3 (2.5)		1 (3.0)	1 (6.2)	1 (1.8)			3 (3.7)	

	Metastatic	4 (3.3)	3 (21.4)		1 (6.2)			2 (5.3)	2 (2.4)	
Leukemia, n (%)	No	118 (98.3)	14 (100.0)	32 (97.0)	16 (100.0)	56 (98.2)	0.829	38 (100.0)	80 (97.6)	1.000
	Yes	2 (1.7)		1 (3.0)		1 (1.8)			2 (2.4)	
Lymphoma, n (%)	No	120 (100.0)	14 (100.0)	33 (100.0)	16 (100.0)	57 (100.0)	1.000	38 (100.0)	82 (100.0)	1.000
AIDS, n (%)	No	118 (98.3)	13 (92.9)	32 (97.0)	16 (100.0)	57 (100.0)	0.243	37 (97.4)	81 (98.8)	0.535
	Yes	2 (1.7)	1 (7.1)	1 (3.0)				1 (2.6)	1 (1.2)	
Charlson comorbidity index, median [Q1,Q3]		4.0 [3.0,6.0]	8.0 [4.0,8.8]	5.0 [3.0,6.0]	4.0 [2.8,5.2]	4.0 [3.0,6.0]	0.027	3.0 [2.0,4.0]	5.0 [4.0,6.0]	<0.001

Table IV. Clinical variables

Grouped by ARDS status								
		Missing	Overall	Mild ARDS	Moderate ARDS	Not requiring intubation	Severe ARDS	P-Value
Pneumothorax, n (%)	No	0	111 (92.5)	13 (92.9)	31 (93.9)	16 (100.0)	51 (89.5)	0.542
	Yes		9 (7.5)	1 (7.1)	2 (6.1)		6 (10.5)	
Acute kidney injury requiring dialysis, n (%)	No	0	101 (84.2)	14 (100.0)	29 (87.9)	14 (87.5)	44 (77.2)	0.159
	Yes		19 (15.8)		4 (12.1)	2 (12.5)	13 (22.8)	
Atrial fibrillation, n (%)	No	0	76 (63.3)	8 (57.1)	20 (60.6)	11 (68.8)	37 (64.9)	0.896
	Yes		44 (36.7)	6 (42.9)	13 (39.4)	5 (31.2)	20 (35.1)	

Cardiac arrest, n (%)	No	0	69 (57.5)	8 (57.1)	24 (72.7)	10 (62.5)	27 (47.4)	0.128
	Yes		51 (42.5)	6 (42.9)	9 (27.3)	6 (37.5)	30 (52.6)	
COVID myocarditis, n (%)	No	0	109 (90.8)	14 (100.0)	31 (93.9)	13 (81.2)	51 (89.5)	0.297
	Yes		11 (9.2)		2 (6.1)	3 (18.8)	6 (10.5)	
Stroke, n (%)	No	0	112 (93.3)	14 (100.0)	32 (97.0)	15 (93.8)	51 (89.5)	0.381
	Yes		8 (6.7)		1 (3.0)	1 (6.2)	6 (10.5)	
Pulnonary embolism, n (%)	No	0	116 (96.7)	14 (100.0)	33 (100.0)	14 (87.5)	55 (96.5)	0.122
	Yes		4 (3.3)			2 (12.5)	2 (3.5)	
DVT, n (%)	No	0	110 (91.7)	14 (100.0)	32 (97.0)	15 (93.8)	49 (86.0)	0.171
	Yes		10 (8.3)		1 (3.0)	1 (6.2)	8 (14.0)	
Acute limb ischemia, n (%)	No	0	117 (97.5)	13 (92.9)	33 (100.0)	16 (100.0)	55 (96.5)	0.435
	Yes		3 (2.5)	1 (7.1)			2 (3.5)	
Temperature min (°C), median [Q1,Q3]		1	36.0 [34.5,36.4]	35.7 [34.5,36.3]	35.7 [34.7,36.3]	36.3 [35.8,36.4]	36.0 [34.3,36.3]	0.561
Temperature max (°C), median [Q1,Q3]		1	38.3 [37.4,39.1]	37.8 [37.0,39.2]	38.8 [38.0,39.2]	37.1 [36.9,37.8]	38.5 [37.8,39.1]	0.002
Mean arterial pressure, median [Q1,Q3]		2	81.5 [63.0,97.8]	73.0 [57.2,89.2]	73.0 [62.0,86.0]	70.5 [55.5,97.8]	84.0 [71.0,98.0]	0.147
Mean arterial pressure min, median [Q1,Q3]		0	42.5 [33.8,55.0]	39.5 [31.2,57.0]	41.0 [30.0,51.0]	47.0 [35.0,58.2]	43.0 [35.0,55.0]	0.658
Heart rate (bpm), median [Q1,Q3]		2	92.0 [78.0,109.5]	109.0 [90.0,117.5]	88.0 [73.0,101.0]	95.5 [65.0,115.8]	92.0 [80.0,108.0]	0.143
Heart rate max (bpm), median [Q1,Q3]		0	135.0 [116.0,1	137.0 [120.2,1	140.0 [116.0,15	113.5 [97.2,13	137.0 [123.0,15	0.021

