Pseudo-safety in a cohort of patients with COVID-19 discharged home from the emergency department

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ABSTRACT

Introduction EDs are often the first line of contact with individuals infected with COVID-19 and play a key role in triage. However, there is currently little specific guidance for deciding when patients with COVID-19 require hospitalisation and when they may be safely observed as an outpatient.

Methods In this retrospective study, we characterised all patients with COVID-19 discharged home from EDs in our US multisite healthcare system from March 2020 to August 2020, focusing on individuals who returned within 2 weeks and required hospital admission. We restricted analyses to first-encounter data that do not depend on laboratory or imaging diagnostics in order to inform point-of-care assessments in resource-limited environments. Vitals and comorbidities were extracted from the electronic health record. We performed ordinal logistic regression analyses to identify predictors of inpatient admission, intensive care and intubation.

Results Of n=923 patients who were COVID-19 positive discharged from the ED, n=107 (11.6%) returned within 2 weeks and were admitted. In a multivariable-adjusted model including n=788 patients with complete risk factor information, history of hypertension increased odds of hospitalisation and severe illness by 1.92-fold (95% CI 1.07 to 3.41), diabetes by 2.20-fold (1.18 to 4.02), chronic lung disease by 2.21-fold (1.22 to 3.92) and fever by 2.89-fold (1.71 to 4.82). Having at least two of these risk factors increased the odds of future hospitalisation by 6.68-fold (3.54 to 12.70). Patients with hypertension, diabetes, chronic lung disease or fever had significantly longer hospital stays (median 5.92 days, 3.08–10.95 vs 3.21, 1.10–5.75, p<0.01) with numerically higher but not significantly different rates of intensive care unit admission (27.02% vs 14.30%, p=0.27) and intubation (12.16% vs 7.14%, p=0.71).

Discussion Patients infected with COVID-19 may appear clinically safe for home convalescence. However, those with hypertension, diabetes, chronic lung disease and fever may in fact be only 'pseudo-safe' and are most at risk for subsequent hospitalisation with more severe illness and longer hospital stays.

Key messages

What is already known on this subject

- Individuals infected with COVID-19 may initially present to the emergency department with mild symptoms but are at risk for rapid deterioration days after disease onset, thus complicating the decision for who to discharge home versus who to admit for inpatient care.

What this study adds

- This multisite retrospective study of patients with COVID-19 discharged from the emergency department found that individuals with a history of hypertension, chronic lung disease, diabetes and/or a fever on presentation, had an especially high risk for developing later severe illness requiring hospitalisation (nearly sevenfold risk if at least two of these risk factors were present), despite having an initial appearance of clinical stability.
- These risk factors should be considered when developing more specific protocols for deciding which COVID-19 infected patients are safe to convalesce at home and which may need more intensive outpatient monitoring.

INTRODUCTION

The swift transmission of COVID-19 worldwide has posed numerous challenges to front-line providers, not the least of which relates to clinical triage.[1] Patients with COVID-19 infection can develop variable degrees of illness severity amidst a diverse range of possible clinical signs and symptoms.[2] A critical decision point for all front-line providers pertains to whether or not a given patient is at high risk for severe illness and thus needs inpatient care as opposed to convalescence at home. Early reports have suggested that some patients with COVID-19 have paradoxically mild presentations at first encounter but are prone to subsequent rapid deterioration.[3] Existing guidelines have few specific criteria for helping identify which patients may be most at risk for subsequent decompensation and should be monitored more closely or admitted to the hospital.[4–6] We examined the extent to which some first-encounter presentations convey an overall picture of clinical stability that precedes the later development of more severe illness.

