Independent Correlates of Hospitalization in 2040 Patients with COVID-19 at a Large Hospital System in Michigan, United States

KEY WORDS: COVID-19; hospitalization; epidemiology; risk factors.

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INTRODUCTION

Prognostic information about the novel coronavirus disease (COVID-19) pandemic is important for patient care. While China reported prediction models on length of stay and mortality¹ and US data is emerging, predictors for hospitalization have not been well defined yet.^{2,3} Our study aims to identify correlates for hospitalization in a large cohort of COVID-19 patients in Michigan.

METHODS

We performed a retrospective review of patients diagnosed with SARS-CoV2 infection by a positive RT-PCR on nasopharyngeal swab from the largest healthcare system in Southeast Michigan (8 hospitals), through April 1, 2020. We abstracted demographics, comorbidities, medications, and calculated disease burden with the Charlson Comorbidity Index (CCI).⁴ Logistic regression evaluated associations and multivariate analyses, including variables with *p* value <0.20 on univariate analysis (SPSS).

RESULTS

Of 2040 COVID-19 positive patients, 1305 (64.0%) were hospitalized and 735 (36.0%) were evaluated in the Emergency Department (ED), discharged home, and did not require reevaluation within 14 days.

Univariate correlates of hospitalization included: Age > 60 (OR:3.4, 95% CI: 2.8–4.1), male (OR:1.4, 95% CI: 1.2–1.7), Caucasian (OR:1.4, 95% CI: 1.0–2.0), obesity (OR:1.5, 95% CI: 1.2–1.9), CCI > 2 (OR:5.2, 95% CI: 4.2–6.5), ACE-I/ARB use (OR:2.4, 95% CI: 2.0–2.9), tachycardia (heart rate > 100 beats/min) (OR:1.6, 95% CI: 1.3–1.9), tachypnea (respiratory rate > 20 breaths/min, OR:5.3, 95% CI: 4.0–7.1), and hypoxia

(oxygen saturation < 90%, OR:21.7, 95% CI: 8.0–59.1, Table 1).

Independent correlates of hospitalization included: Age > 60 (aOR:2.1, 95% CI: 1.4–3.1), CCI > 2 (aOR:3.2, 95% CI: 2.1–4.8), male (aOR:1.9, 95% CI: 1.5–2.5), obesity (aOR:1.8, 95% CI: 1.4–2.4), ACE-I/ARB use (aOR:1.5, 95% CI: 1.1–2.0), tachycardia (aOR:1.5, 95% CI: 1.1–2.0), tachypnea (aOR:2.9, 95% CI: 2.1–4.1), and hypoxia (aOR:15.0, 95% CI: 4.7–48.0, Table 1).

DISCUSSION

We found that older age (>60 years), obesity, CCI > 2, ACE-I/ARB use, and male sex as independent correlates for hospitalization in COVID-19 patients, after controlling for objective clinical findings of illness severity of tachycardia, tachypnea, and hypoxia. Older age and higher comorbidity burden have also been reported as risk factors for mortality in hospitalized COVID-19 patients.^{2,5,6} This information can provide insight to help guide triage decisions of COVID-19 patients in the emergency center and help appropriate allocation of healthcare resources in the time of a pandemic. The main limitations of our study include its retrospective nature, limited follow-up time, and potential inaccuracies in the medical records. Additionally, the high admission rate in our cohort suggests high patient acuity hence limiting the utility of the identified correlates in other settings such as outpatient offices.

CONCLUSION

Older age, medical comorbidities, obesity, ACE-I/ARB use, and male sex are independent correlates of hospitalization in COVID-19 patients presenting to the emergency department.