			50.0]	47.5]	5.0]	0.5]	0.0]	
Respiratory rate (rpm), median [Q1,Q3]		2	25.0 [20.0,30.0]	25.0 [22.0,29.5]	27.0 [21.0,32.0]	21.5 [18.0,26.2]	25.0 [20.0,30.0]	0.494
Respiratory rate max (rpm), median [Q1,Q3]		0	40.0 [34.8,48.0]	35.5 [29.0,40.0]	40.0 [35.0,45.0]	37.0 [28.8,41.2]	44.0 [36.0,51.0]	0.015
Oxygen saturation (%), median [Q1,Q3]		2	88.5 [80.0,96.8]	95.0 [90.5,98.0]	88.0 [78.0,93.0]	95.5 [85.8,99.8]	86.0 [77.0,95.0]	0.009
Oxygen saturation min (%), median [Q1,Q3]		0	74.0 [60.8,83.0]	80.5 [57.0,83.8]	77.0 [60.0,83.0]	84.0 [76.2,87.0]	68.0 [60.0,78.0]	0.015
Ferritin max (ng/mL), median [Q1,Q3]		28	1151.5 [483.8,1780.0]	755.0 [318.0,1605.5]	1322.0 [698.0,1842.0]	775.0 [230.0,1480.5]	1195.5 [629.8,1681.0]	0.446
D-Dimer (ng/mL), median [Q1,Q3]		40	2.4 [1.1,7.2]	2.2 [0.9,4.6]	2.3 [1.3,5.3]	2.2 [0.7,9.8]	2.7 [1.1,10.5]	0.807
D-Dimer max (ng/mL), median [Q1,Q3]		24	4.0 [1.9,13.1]	3.8 [2.1,7.5]	4.0 [2.0,12.2]	4.0 [1.7,10.2]	4.1 [1.9,15.2]	0.956
CRP (mg/dL), median [Q1,Q3]		46	13.1 [6.3,15.8]	12.3 [5.4,15.3]	14.0 [8.6,15.9]	7.0 [1.5,14.6]	14.0 [9.2,17.9]	0.106
CRP max (mg/dL), median [Q1,Q3]		28	14.6 [7.7,19.0]	15.1 [5.5,24.1]	14.1 [9.3,18.4]	9.2 [4.7,15.0]	15.0 [12.2,19.2]	0.196
Lymphocytes (10e3/µL %), median [Q1,Q3]		4	7.0 [4.0,11.0]	9.0 [6.0,16.5]	7.0 [4.0,13.0]	8.0 [5.5,18.5]	5.5 [3.0,9.0]	0.052
Lymphocytes min (10e3/µL %), median [Q1,Q3]		1	3.0 [2.0,6.0]	4.5 [2.0,7.8]	4.0 [2.0,6.0]	5.5 [3.8,9.0]	3.0 [2.0,4.2]	0.021
Leukocytes (10e3 /µL), median [Q1,Q3]		0	11.0 [8.0,15.8]	10.8 [8.1,15.1]	10.0 [8.6,13.5]	13.7 [10.2,16.4]	10.7 [7.2,17.6]	0.503
Leukocytes max (10e3 /µL), median [Q1,Q3]		0	17.5 [13.3,24.6]	17.6 [12.3,22.9]	16.7 [13.6,19.5]	14.0 [11.5,17.4]	20.0 [14.7,28.6]	0.063

Procalcitonin (ng/mL), median [Q1,Q3]		64	0.6 [0.2,1.9]	1.2 [0.2,12.0]	0.6 [0.2,1.2]	1.8 [0.1,3.2]	0.5 [0.2,1.2]	0.769
Procalcitonin max (ng/mL), median [Q1,Q3]		46	1.0 [0.2,3.8]	1.2 [0.2,12.0]	0.8 [0.2,3.3]	1.8 [0.1,3.6]	0.7 [0.3,4.4]	0.875
Platelets (10e3/mm3), median [Q1,Q3]		0	214.5 [142.8,290.0]	203.0 [142.2,286.2]	253.0 [143.0,299.0]	171.5 [147.5,202.2]	225.0 [145.0,298.0]	0.296
Platelets max (10e3/mm3), median [Q1,Q3]		0	282.0 [179.0,370.5]	270.5 [185.0,299.5]	304.0 [193.0,459.0]	189.5 [155.8,248.2]	292.0 [200.0,387.0]	0.037
Bilirubin (mg/dL), median [Q1,Q3]		9	0.7 [0.4,0.9]	0.6 [0.5,0.7]	0.6 [0.4,1.0]	0.8 [0.5,0.9]	0.7 [0.4,1.0]	0.671
Bilirubin max (mg/dL), median [Q1,Q3]		2	1.0 [0.7,1.5]	0.7 [0.5,1.1]	0.9 [0.6,1.3]	0.9 [0.8,1.6]	1.1 [0.7,1.8]	0.227
Troponin (ng/mL), median [Q1,Q3]		56	0.1 [0.0,0.3]	0.0 [0.0,0.1]	0.1 [0.1,0.2]	0.1 [0.0,0.2]	0.2 [0.1,0.5]	0.362
Troponin max (ng/mL), median [Q1,Q3]		43	0.2 [0.0,0.8]	0.1 [0.0,0.3]	0.1 [0.1,0.3]	0.4 [0.0,0.7]	0.3 [0.1,1.4]	0.699
PaO2/FiO2 at intubation, median [Q1,Q3]		16	94.0 [66.8,146.2]	289.5 [243.5,447.2]	136.0 [110.0,164.0]	nan [nan,nan]	71.0 [54.0,82.0]	nan
PaO2/FiO2 min, median [Q1,Q3]		11	80.0 [54.0,114.0]	239.0 [181.5,313.0]	104.0 [86.0,134.0]	105.0 [83.0,461.0]	59.0 [48.0,79.0]	<0.001
PaCO2 (mmHg), median [Q1,Q3]		16	44.0 [35.0,57.5]	32.5 [29.2,43.8]	47.0 [38.0,53.0]	nan [nan,nan]	44.0 [36.0,61.0]	nan
PacCO3 max (mmHg), median [Q1,Q3]		11	55.0 [38.0,77.0]	41.0 [30.5,53.5]	58.0 [47.0,78.0]	50.0 [36.0,51.0]	66.0 [40.0,79.0]	0.043
Intubated, n (%)	No	0	55 (45.8)	9 (64.3)	9 (27.3)	13 (81.2)	24 (42.1)	0.002
	Yes		65 (54.2)	5 (35.7)	24 (72.7)	3 (18.8)	33 (57.9)	
Oxygenation: Nasal cannula, n (%)	No	0	36 (30.0)	4 (28.6)	6 (18.2)	6 (37.5)	20 (35.1)	0.342
	Yes		84 (70.0)	10 (71.4)	27 (81.8)	10 (62.5)	37 (64.9)	

Oxygenation: Venti-mask, n (%)	No	0	103 (85.8)	13 (92.9)	30 (90.9)	14 (87.5)	46 (80.7)	0.468
	Yes		17 (14.2)	1 (7.1)	3 (9.1)	2 (12.5)	11 (19.3)	
Oxygenation: NRB, n (%)	No	0	21 (17.5)	4 (28.6)	5 (15.2)	9 (56.2)	3 (5.3)	<0.001
	Yes		99 (82.5)	10 (71.4)	28 (84.8)	7 (43.8)	54 (94.7)	
Oxygenation: HIFLOW, n (%)	No	0	54 (45.0)	8 (57.1)	13 (39.4)	12 (75.0)	21 (36.8)	0.035
	Yes		66 (55.0)	6 (42.9)	20 (60.6)	4 (25.0)	36 (63.2)	
Oxygenation: BiPAP, n (%)	No	0	55 (45.8)	6 (42.9)	16 (48.5)	13 (81.2)	20 (35.1)	0.012
	Yes		65 (54.2)	8 (57.1)	17 (51.5)	3 (18.8)	37 (64.9)	
Oxygenation: Mechanical ventilation, n (%)	No	0	55 (45.8)	9 (64.3)	8 (24.2)	14 (87.5)	24 (42.1)	<0.001
	Yes		65 (54.2)	5 (35.7)	25 (75.8)	2 (12.5)	33 (57.9)	
Number of modes of mechanical ventilation used, n (%)	0.0	53	1 (1.5)			1 (50.0)		0.001
	1.0		29 (43.3)	4 (66.7)	13 (50.0)		12 (36.4)	
	2.0		27 (40.3)	1 (16.7)	10 (38.5)	1 (50.0)	15 (45.5)	
	3.0		8 (11.9)	1 (16.7)	3 (11.5)		4 (12.1)	
	4.0		1 (1.5)				1 (3.0)	
	5.0		1 (1.5)				1 (3.0)	
Mechanical ventilation mode: PRVC, n (%)	No	0	64 (53.3)	9 (64.3)	11 (33.3)	15 (93.8)	29 (50.9)	0.001
	Yes		56 (46.7)	5 (35.7)	22 (66.7)	1 (6.2)	28 (49.1)	
Mechanical ventilation mode: Volume control, n (%)	No	0	84 (70.0)	13 (92.9)	22 (66.7)	15 (93.8)	34 (59.6)	0.012
	Yes		36 (30.0)	1 (7.1)	11 (33.3)	1 (6.2)	23 (40.4)	
Mechanical ventilation mode: Pressure control, n (%)	No	0	110 (91.7)	13 (92.9)	30 (90.9)	16 (100.0)	51 (89.5)	0.601
	Yes		10 (8.3)	1 (7.1)	3 (9.1)		6 (10.5)	