METHODS

We performed a retrospective study from 1 March 2020 to 24 August 2020 of all patients with SARS-CoV-2 infection, confirmed by reverse transcriptase PCR of RNA extracted from nasopharyngeal swabs, who were discharged home from EDs in our US multisite healthcare system. Providers discharged patients from the ED according to individualised assessments of clinical stability and comorbidities. We focused our analyses on first-encounter data that do not depend on laboratory or imaging diagnostics in order to inform point-of-care

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Table 1 Characteristics associated with hospitalisation and severity of illness following discharge from the ED

	Age-and sex- adjusted model		Multivariable-adjusted model*	
	OR (95% CI)	P value	OR (95% CI)	P value
Age, per 10 years	**1.48 (1.32 to 1.66)**	**<0.001**	**1.34 (1.10 to 1.48)**	**<0.001**
Male sex	1.27 (0.84 to 1.93)	0.27	–	–
African-American race	0.77 (0.41 to 1.34)	0.38	0.48 (0.23 to 0.92)	0.05
Hispanic ethnicity	0.75 (0.47 to 1.19)	0.23	0.61 (0.36 to 1.02)	0.06
Obesity	2.13 (1.23 to 3.59)	0.01	–	
Hypertension	**2.11 (1.30 to 3.40)**	**0.002**	**1.92 (1.07 to 3.41)**	**0.03**
Diabetes mellitus	**2.78 (1.64 to 4.62)**	**<0.001**	**2.20 (1.18 to 4.02)**	**0.01**
Prior myocardial infarction or heart failure	3.13 (1.48 to 6.40)	0.002	1.94 (0.80 to 4.54)	0.13
Prior COPD or asthma	**2.69 (1.59 to 4.45)**	**<0.001**	**2.21 (1.22 to 3.92)**	**0.01**
Chronic kidney disease	3.23 (1.50 to 6.75)	0.002	2.04 (0.83 to 4.82)	0.11
Systolic blood pressure, per 10 mm Hg†	**0.84 (0.74 to 0.95)**	**0.005**	**0.74 (0.66 to 0.90)**	**<0.001**
Diastolic blood pressure, per 10 mm Hg†	0.79 (0.65 to 0.95)	0.02	–	–
Heart rate, per 10 beats per minute†	0.93 (0.81 to 1.06)	0.29	–	–
Respiratory rate†	1.04 (0.96 to 1.13)	0.29	–	–
Oxygen saturation†	0.97 (0.86 to 1.10)	0.64	–	–
Maximal temperature >100.4°Fahrenheit†	**2.30 (1.41 to 3.71)**	**<0.001**	**2.89 (1.71 to 4.82)**	**<0.001**

The primary outcome of COVID-19 severity score in the total sample was defined as an ordinal variable wherein: 0=never admitted, 1=admitted but never required intensive care, 2=required intensive care but never intubation and 3=required intubation.
All comorbidities (obesity, hypertension, diabetes mellitus, prior myocardial infarction or heart failure, prior COPD or asthma chronic kidney disease) were identified by ICD coding according to standard Elixhauser comorbidity definitions.[8]
Bolded characteristics were significant at a P value < 0.05 for both the Age- and sex-adjusted model as well as the Multivariable-adjusted model.
*To avoid model overfitting given the sample size, covariates included in the multivariable model were selected using stepwise backward selection by AIC.
†All vital signs were measured during the patient's first clinical encounter in the ED.
AIC, Akaike Information Criteria; COPD, chronic obstructive pulmonary disease.

assessments made in resource-limited environments. This included vital signs and clinical comorbidities identified as risk factors for severe illness in patients with COVID-19.[3 7] These data were extracted from the electronic health records (EHRs) system and International Classification of Diseases (ICD)-10 codes. All comorbidities (obesity, hypertension, diabetes mellitus, prior myocardial infarction or heart failure, prior chronic obstructive pulmonary disease (COPD) or asthma, chronic kidney disease) were identified by ICD coding according to standard Elixhauser comorbidity definitions.[8]

We used EHR data to determine our outcome of interest: hospital admission within 2 weeks of discharge from the ED as well as whether patients required intensive care and intubation. As analyses were performed more than 2 weeks after the end of the study period (24 August 2020), we could assess the outcome status of all patients in our cohort. Since intensive care and intubation represent increasing levels in severity of the outcome (0=never admitted, 1=admitted but never required intensive care, 2=required intensive care but never intubation and 3=required intubation), we performed ordinal logistic regression analyses to identify patient risk factors associated with these events. To avoid overfitting, the final multivariable model included predictors selected using stepwise backward selection by Akaike Information Criteria (AIC). Next, using hospitalisation as a binary outcome, we performed logistic regressions looking at the cumulative effects of having 0, 1, or ≥2 of the most significant risk factors (diabetes, chronic lung disease, hypertension and fever), adjusting for the rest of the predictors selected by stepwise backward selection from the prior multivariable model (age, African American race, Hispanic ethnicity, prior myocardial infarction or heart failure, chronic kidney disease, systolic blood pressure on presentation). Among patients who were discharged from the ED and later admitted, we assessed differences in hospital stay characteristics (length of stay, rate of intensive care unit (ICU) admission, rate of intubation). Differences in median length of stay were assessed using the Wilcoxon rank-sum test. Differences in numbers of ICU admission and intubation were assessed using χ^2 testing. Our institutional review board approved all study protocols. Patients and the public were not involved in the design, conduct, reporting

