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CE-RESEARCH LETTER TO THE EDITOR

Not so mild: emergency department utilization after index COVID infection stratified by disease severity

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Dear Editor,

As of February 1st, 2022, over 419 million cases of COVID-19 had been confirmed worldwide with over 5 million deaths [1]. In the United States alone there have been over 79 million cases of COVID-19 with over 950,000 deaths [2]. Despite efforts to mitigate the stress on the entire healthcare system, including lockdowns and vaccine mandates, significant concern remains regarding our ability to handle the downstream effects of the COVID-19 pandemic. One of these concerns revolves around lingering health issues and healthcare utilization of COVID-19 patients after their index infection. To date no large-scale study has described the rate of ED utilization for patients after their index COVID-19 infection with respect to the severity of their illness, specifically comparing "mild" vs. "severe" cases.

Our objective was to describe the prevalence of patients who returned to the Emergency Department after their COVID-19 index infection as stratified by disease severity. Furthermore, we sought to compare the quantity and quality of those visits for patients who initially presented with mild ("non-hospitalized") infection compared with those who had severe ("hospitalized") infection. Our study was conducted across an eight-hospital health system in southeast Michigan, including a large academic tertiary care center and multiple large and small community hospitals. We conducted a retrospective analysis of all patients who presented to the health system with a positive COVID-19 PCR test. Given the ubiquitous and all-encompassing nature of COVID-19 during the study period, we did not have a non-COVID-19 comparison group. Furthermore, given this study design, significant restrictions were placed on our initial cohort to confirm that these patients were active within our healthcare system prior to their index COVID-19 diagnosis. Our inclusion criteria required that within one year prior to their index COVID-19 infection, patients had: (1) At least one office visit, (2) A documented problem list, and (3) A medical history documented in the health system EHR. Patients were also only included in the analysis if they had their index COVID-19 infection before April 30, 2021. This allowed for: (1) At least a six-month follow-up period and (2) Limited the time of the cohort to when patients did not readily have home testing available. Finally, patients were separated into two groups: (1) Mild cases, defined by those who were not hospitalized within 14 days of their initial COVID-19 diagnosis; (2) Severe cases, defined by those who were hospitalized within 14 days of their initial COVID-19 diagnosis**.** Expired patients were excluded from the final analysis. Finally, we wanted to specifically tease out the impact of COVID-19 between the mild and severe cohorts. To that end, we extracted all existing ICD-10 diagnosis codes (for any time and any encounter) for each patient prior to their index COVID-19 diagnosis and compared this information to the ED encounter ICD-10 diagnoses codes within the six-month follow-up period. Chronic diseases were derived based on the CMS definitions for each patient using ICD-10 codes extracted from their problem list and medical histories at any time prior to their index diagnosis [3].

Our primary outcome was the percentage of patients who came back to the Emergency Department after their COVID-19 diagnosis stratified by the severity of their initial infection (Mild vs. Severe). Among the patients who returned to the ED after their index diagnosis, we examined only the new ICD-10 codes associated with their subsequent visits, understanding that ICD-10 codes are biased toward more

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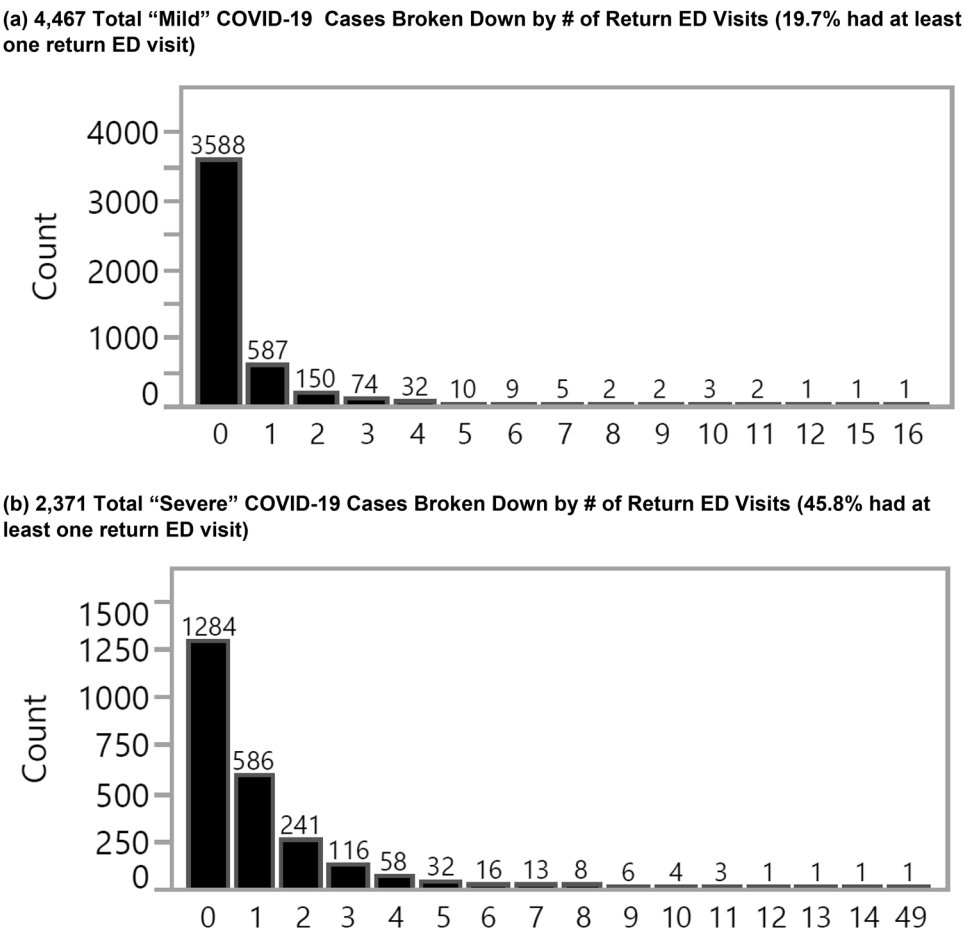