Mechanical ventilation mode: APRV, n (%)	No	0	120 (100.0)	14 (100.0)	33 (100.0)	16 (100.0)	57 (100.0)	1.000
Mechanical ventilation mode: CMV, n (%)	No	0	115 (95.8)	14 (100.0)	30 (90.9)	15 (93.8)	56 (98.2)	0.306
	Yes		5 (4.2)		3 (9.1)	1 (6.2)	1 (1.8)	
Mechanical ventilation mode: SIMV, n (%)	No	0	115 (95.8)	14 (100.0)	30 (90.9)	16 (100.0)	55 (96.5)	0.338
	Yes		5 (4.2)		3 (9.1)		2 (3.5)	
Patient on mechanical ventilation on ICU admission, n (%)	No	45	38 (50.7)	2 (28.6)	17 (60.7)	2 (100.0)	17 (44.7)	0.173
	Yes		37 (49.3)	5 (71.4)	11 (39.3)		21 (55.3)	
Days from hospital admission to mechanical ventilation, median [Q1,Q3]		54	5.0 [1.0,10.0]	0.0 [0.0,14.0]	5.0 [1.5,6.5]	15.5 [14.8,16.2]	4.0 [1.0,10.0]	0.250
Tidal volume max, median [Q1,Q3]		54	490.0 [422.5,500.0]	500.0 [500.0,500.0]	450.0 [420.0,500.0]	475.0 [437.5,512.5]	500.0 [450.0,500.0]	0.535
Tidal volume min, median [Q1,Q3]		54	400.0 [340.0,450.0]	400.0 [400.0,470.0]	385.0 [332.5,440.0]	420.0 [410.0,430.0]	420.0 [340.0,450.0]	0.689
Tidal volume≤ 6 ml/kg at intubation, n (%)	No	56	45 (70.3)	4 (80.0)	18 (69.2)		23 (69.7)	0.885
	Yes		19 (29.7)	1 (20.0)	8 (30.8)		10 (30.3)	
Tidal volume (ml/kg), median [Q1,Q3]		0	5.6 [0.0,6.7]	0.0 [0.0,7.1]	6.4 [5.7,7.4]	0.0 [0.0,0.0]	6.0 [0.0,6.5]	<0.001
Tidal volume max (ml/kg), median [Q1,Q3]		54	7.4 [6.9,8.1]	8.5 [8.4,9.1]	7.4 [7.0,8.4]	7.0 [6.9,7.1]	7.1 [6.7,7.8]	0.021
Tidal volume min (ml/kg), median [Q1,Q3]		54	6.0 [5.8,6.5]	7.3 [6.1,8.0]	6.1 [5.9,6.6]	6.2 [6.0,6.5]	6.0 [5.8,6.2]	0.175
Positive end expiratory pressure/PEEP (cm H2O), median [Q1,Q3]		56	10.0 [8.0,13.2]	5.0 [5.0,5.0]	10.0 [10.0,12.0]	nan [nan,nan]	12.0 [10.0,14.0]	nan
PEEP max (cm H2O), median [Q1,Q3]		54	14.0 [10.0,16.	5.0 [5.0,5.0]	13.0 [10.0,16.	11.0 [10.5,11.	15.0 [14.0,18.	0.018

			0]		0]	5]	0]	
PEEP min (cm H2O), median [Q1,Q3]		54	6.0 [5.0,10.0]	5.0 [5.0,5.0]	5.5 [5.0,9.5]	9.0 [8.5,9.5]	7.0 [5.0,10.0]	0.081
PEEP>12 (cm H20), n (%)	No	54	26 (39.4)	4 (80.0)	13 (50.0)	1 (50.0)	8 (24.2)	0.047
	Yes		40 (60.6)	1 (20.0)	13 (50.0)	1 (50.0)	25 (75.8)	
FiO2, median [Q1,Q3]		56	100.0 [100.0,100.0]	100.0 [100.0,100.0]	100.0 [100.0,100.0]	nan [nan,nan]	100.0 [100.0,100.0]	nan
Respiratory rate (bpm), median [Q1,Q3]		56	25.0 [21.5,28.5]	25.0 [20.0,28.0]	27.0 [24.0,28.0]	nan [nan,nan]	24.0 [20.0,30.0]	nan
Respiratory rate max (bpm), median [Q1,Q3]		54	35.5 [30.2,40.0]	28.0 [26.0,36.0]	35.0 [30.2,39.0]	36.0 [34.0,38.0]	36.0 [35.0,40.0]	0.704
Plateau pressure (cmH2O), median [Q1,Q3]		59	26.0 [21.0,30.0]	15.0 [15.0,19.0]	26.5 [22.5,29.8]	nan [nan,nan]	26.0 [21.2,30.0]	nan
Plateau pressure max (cmH2O), median [Q1,Q3]		56	33.0 [25.8,38.0]	21.0 [17.0,22.0]	32.0 [25.2,36.8]	33.5 [31.8,35.2]	35.0 [28.0,39.0]	0.229
Driving pressure (cm H20), median [Q1,Q3]		59	15.0 [11.0,17.0]	10.0 [10.0,14.0]	15.0 [12.0,16.8]	nan [nan,nan]	15.5 [12.0,17.8]	nan
Respiratory system static compliance (ml/cm H20), median [Q1,Q3]		59	31.2 [23.7,38.5]	50.0 [35.7,50.0]	30.6 [23.6,35.4]	nan [nan,nan]	29.7 [24.0,38.2]	nan
Ventilatory ratio max, median [Q1,Q3]		57	2.2 [2.0,2.9]	2.2 [2.0,3.2]	2.2 [2.0,3.0]	2.5 [2.3,2.6]	2.2 [2.0,2.9]	0.914
Prone, n (%)	No	1	96 (80.7)	14 (100.0)	26 (78.8)	15 (100.0)	41 (71.9)	0.020
	Yes		23 (19.3)		7 (21.2)		16 (28.1)	
Neuromuscular blockers, n (%)	No	1	87 (73.1)	12 (85.7)	22 (66.7)	14 (93.3)	39 (68.4)	0.134
	Yes		32 (26.9)	2 (14.3)	11 (33.3)	1 (6.7)	18 (31.6)	