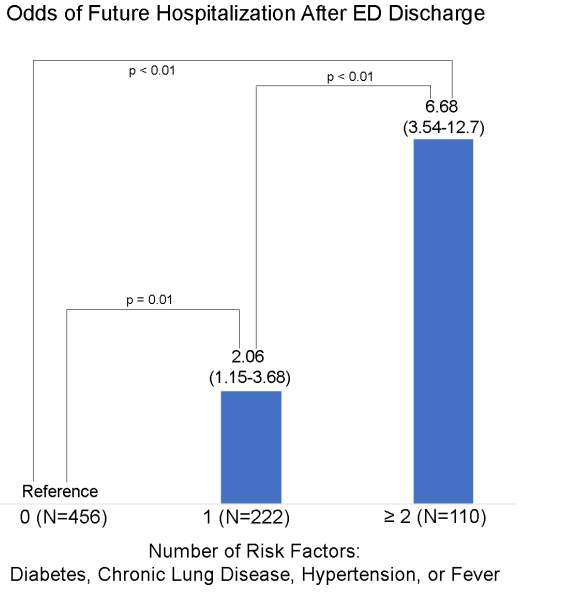

Figure 1 Odds of future hospitalisation after ED discharge. Odds (95% CI) were risk adjusted for age, African-American race, Hispanic ethnicity, prior myocardial infarction or heart failure, chronic kidney disease, first ED systolic blood pressure (ie, covariates selected by stepwise backwards regression (see table 1)). Chronic lung disease is defined as prior history of COPD or asthma. Fever is defined as a temperature >100.4°Fahrenheit. COPD, chronic obstructive pulmonary disease.

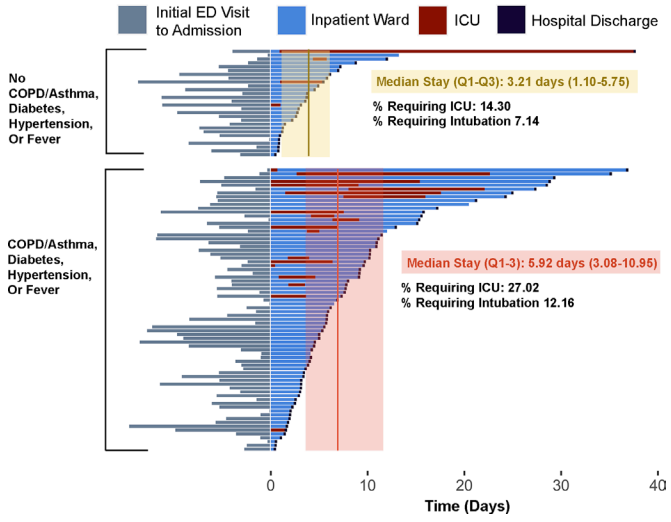

Figure 2 Outpatient and hospital course for patients with COVID-19 requiring hospital admission after recent discharge from the ED. COPD, chronic obstructive pulmonary disease; ICU, intensive care unit.

or dissemination plans of this study. All analysis was performed with R software (V.3.4.1, Vienna, Austria). We used the MASS package for stepwise predictor selection by AIC.