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Table 1 Univariate and multivariate analyses of demographic, comorbidity and clinical indices among hospitalized and outpatient cohorts

Mortality		
Univariate Analysis	OR (95% CI)	P value
Demographics		
Age > 60 years	3.4 (2.8,4.1)	<0.0005
Male	1.4 (1.2,1.7)	<0.0005
Caucasian Race compared to African-American	1.4 (1.0,2.0)	0.037
Other Race compared to African-American	0.87 (0.61,1.3)	0.467
Smoking history	1.4 (0.83, 2.3)	0.212
BMI > 30	1.5 (1.2,1.9)	0.002
Medications		
NSAID use	1.0 (0.85,1.2)	0.831
ACE-I/ARB use	2.4 (2.0,2.9)	<0.0005
Comorbidities		
CCI > 2	5.2 (4.2,6.5)	<0.0005
HTN	4.4 (3.6,5.4)	<0.0005
DM	3.9 (3.0,5.1)	<0.0005
CKD	8.0 (5.0,12.9)	<0.0005
COPD	2.5 (1.6,4.0)	<0.0005
CAD/PAD	4.2 (2.8, 6.1)	<0.0005
Cancer	2.4 (1.5,4.0)	<0.0005
Heart Failure	4.4 (2.3,8.6)	<0.0005
OSA	2.2 (1.5,3.3)	<0.0005
Bronchial Asthma	1.4 (1.0,2.0)	0.053
CVA or TIA	14.3 (5.3, 39.2)	<0.0005
VTE	3.0 (1.7,5.5)	<0.0005
Dementia	2.5 (0.70,8.6)	0.162
Immunosuppression	1.2 (0.46,3.2)	0.685
Peptic Ulcer Disease	5.4 (1.3,23.3)	0.023
Connective Tissue Disease	1.9 (0.95,4.00)	0.068
Vitals Signs		
Tachycardia (HR > 100 beats/min)	1.6 (1.3,1.9)	<0.0005
Tachypnea (RR > 20 breaths/min)	5.3 (4.0,7.1)	<0.0005
Hypoxia (SpO ₂ < 90%)	21.7 (8.0,59.1)	<0.0005
Multivariate Analysis		
Variable	aOR (95% CI)	P value
Age > 60	2.1 (1.4,3.1)	0.015
CCI > 2 ¹	3.2 (2.1,4.8)	<0.0005
Male	1.9 (1.5,2.5)	<0.0005
Caucasian Race compared to African-American	1.4 (0.83,2.3)	0.220
ACE-I/ARB use	1.5 (1.1,2.0)	0.015
Other race compared to African-American	0.90 (0.53,1.6)	0.709
BMI > 30	1.8 (1.4,2.4)	<0.0005
Tachycardia (HR > 100 bpm)	1.5 (1.1,2.0)	0.007
Tachypnea (RR > 20 breaths/min)	2.9 (2.1,4.1)	<0.0005
Hypoxia (SpO ₂ < 90%)	15.0 (4.7,48.0)	<0.0005

Abbreviations: CKD, chronic kidney disease; COPD: chronic obstructive pulmonary disease; OSA: Obstructive Sleep Apnea; HTN, hypertension; VTE, venous thromboembolic disease; TIA, Transient Ischemic Attack; CVA, Cerebrovascular Accident; NSAIDs: Non-steroidal anti-inflammatory medication; ACE-I: angiotensin converting enzyme-inhibitor; ARB: angiotensin receptor blocker; OR: Odds ratio; aOR: adjusted odds ratio; CI, confidence interval; CAD, coronary artery disease; PAD, peripheral artery disease; CCI, Charlson Comorbidity Index; RR: respiratory rate; HR, heart rate; SpO₂, oxygen saturation; BMI, body mass index; bpm, beats per minute
CCI utilized in multivariate analysis as surrogate for comorbidities

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Author Contributions A.H. was involved with the development and implementation of the study design and methods and revised the manuscript. All authors were involved with manuscript preparation, multiple draft revisions, conception of tables and have reviewed and approved the manuscript for submission.

A.H., F.O. and Z.I. had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

Compliance with Ethical Standards:

Conflict of Interest: None.

Conflict of Interest: The inpatient cohort reported in this manuscript has been evaluated by our research group for mortality correlates separately in another study that is currently accepted for publication. The outpatient cohort is part of a larger cohort that was analyzed in a separate study currently submitted for publication. Neither of these studies evaluated the outcomes reported in this study or compared the two cohorts of patients.

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