Antibiotics given, n (%)	No	0	12 (10.0)		3 (9.1)	6 (37.5)	3 (5.3)	0.001
	Yes		108 (90.0)	14 (100.0)	30 (90.9)	10 (62.5)	54 (94.7)	
Steroid given, n (%)	No	0	19 (15.8)	3 (21.4)	5 (15.2)	5 (31.2)	6 (10.5)	0.222
	Yes		101 (84.2)	11 (78.6)	28 (84.8)	11 (68.8)	51 (89.5)	
Steroid: Hydrocortisone stress dose, n (%)	No	0	98 (81.7)	11 (78.6)	26 (78.8)	13 (81.2)	48 (84.2)	0.914
	Yes		22 (18.3)	3 (21.4)	7 (21.2)	3 (18.8)	9 (15.8)	
Steroid: DEXA-ARDS, n (%)	No	0	99 (82.5)	11 (78.6)	28 (84.8)	14 (87.5)	46 (80.7)	0.878
	Yes		21 (17.5)	3 (21.4)	5 (15.2)	2 (12.5)	11 (19.3)	
Steroid: RECOVERY, n (%)	No	0	53 (44.2)	9 (64.3)	15 (45.5)	7 (43.8)	22 (38.6)	0.386
	Yes		67 (55.8)	5 (35.7)	18 (54.5)	9 (56.2)	35 (61.4)	
Steroid: Other, n (%)	No	0	102 (85.0)	12 (85.7)	28 (84.8)	16 (100.0)	46 (80.7)	0.301
	Yes		18 (15.0)	2 (14.3)	5 (15.2)		11 (19.3)	
Remdesivir, n (%)	No	0	56 (46.7)	8 (57.1)	17 (51.5)	11 (68.8)	20 (35.1)	0.068
	Yes		64 (53.3)	6 (42.9)	16 (48.5)	5 (31.2)	37 (64.9)	
Hydroxychloroquine, n (%)	No	0	99 (82.5)	13 (92.9)	23 (69.7)	16 (100.0)	47 (82.5)	0.042
	Yes		21 (17.5)	1 (7.1)	10 (30.3)		10 (17.5)	
Tocilizumab, n (%)	No	0	112 (93.3)	14 (100.0)	29 (87.9)	15 (93.8)	54 (94.7)	0.430
	Yes		8 (6.7)		4 (12.1)	1 (6.2)	3 (5.3)	
Convalescent plasma, n (%)	No	0	74 (61.7)	11 (78.6)	18 (54.5)	12 (75.0)	33 (57.9)	0.267
	Yes		46 (38.3)	3 (21.4)	15 (45.5)	4 (25.0)	24 (42.1)	
	No	0	58 (48.3)	7 (50.0)	14 (42.4)	8 (50.0)	29 (50.9)	0.887

Full dose anticoagulation Given, n (%)	Yes		62 (51.7)	7 (50.0)	19 (57.6)	8 (50.0)	28 (49.1)	
Anticoagulation type: Lovenox, n (%)	No	0	82 (68.3)	10 (71.4)	21 (63.6)	14 (87.5)	37 (64.9)	0.331
	Yes		38 (31.7)	4 (28.6)	12 (36.4)	2 (12.5)	20 (35.1)	
Anticoagulation type: Heparin, n (%)	No	0	88 (73.3)	11 (78.6)	26 (78.8)	9 (56.2)	42 (73.7)	0.378
	Yes		32 (26.7)	3 (21.4)	7 (21.2)	7 (43.8)	15 (26.3)	
Anticoagulation type: not given, n (%)	No	0	69 (57.5)	7 (50.0)	19 (57.6)	10 (62.5)	33 (57.9)	0.921
	Yes		51 (42.5)	7 (50.0)	14 (42.4)	6 (37.5)	24 (42.1)	
Diuretics, n (%)	No	0	34 (28.3)	6 (42.9)	6 (18.2)	9 (56.2)	13 (22.8)	0.018
	Yes		86 (71.7)	8 (57.1)	27 (81.8)	7 (43.8)	44 (77.2)	
Vasopressors given, n (%)	No	0	43 (35.8)	4 (28.6)	10 (30.3)	11 (68.8)	18 (31.6)	0.033
	Yes		77 (64.2)	10 (71.4)	23 (69.7)	5 (31.2)	39 (68.4)	
Pressor type: Levophed, n (%)	No	0	43 (35.8)	4 (28.6)	10 (30.3)	11 (68.8)	18 (31.6)	0.033
	Yes		77 (64.2)	10 (71.4)	23 (69.7)	5 (31.2)	39 (68.4)	
Pressor type: Vasopressin, n (%)	No	0	70 (58.3)	9 (64.3)	18 (54.5)	14 (87.5)	29 (50.9)	0.063
	Yes		50 (41.7)	5 (35.7)	15 (45.5)	2 (12.5)	28 (49.1)	
Pressor type: Phenylephrine, n (%)	No	0	96 (80.0)	12 (85.7)	26 (78.8)	16 (100.0)	42 (73.7)	0.125
	Yes		24 (20.0)	2 (14.3)	7 (21.2)		15 (26.3)	
Pressor type: Epinephrine, n (%)	No	0	111 (92.5)	14 (100.0)	30 (90.9)	16 (100.0)	51 (89.5)	0.347
	Yes		9 (7.5)		3 (9.1)		6 (10.5)	
Pressor type: Dopamine, n (%)	No	0	118 (98.3)	14 (100.0)	32 (97.0)	16 (100.0)	56 (98.2)	0.829
	Yes		2 (1.7)		1 (3.0)		1 (1.8)	