RESULTS

A total of n=923 COVID-19 positive patients were evaluated and discharged directly from the ED from 1 March 2020 to 24 August 2020. Of these patients, n=107 (11.6%) returned and were subsequently admitted for inpatient care within 2 weeks. The mean time from initial ED discharge to return for hospitalisation was 4.78±3.39 (mean±SD) days. A total of 788 (85%) patients had complete risk factor information and were included in multivariable analyses (online supplemental table S1 for distribution of missing data). Compared with patients who never required hospitalisation, returning patients were more likely to be older, obese, hypertensive, diabetic, have prior heart failure or myocardial infarction, prior COPD or asthma and chronic kidney disease; they were also more likely to be febrile and more hypotensive during their initial visit (table 1). In the multivariable-adjusted model, history of hypertension increased odds of hospitalisation, intensive care, and/or intubation by nearly twofold (OR 1.92, 95% CI 1.07 to 3.41), diabetes by over twofold (OR 2.20, 1.18–4.02), chronic lung disease by over twofold (OR 2.21, 1.22–3.92) and fever (defined as temperature ≥100.4° Fahrenheit) by nearly threefold (OR 2.89, 1.71–4.82). Advanced age and systolic blood pressure on presentation also had significant but lesser associations with risk (OR 1.34 per 10 years in age, 1.10–1.48); OR 0.74 per 10 mm Hg increase in systolic blood pressure, 0.66–0.90. We then considered fever, diabetes, hypertension and prior COPD or asthma together. After multivariable adjustment for other comorbidities, having one of these risk factors increased the odds of future hospitalisation by 2.06-fold (95% CI 1.15 to 3.68), while having at least two risk factors increased the odds of future hospitalisation by 6.68-fold (3.54–12.70; figure 1).

Among patients who were discharged from the ED and then returned later and were admitted, the median length of hospital stay was 5.30 days (Q1–Q3 2.68–10.12 with n=5 still admitted at time of analysis). A total of n=28 (26.2%) required intensive care and n=11 (10.28%) required intubation (figure 2). Patients with chronic lung disease, diabetes, history of hypertension or fever on presentation had significantly longer hospital stays (median 5.92 days, 3.08–10.95 vs 3.21, 1.10–5.75, p<0.01) with numerically higher but not significantly different rates of ICU admission (27.02% vs 14.30%, p=0.27) and intubation (12.16% vs 7.14%, p=0.71) than those without these presenting features.

DISCUSSION

During first-encounter evaluations being conducted on the front line of COVID-19 care, identifying which patients will require hospitalisation remains challenging.[1] Our study provides evidence that a history of diabetes mellitus, chronic lung disease, hypertension or a fever of at least 100.4° Fahrenheit, substantially increases the risk of severe illness requiring hospitalisation—above and beyond variations in other vital signs or presenting features. This risk also appears to be cumulative with more of these risk factors conferring independent additional risk. In effect, our findings indicate that an apparently stable clinical presentation with even normal cardiopulmonary vital signs may offer an impression of 'pseudo-safety' for certain patients being cared for by ED providers. These patients who are most at risk for later decompensation may benefit from either early hospitalisation or closer outpatient monitoring. While prior studies have shown that multiple traditional medical comorbidities, including the ones identified in this paper, are risk factors for severe illness and mortality in hospitalised patients, this is one of the first studies to help distinguish which of these comorbidities is most significant as it pertains to stable patients who would be otherwise considered safe for outpatient care.[3 7] These findings may therefore be uniquely helpful to providers in the ED and other ambulatory settings, where such patients are frequently encountered, but specific guidance on patient triage and monitoring is currently limited. Additional work such as the development of more specific clinical protocols for these settings is needed to guide decision-making and optimal utilisation of healthcare resources during the current COVID-19 pandemic.

Several limitations to this study merit consideration. We studied patients beginning from the earliest parts of the COVID-19 pandemic, and it remains unknown whether the disease behaviour and patient populations affected will change with time. This is a single-centre study of patients at a large multisite urban medical centre, which may affect generalisability to patient populations in different settings. However, the patient cohort in this study was relatively diverse. Lastly, it is unknown whether some of the patients in this cohort were admitted at other hospitals or experienced adverse events at home. This would result in an underestimate of return visits. However, we have no reason to believe that these scenarios would significantly affect our results by occurring disproportionately in patients with the risk factors we identified (COPD, asthma, diabetes, or hypertension). Further research with additional patients from multiple centres would be helpful to confirm our findings.

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Competing interests None declared.

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