Fig. 1 ED visits after mild (**a**) and severe (**b**) COVID-19 infection. **a** 4467 total "Mild" COVID-19 Cases Broken Down by # of Return ED Visits (19.7% had at least one return ED visit). **b** 2371 total "Severe" COVID-19 Cases Broken Down by # of Return ED Visits (45.8% had at least one return ED visit)

severe symptomology. New codes were defined as those which only appeared in ED encounter billing diagnosis post-index COVID-19 diagnosis and that were not documented previously at any point in the patients EHR. Specifically, we counted all new ICD-10 codes which were present in greater than five percent of either the mild or severe cohort and represented the common systems affected by COVID-19 (Pulmonary, Cardiac, Renal, and Constitutional). Secondary outcomes include the difference in ED utilization broken down by initial disease severity (Outpatient vs Inpatient), demographics, and co-morbidities as defined by the number of Chronic Conditions listed in their EMR. Baseline characteristics and clinical outcomes were compared between patients with mild versus severe COVID-19. Normal or approximately normal variables were reported using the mean (standard deviation), whereas skewed variables were

Table 1 Baseline characteristics of COVID-19 population seeking hospital-level care after initial infection

	Mild disease ($n=4467$)	Severe disease ($n=2371$)	Significance
Age in years	51.4 (17.1)	63.8 (15.7)	<0.0001
Female	2917(55.5%)	1318 (65.3%)	<.0001
Race			
African American	975 (21.8%)	766 (32.2%)	
Caucasian	3032 (67.9%)	1415 (59.7%)	<.0001
Asian	112(2.5%)	51 (2.2%)	
More than one	91(2.0%)	44(1.9%)	
Other	257 (5.8%)	95 (4.0%)	
Chronic Disease Count	4(5)	7(5)	<0.0001

Age is presented as mean (standard deviation). Chronic disease count presented as median (IQR). Other numbers represent *n* (%)

Table 2 New ICD-10 Codes for patients presenting to the Emergency Department after index COVID-19 infection, stratified by severity of the disease (Mild vs. Severe)