Pressor type: Angiotensin II, n (%)	No	0	119 (99.2)	14 (100.0)	32 (97.0)	16 (100.0)	57 (100.0)	0.447
	Yes		1 (0.8)		1 (3.0)			
Tracheostomy, n (%)	No	36	72 (85.7)	7 (87.5)	25 (86.2)	9 (100.0)	31 (81.6)	0.561
	Yes		12 (14.3)	1 (12.5)	4 (13.8)		7 (18.4)	
Extubation, n (%)	No	52	36 (52.9)	3 (60.0)	11 (40.7)	2 (66.7)	20 (60.6)	0.437
	Yes		32 (47.1)	2 (40.0)	16 (59.3)	1 (33.3)	13 (39.4)	
Total length of stay (days) , median [Q1,Q3]		0	12.0 [7.0,25.2]	9.5 [5.8,15.8]	15.0 [9.0,28.0]	9.5 [4.0,16.8]	12.0 [8.0,27.0]	0.141
ICU length of stay (days), median [Q1,Q3]		1	7.0 [2.0,14.5]	5.5 [2.2,10.2]	10.0 [5.0,19.0]	2.0 [2.0,5.0]	7.0 [4.0,15.0]	0.008
Deceased, n (%)	No	1	49 (41.2)	7 (50.0)	15 (45.5)	9 (56.2)	18 (32.1)	0.252
	Yes		70 (58.8)	7 (50.0)	18 (54.5)	7 (43.8)	38 (67.9)	
dispo, n (%)	Home	1	16 (13.4)	1 (7.1)	4 (12.1)	4 (25.0)	7 (12.5)	0.369
	Home with home health care		11 (9.2)	1 (7.1)	4 (12.1)	3 (18.8)	3 (5.4)	
	Skilled nursing facility		6 (5.0)	1 (7.1)	3 (9.1)	1 (6.2)	1 (1.8)	
	Long term acute care		4 (3.4)		1 (3.0)		3 (5.4)	
	Hospice		12 (10.1)	4 (28.6)	3 (9.1)	1 (6.2)	4 (7.1)	
	Deceased		70 (58.8)	7 (50.0)	18 (54.5)	7 (43.8)	38 (67.9)	

Table V. Clinical Variables grouped by Mortality and Hospice

Grouped by mortality and hospice						
		Missing	Overall	No	Yes	P-Value
Pneumothorax, n (%)	No	0	111 (92.5)	36 (94.7)	75 (91.5)	0.718
	Yes		9 (7.5)	2 (5.3)	7 (8.5)	
Acute kidney injury requiring dialysis, n (%)	No	0	101 (84.2)	37 (97.4)	64 (78.0)	0.015
	Yes		19 (15.8)	1 (2.6)	18 (22.0)	
Atrial fibrillation, n (%)	No	0	76 (63.3)	27 (71.1)	49 (59.8)	0.322
	Yes		44 (36.7)	11 (28.9)	33 (40.2)	
Cardiac arrest, n (%)	No	0	69 (57.5)	37 (97.4)	32 (39.0)	<0.001
	Yes		51 (42.5)	1 (2.6)	50 (61.0)	
COBID myocarditis, n (%)	No	0	109 (90.8)	32 (84.2)	77 (93.9)	0.100
	Yes		11 (9.2)	6 (15.8)	5 (6.1)	
Stroke, n (%)	No	0	112 (93.3)	36 (94.7)	76 (92.7)	1.000
	Yes		8 (6.7)	2 (5.3)	6 (7.3)	
Pulmonary embolism, n (%)	No	0	116 (96.7)	36 (94.7)	80 (97.6)	0.590
	Yes		4 (3.3)	2 (5.3)	2 (2.4)	
DVT, n (%)	No	0	110 (91.7)	32 (84.2)	78 (95.1)	0.071
	Yes		10 (8.3)	6 (15.8)	4 (4.9)	
Acute limb ischemia, n (%)	No	0	117 (97.5)	38 (100.0)	79 (96.3)	0.551

	Yes		3 (2.5)		3 (3.7)	
Temperature min (°C), median [Q1,Q3]		1	36.0 [34.5,36.4]	36.2 [36.0,36.4]	35.5 [34.0,36.3]	0.007
Temperature max (°C), median [Q1,Q3]		1	38.3 [37.4,39.1]	38.1 [37.3,39.2]	38.5 [37.4,39.1]	0.950
Mean arterial pressure, median [Q1,Q3]		2	81.5 [63.0,97.8]	88.5 [68.5,114.8]	79.0 [61.0,91.0]	0.009
Mean arterial pressure min, median [Q1,Q3]		0	42.5 [33.8,55.0]	48.5 [39.5,59.0]	40.0 [30.0,50.8]	0.003
Heart rate (bpm), median [Q1,Q3]		2	92.0 [78.0,109.5]	86.0 [73.8,106.5]	94.0 [80.0,110.0]	0.117
Heart rate max (bpm), median [Q1,Q3]		0	135.0 [116.0,150.0]	122.0 [104.2,146.2]	137.0 [123.2,150.0]	0.044
Respiratory rate (rpm), median [Q1,Q3]		2	25.0 [20.0,30.0]	25.0 [21.2,28.0]	25.0 [20.0,30.0]	0.773
Respiratory rate max (rpm), median [Q1,Q3]		0	40.0 [34.8,48.0]	41.0 [33.8,49.0]	40.0 [35.0,47.0]	0.429
Oxygen saturation (%), median [Q1,Q3]		2	88.5 [80.0,96.8]	91.5 [80.2,97.8]	88.0 [80.0,96.0]	0.478
Oxygen saturation min (%), median [Q1,Q3]		0	74.0 [60.8,83.0]	78.0 [65.0,84.8]	74.0 [57.2,80.8]	0.044
Ferritin max (ng/mL), median [Q1,Q3]		28	1151.5 [483.8,1780.0]	1128.0 [332.0,1628.0]	1175.0 [685.5,1837.0]	0.299
D-Dimer (ng/mL), median [Q1,Q3]		40	2.4 [1.1,7.2]	1.4 [0.9,3.3]	3.3 [1.3,9.0]	0.043
D-Dimer max (ng/mL), median [Q1,Q3]		24	4.0 [1.9,13.1]	3.2 [1.5,10.1]	4.9 [2.3,15.0]	0.129
CRP (mg/dL), median [Q1,Q3]		46	13.1 [6.3,15.8]	12.4 [7.0,16.7]	13.9 [6.2,15.6]	0.811
CRP max (mg/dL), median [Q1,Q3]		28	14.6 [7.7,19.0]	13.2 [5.1,18.8]	14.8 [11.5,19.0]	0.223
Lymphocytes (10e3/µL %), median [Q1,Q3]		4	7.0 [4.0,11.0]	9.0 [4.2,11.8]	6.0 [4.0,10.8]	0.310
Lymphocytes min (10e3/µL %), median [Q1,Q3]		1	3.0 [2.0,6.0]	4.0 [3.0,6.0]	3.0 [2.0,5.0]	0.047

