Risk factors associated with critical COVID-19 requiring mechanical ventilation

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Background

- The global pandemic due SARS CoV-2, the novel coronavirus that causes COVID-19, which started in Wuhan, China in December 2019, has had a profound impact on communities and healthcare systems.
- Twenty percent of patients infected with COVID-19 develop disease requiring hospitalization and up to 25% of hospitalized patients require intensive care unit (ICU) admission
- Among 5700 patients hospitalized with COVID-19 in New York, 20% required mechanical ventilation
- Understanding risk factors for requiring mechanical ventilation may allow for more targeted monitoring and therapeutics that may improve outcomes
- We aimed to determine patient factors associated with the need for mechanical intubation at our institution

Methods

- We performed a retrospective case series of all patients admitted within thirty days of a positive SARS CoV-2 PCR test to an integrated health system near Chicago, Illinois between March 12 and May 31, 2020
- The covariates we evaluated included demographics, symptoms on admission, vital signs, medications, comorbidities, census tract data and social history
- All vairables were extracted from the enterprise database warehouse at NorthShore University Health System
- Univariable analysis was performed and variables with an alpha of 0.05 or less were included in multivariable regression modeling to identify factors associated with mechanical ventilation
- The area under the curve (AUC) was used to assess performance of the model.

	Population N = 990
Age (yr)	68.0 [55.0-82.0]
Female	479 (48.5%)
Body Mass Index (kg/m2)	28.3 [24.6 – 32.8]
Body Mass Index >= 30 kg/m2	352 (35.6%)
Past or Current Smoker	255 (25.8%)
Race	
Caucasian	491 (49.6%)
African American	92 (9.3%)
Asian	75 (7.6%)
Ethnicity	
Hispanic/Latino	181 (18.3%)
Non-Hispanic	809 (81.7%)
Census Tract	
Median Family Income in dollars	76765.0 [57558.0-110666.0]
Percent of English Speaking Population in Census Tract	59.9 [43.5-74.5]
Symptoms on Admission	
Cough	133 (13.4%)
Shortness of Breath	411 (41.5%)
Fever	225 (22.7%)
Gastrointestinal Symptoms	60 (6.1%)
Fatigue	28 (2.8%)
Myalgia	76 (7.7%)
First Vital After Admission	
Temperature (Fahrenheit)	99.4 [98.5-100.9]
Systolic Blood Pressure (mmHg)	129.0 [116.0-144.0]
Diastolic Blood Pressure (mmHg)	76.0 [66.0-85.0]
Respiration (per minute)	22.0 [19.0-26.0]
Pulse (per minute)	94.0 [81.2-108.0]
Oxygen Saturation (percent)	94.0 [91.0-97.0]

	Population N=990
Past Medical History	
Acute Myocardial Infarction	31 (3.1%)
Asthma	78 (7.9%)
Coronary Artery Disease	133 (13.4%)
Congestive Heart Failure	12. (12.1%)
Chronic Kidney Disease	126 (12.7%)
Chronic Obstructive Pulmonary Disease	119 (12.0%)
Cerebrovascular Accident	93 (9.4%)
Diabetes	279 (28.2%)
End Stage Renal Disease	32 (3.2%)
Hematologic Malignancy	22 (2.2%)
Hypertension	48 (48.7%)
Liver Disease	56 (5.7%)
Metastatic Solid Tumor	14 (1.4%)
Peripheral vascular Disease	64 (6.5%
Solid Tumor	181 (18.3%)
Medications Taken in the Past 6 Months	
ACE/ARB	184 (18.6%)
Chemotherapy	15 (1.5%)
Insulin	88 (8.9%)
Statin	174 (17.6%)
Steroid in Last Month	55 (5.6%)

	Adjusted Odds Ratio	P-Value
Age (yr)	0.997 [0.985-1.009]	0.7023
Female	0.621 [0.427-0.903]	0.0363
Body Mass Index (Kg/m2)	1.05 [1.001-1.060]	**0.0175**
Percent of English Speaking Population	0.989 [0.979-0.998]	**0.0454**
Shortness of Breath	1.244 [0.844-1.835]	0.3549
Respiration (per minute)	1.054 [1.027-1.083]	**0.0011**
Pulse (per minute)	1.005 [0.995-1.014]	0.4005
Oxygen Saturation (percent)	0.922 [0.901-0.943]	**0.0000**
Conduction Abnormalities	0.634 [0.374-1.007]	0.1569
Cerebrovascular Accident	0.176 [0.051-0.605]	**0.0207**
Hematologic Malignancy	3.668 [1.403-9.590]	**0.0261**
Non-Hispanic	1.125 [0.706-1.795]	0.6771

Table 1 (Above top): Characteristics of patients admitted with COVID-19
Table 2 (Right): Multivariable logistic regression to identify risk factors associated with mechanical ventilation

Results

- There were 990 patients admitted with COVID-19out of which 125/990 (12.6%) were mechanically ventilated. The median age was 68 (interquartile range 55-82), 48.4% (479) were female and 49.6% (491) were Caucasian
- Independent factors associated with mechanical ventilation included female sex (p=0.0175), percent of English speaking population within patient's census tract (p=0.0011), oxygen saturation (p< 0.0001), cerebrovascular accident (p=0.0207) and hematologic malignancy (p=0.0261)
- AUC of the model was 0.8 (0.75-0.84)

Conclusions

- Risk factors associated with mechanical ventilation included male gender, elevated BMI, census tract with lower percentage of English speakers, increased respiratory rate, low oxygen saturation, hematologic malignancy and not having a cerebrovascular accident
- We suspect that history of cerebrovascular accident may have been associated with overall patient debility in which aggressive measures such as intubation were not deemed appropriate
- Low percentage of English language speakers may have increased communication barriers and delayed targeted therapy
- Identifying patients with risk factors associated with mechanical ventilation may allow for early and targeted interventions to improve outcomes

References

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