Leukocytes (10e3 /µL), median [Q1,Q3]		0	11.0 [8.0,15.8]	11.6 [7.3,14.3]	10.9 [8.1,17.6]	0.431
Leukocytes max (10e3 /µL), median [Q1,Q3]		0	17.5 [13.3,24.6]	14.9 [11.8,17.9]	19.4 [13.9,25.6]	0.014
Procalcitonin (ng/mL), median [Q1,Q3]		64	0.6 [0.2,1.9]	0.3 [0.2,2.0]	1.0 [0.2,1.7]	0.365
Procalcitonin max (ng/mL), median [Q1,Q3]		46	1.0 [0.2,3.8]	0.6 [0.2,3.9]	1.1 [0.3,3.8]	0.368
Platelets (10e3/mm3), median [Q1,Q3]		0	214.5 [142.8,290.0]	240.0 [196.5,297.0]	186.0 [132.8,288.0]	0.030
Platelets max (10e3/mm3), median [Q1,Q3]		0	282.0 [179.0,370.5]	324.0 [244.0,456.2]	257.0 [166.2,327.8]	0.001
Bilirubin (mg/dL), median [Q1,Q3]		9	0.7 [0.4,0.9]	0.7 [0.5,1.0]	0.6 [0.4,0.9]	0.112
Bilirubin max (mg/dL), median [Q1,Q3]		2	1.0 [0.7,1.5]	1.0 [0.7,1.5]	1.0 [0.7,1.5]	0.727
Troponin (ng/mL), median [Q1,Q3]		56	0.1 [0.0,0.3]	0.1 [0.0,0.5]	0.1 [0.0,0.2]	0.883
Troponin max (ng/mL), median [Q1,Q3]		43	0.2 [0.0,0.8]	0.1 [0.0,0.6]	0.2 [0.0,0.9]	0.529
PaO2/FiO2 at intubation, median [Q1,Q3]		16	94.0 [66.8,146.2]	100.0 [63.5,133.0]	94.0 [68.8,152.2]	0.980
PaO2/FiO2 min, median [Q1,Q3]		11	80.0 [54.0,114.0]	91.0 [59.5,142.5]	73.5 [53.0,104.8]	0.121
PaCO2 (mmHg), median [Q1,Q3]		16	44.0 [35.0,57.5]	42.0 [36.0,53.8]	45.0 [35.0,60.5]	0.654
PacCO3 max (mmHg), median [Q1,Q3]		11	55.0 [38.0,77.0]	54.0 [39.0,69.0]	55.5 [36.5,79.0]	0.692
Intubated, n (%)	No	0	55 (45.8)	20 (52.6)	35 (42.7)	0.412
	Yes		65 (54.2)	18 (47.4)	47 (57.3)	
Oxygenation: Nasal cannula, n (%)	No	0	36 (30.0)	4 (10.5)	32 (39.0)	0.003
	Yes		84 (70.0)	34 (89.5)	50 (61.0)	

Oxygenation: Venti-mask, n (%)	No	0	103 (85.8)	30 (78.9)	73 (89.0)	0.234
	Yes		17 (14.2)	8 (21.1)	9 (11.0)	
Oxygenation: NRB, n (%)	No	0	21 (17.5)	10 (26.3)	11 (13.4)	0.141
	Yes		99 (82.5)	28 (73.7)	71 (86.6)	
Oxygenation: HIFLOW, n (%)	No	0	54 (45.0)	14 (36.8)	40 (48.8)	0.305
	Yes		66 (55.0)	24 (63.2)	42 (51.2)	
Oxygenation: BiPAP, n (%)	No	0	55 (45.8)	19 (50.0)	36 (43.9)	0.670
	Yes		65 (54.2)	19 (50.0)	46 (56.1)	
Oxygenation: Mechanical ventilation, n (%)	No	0	55 (45.8)	20 (52.6)	35 (42.7)	0.412
	Yes		65 (54.2)	18 (47.4)	47 (57.3)	
Number of modes of mechanical ventilation used, n (%)	0.0	53	1 (1.5)	1 (5.3)		0.349
	1.0		29 (43.3)	8 (42.1)	21 (43.8)	
	2.0		27 (40.3)	7 (36.8)	20 (41.7)	
	3.0		8 (11.9)	2 (10.5)	6 (12.5)	
	4.0		1 (1.5)	1 (5.3)		
	5.0		1 (1.5)		1 (2.1)	
Mechanical ventilation mode: PRVC, n (%)	No	0	64 (53.3)	21 (55.3)	43 (52.4)	0.927
	Yes		56 (46.7)	17 (44.7)	39 (47.6)	
Mechanical ventilation mode: Volume control, n (%)	No	0	84 (70.0)	29 (76.3)	55 (67.1)	0.416
	Yes		36 (30.0)	9 (23.7)	27 (32.9)	

Mechanical ventilation mode: Pressure control, n (%)	No	0	110 (91.7)	35 (92.1)	75 (91.5)	1.000
	Yes		10 (8.3)	3 (7.9)	7 (8.5)	
Mechanical ventilation mode: APRV, n (%)	No	0	120 (100.0)	38 (100.0)	82 (100.0)	1.000
Mechanical ventilation mode: CMV, n (%)	No	0	115 (95.8)	37 (97.4)	78 (95.1)	1.000
	Yes		5 (4.2)	1 (2.6)	4 (4.9)	
Mechanical ventilation mode: SIMV, n (%)	No	0	115 (95.8)	36 (94.7)	79 (96.3)	0.651
	Yes		5 (4.2)	2 (5.3)	3 (3.7)	
Patient on mechanical ventilation on ICU admission, n (%)	No	45	38 (50.7)	11 (50.0)	27 (50.9)	0.858
	Yes		37 (49.3)	11 (50.0)	26 (49.1)	
Days from hospital admission to mechanical ventilation, median [Q1,Q3]		54	5.0 [1.0,10.0]	4.0 [1.0,6.5]	5.0 [1.0,11.0]	0.323
Tidal volume max, median [Q1,Q3]		54	490.0 [422.5,500.0]	485.0 [442.5,507.5]	490.0 [420.0,500.0]	0.715
Tidal volume min, median [Q1,Q3]		54	400.0 [340.0,450.0]	400.0 [350.0,447.5]	400.0 [337.5,450.0]	0.740
Tidal volume≤ 6 ml/kg at intubation, n (%)	No	56	45 (70.3)	13 (72.2)	32 (69.6)	0.924
	Yes		19 (29.7)	5 (27.8)	14 (30.4)	
Tidal volume (ml/kg), median [Q1,Q3]		0	5.6 [0.0,6.7]	0.0 [0.0,6.5]	5.8 [0.0,6.7]	0.515
Tidal volume max (ml/kg), median [Q1,Q3]		54	7.4 [6.9,8.1]	7.2 [6.9,7.9]	7.4 [7.0,8.1]	0.676
Tidal volume min (ml/kg), median [Q1,Q3]		54	6.0 [5.8,6.5]	6.0 [5.7,6.5]	6.0 [5.8,6.5]	0.751
Positive end expiratory pressure/PEEP (cm H2O), median [Q1,Q3]		56	10.0 [8.0,13.2]	12.0 [10.0,14.0]	10.0 [8.0,12.0]	0.038
PEEP max (cm H2O), median [Q1,Q3]		54	14.0 [10.0,16.0]	14.0 [12.0,15.8]	14.0 [10.0,16.0]	1.000

PEEP min (cm H2O), median [Q1,Q3]		54	6.0 [5.0,10.0]	5.0 [5.0,7.5]	7.5 [5.0,10.0]	0.050
PEEP>12 (cm H20), n (%)	No	54	26 (39.4)	7 (38.9)	19 (39.6)	0.817
	Yes		40 (60.6)	11 (61.1)	29 (60.4)	
FiO2, median [Q1,Q3]		56	100.0 [100.0,100.0]	100.0 [100.0,100.0]	100.0 [100.0,100.0]	0.336
Respiratory rate (bpm), median [Q1,Q3]		56	25.0 [21.5,28.5]	24.5 [21.0,28.0]	27.0 [22.0,30.0]	0.469
Respiratory rate max (bpm), median [Q1,Q3]		54	35.5 [30.2,40.0]	35.0 [30.2,42.8]	36.0 [30.8,40.0]	0.862
Plateau pressure (cmH2O), median [Q1,Q3]		59	26.0 [21.0,30.0]	24.5 [21.2,29.2]	27.0 [21.0,30.0]	0.716
Plateau pressure max (cmH2O), median [Q1,Q3]		56	33.0 [25.8,38.0]	30.0 [25.0,35.8]	34.0 [27.2,39.5]	0.468
Driving pressure (cm H20), median [Q1,Q3]		59	15.0 [11.0,17.0]	13.5 [10.0,15.0]	16.0 [12.0,18.5]	0.059
Respiratory system static compliance (ml/cm H20), median [Q1,Q3]		59	31.2 [23.7,38.5]	35.7 [30.3,45.0]	29.4 [23.4,36.2]	0.074
Ventilatory ratio max, median [Q1,Q3]		57	2.2 [2.0,2.9]	2.5 [2.0,2.9]	2.1 [2.0,2.9]	0.272
Prone, n (%)	No	1	96 (80.7)	29 (76.3)	67 (82.7)	0.565
	Yes		23 (19.3)	9 (23.7)	14 (17.3)	
Neuromuscular blockers, n (%)	No	1	87 (73.1)	28 (73.7)	59 (72.8)	0.901
	Yes		32 (26.9)	10 (26.3)	22 (27.2)	
Antibiotics given, n (%)	No	0	12 (10.0)	8 (21.1)	4 (4.9)	0.017
	Yes		108 (90.0)	30 (78.9)	78 (95.1)	
Steroid given, n (%)	No	0	19 (15.8)	5 (13.2)	14 (17.1)	0.781
	Yes		101 (84.2)	33 (86.8)	68 (82.9)	

Steroid: Hydrocortisone stress dose, n (%)	No	0	98 (81.7)	35 (92.1)	63 (76.8)	0.079
	Yes		22 (18.3)	3 (7.9)	19 (23.2)	
Steroid: DEXA-ARDS, n (%)	No	0	99 (82.5)	31 (81.6)	68 (82.9)	0.938
	Yes		21 (17.5)	7 (18.4)	14 (17.1)	
Steroid: RECOVERY, n (%)	No	0	53 (44.2)	12 (31.6)	41 (50.0)	0.091
	Yes		67 (55.8)	26 (68.4)	41 (50.0)	
Steroid: Other, n (%)	No	0	102 (85.0)	36 (94.7)	66 (80.5)	0.079
	Yes		18 (15.0)	2 (5.3)	16 (19.5)	
Remdesivir, n (%)	No	0	56 (46.7)	19 (50.0)	37 (45.1)	0.763
	Yes		64 (53.3)	19 (50.0)	45 (54.9)	
Hydroxychloroquine, n (%)	No	0	99 (82.5)	31 (81.6)	68 (82.9)	0.938
	Yes		21 (17.5)	7 (18.4)	14 (17.1)	
Tocilizumab, n (%)	No	0	112 (93.3)	34 (89.5)	78 (95.1)	0.261
	Yes		8 (6.7)	4 (10.5)	4 (4.9)	
Convalescent plasma, n (%)	No	0	74 (61.7)	22 (57.9)	52 (63.4)	0.706
	Yes		46 (38.3)	16 (42.1)	30 (36.6)	
Full dose anticoagulation Given, n (%)	No	0	58 (48.3)	17 (44.7)	41 (50.0)	0.734
	Yes		62 (51.7)	21 (55.3)	41 (50.0)	
Anticoagulation type: Lovenox, n (%)	No	0	82 (68.3)	26 (68.4)	56 (68.3)	0.844
	Yes		38 (31.7)	12 (31.6)	26 (31.7)	

Anticoagulation type: Heparin, n (%)	No	0	88 (73.3)	28 (73.7)	60 (73.2)	0.871
	Yes		32 (26.7)	10 (26.3)	22 (26.8)	
Anticoagulation type: not given, n (%)	No	0	69 (57.5)	24 (63.2)	45 (54.9)	0.512
	Yes		51 (42.5)	14 (36.8)	37 (45.1)	
Diuretics, n (%)	No	0	34 (28.3)	9 (23.7)	25 (30.5)	0.581
	Yes		86 (71.7)	29 (76.3)	57 (69.5)	
Vasopressors given, n (%)	No	0	43 (35.8)	20 (52.6)	23 (28.0)	0.016
	Yes		77 (64.2)	18 (47.4)	59 (72.0)	
Pressor type: Levophed, n (%)	No	0	43 (35.8)	20 (52.6)	23 (28.0)	0.016
	Yes		77 (64.2)	18 (47.4)	59 (72.0)	
Pressor type: Vasopressin, n (%)	No	0	70 (58.3)	29 (76.3)	41 (50.0)	0.012
	Yes		50 (41.7)	9 (23.7)	41 (50.0)	
Pressor type: Phenylephrine, n (%)	No	0	96 (80.0)	35 (92.1)	61 (74.4)	0.044
	Yes		24 (20.0)	3 (7.9)	21 (25.6)	
Pressor type: Epinephrine, n (%)	No	0	111 (92.5)	38 (100.0)	73 (89.0)	0.056
	Yes		9 (7.5)		9 (11.0)	
Pressor type: Dopamine, n (%)	No	0	118 (98.3)	36 (94.7)	82 (100.0)	0.098
	Yes		2 (1.7)	2 (5.3)		
Pressor type: Angiotensin II, n (%)	No	0	119 (99.2)	38 (100.0)	81 (98.8)	1.000
	Yes		1 (0.8)		1 (1.2)	

Tracheostomy, n (%)	No	36	72 (85.7)	19 (76.0)	53 (89.8)	0.169
	Yes		12 (14.3)	6 (24.0)	6 (10.2)	
Extubation, n (%)	No	52	36 (52.9)	6 (31.6)	30 (61.2)	0.054
	Yes		32 (47.1)	13 (68.4)	19 (38.8)	
Total length of stay (days) , median [Q1,Q3]		0	12.0 [7.0,25.2]	16.0 [10.2,29.5]	11.0 [6.0,22.2]	0.022
ICU length of stay (days), median [Q1,Q3]		1	7.0 [2.0,14.5]	7.5 [3.2,22.2]	6.0 [2.0,13.0]	0.143

Figure I.

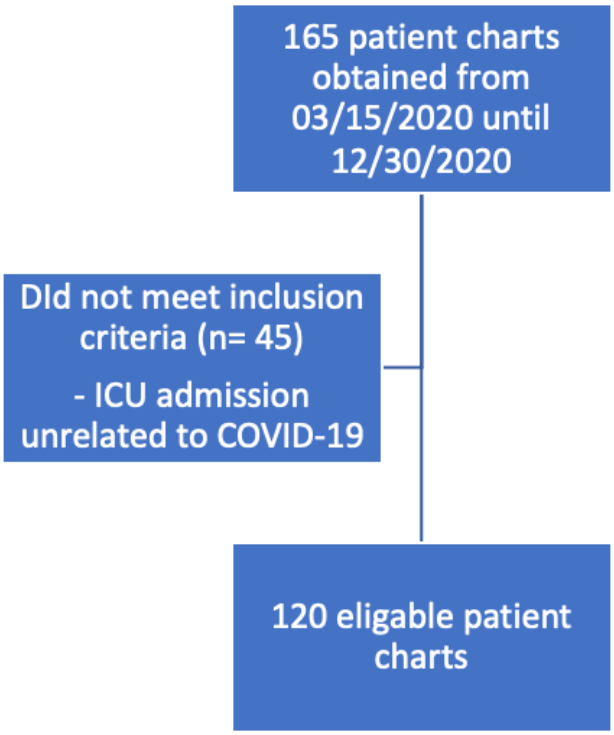


Figure II.

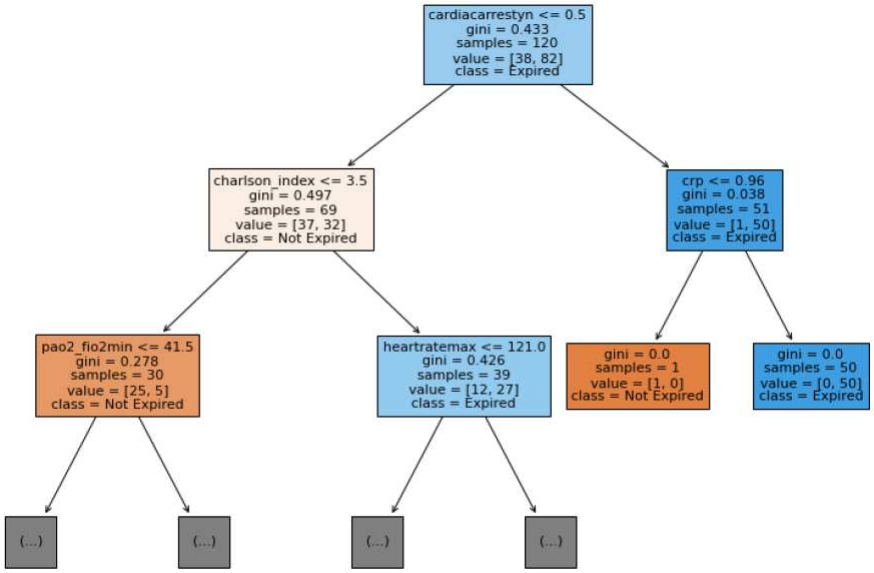
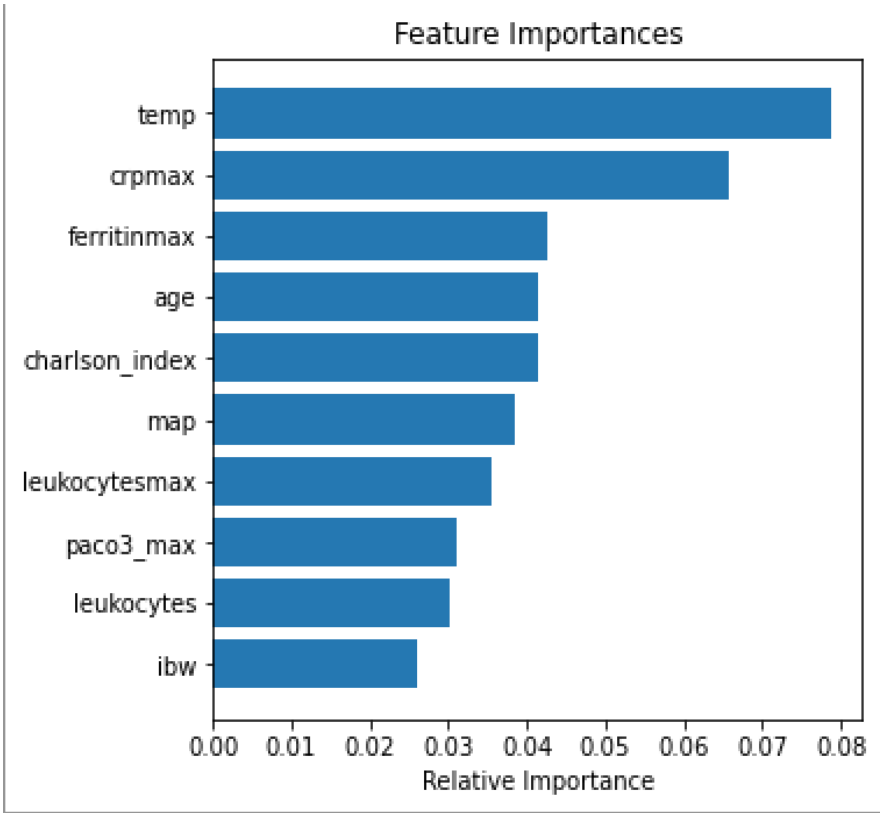


Figure III.



LIST OF ABBREVIATIONS

- Acute respiratory distress syndrome (ARDS)
- Chronic obstructive pulmonary disease (COPD)
- Coronavirus Disease 2019 (COVID-19)
- C-reactive protein (CRP)
- Intensive care unit (ICU)
- Positive end-expiratory pressure (PEEP)

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- STARDChecklist.docx