System	Severe		Mild		*p* value (Fisher's exact)
	Patient Count	ED Percentage (%)	Patient Count	ED Percentage (%)	
Pulmonary					
Shortness of Breath (R06.02)	47	4.3	81	9	0.5709
Cough (R05)	40	3.7	74	8.2	0.9212
Acute Respiratory Failure with hypoxia (J96.01)	226	20.7	15	1.7	< 0.0001
Acute and chronic respiratory failure with hypoxia (J96.21)	51		4		< 0.0001
Chronic respiratory failure with hypoxia (J96.11)	24		4		< 0.0001
Viral Pneumonia (J12.89)	178	16.3	22	2.4	< 0.0001
Oxygen Dependence (Z99.81)	57	5.2	31	3.4	< 0.0001
Cardiac					
Other chest pain(R07.89)	34	3.1	75	8.3	0.7556
Chest pain unspecified (R07.9)					0.1507
Tachycardia, unspecified (R00.0)	69	6.3	60	6.7	< 0.0001
New ASA use (Z79.82)	*84*	7.7	46	5.1	< 0.0001
New Anticoagulant use (Z79.01)	96	8.8	23	2.5	< 0.001
Renal					
Dehydration (E86.0)	120	11	47	5.2	< 0.0001
Hyperosmolality/hypernatremia (E87.0)	50	4.6	47	5.2	< 0.0001
Hypovolemia (E86.1)	36	3.3	47	5.2	< 0.0001
Hyperkalemia (E87.5)	59	5.4	17	1.9	< 0.0001
Hypokalemia (E87.6)	128	11.7	42	4.7	< 0.0001
Hypomagnesemia (E83.42)	89	8.2	20	2.2	< 0.0001
Acute Kidney Failure, unspecified (N17.9)	118	10.8	35	3.9	< 0.0001
Acidosis (E87.2)	114	10.4	31	3.4	< 0.0001
Hypo-osmolality/hyponatremia (E87.1)	104	9.5	25	2.8	< 0.0001
Hypertensive Kidney Failure (I12.9)	73	6.7	21	2.3	< 0.0001
Chronic Kidney Disease, unspecified (N18.9)	71	6.5	20	2.2	< 0.0001
Constitutional					
Weakness (R53.1)	67	6.2	33	3.7	< 0.0001
Fatigue (R53.83)	51	4.7	56	6.2	0.0074
Malaise (R53.81)	71	6.5	21	2.3	< 0.0001
Headache (R51.9)	36	3.3	74	8.2	0.6879

reported with the median (interquartile range [IQR]). Categorical variables were compared using the Chi-square test or Fisher exact test. Normal variables were compared using a 2-sided Student *t* test and ordinal variables used the Kruskal–Wallis test. To evaluate the association between baseline comorbid conditions and severity of disease, an age-adjusted logistic regression analysis was performed, with continuous variables as co-variables and categorical variables as factors. All *p* values were 2-sided and a $p < 0.05$ was considered to indicate statistical significance. Statistical analysis was performed using SAS 9.4 (SAS Institute, Cary, North Carolina). The authors of this IRB exempt study have no relavent conflicts of interest.

Our study population included a total of 6,838 adult patients with a PCR-confirmed diagnosis of COVID-19. Among these, 65% ($n = 4{,}467$) had mild disease, who did not require hospitalization within 14 days of the index diagnosis. Table 1 reports demographics and for mild and severe COVID-19 groups. In the mild cohort, 879 out of 4,467 (19.7%) of the patients had at least one return ED visit, while 1087 of the 2,371 (45.8%) of the severe patients had a return ED visit (Fig. 1). These counts represented 2.27 higher odds (95% CL 1.987, 2.58, $p < 0.0001$) of repeat ED visits in severe compared to mild cases. As expected, those with increased chronic disease count had 1.09 higher odds of developing a severe infection with each additional chronic condition. To determine the possible reasons for the return

ED visits, we filtered the ED billing diagnosis codes that were never previously recorded in the EHR of each patient. Table 2 shows the new ICD-10 codes, broken down by organ systems for severe and mild cases. With regard to the pulmonary system, *cough* and *shortness of breath* were more common in the mild group while *respiratory failure*, *viral pneumonia* and *oxygen dependence* were more common in the severe cohort. For the cardiovascular system, *chest pain* and *new anticoagulant use* were more common in the mild group while *long-term anti-coagulant use* was more common in the severe cohort. With regard to the renal system, *dehydration*, *hypovolemia* and *hyperosmolality/hypernatremia* were the most common for the mild cohort, while multiple electrolyte imbalances and evidence of acute and chronic kidney failure were common for the severe cohort. Finally, both cohorts had evidence of new constitutional symptoms including *weakness*, *fatigue* and *malaise*. The incidence of headaches was higher (8.2%) in the mild cases compared to the severe cases (3.3%).

As both severe and mild COVID-19 patients present back to the emergency department after their initial infection, an understanding of the quantity and characteristics of those visits is vital in delivering quality care. In addition, the ubiquitous presence of COVID-19 testing would render a similar analysis describing the outcomes of mild cases impossible. We present the largest cohort to date of both mild and severe covid patients who presented back to the ED at least 14 days after their index infection. In describing these patients, we have identified that both severe and mild cases have repeat ED visits after index infection. Although, patients with an initial severe case present back to the emergency department and are subsequently admitted more often than their mild counterparts; the mild cohort still represents a significant burden to the healthcare system with 19.7% of those patients returning to the emergency department within six months. Finally, both in our cohort and relevant scientific literature regarding COVID-19, mild cases represent significant morbidity with patients mirroring the symptomatology of their severe counterparts [4, 5]. Symptoms such as fatigue, weakness, headache, and malaise are well represented within our cohorts and are known to persist despite the initial severity of the illness [6]. It is important to note that other cofactors including vaccination status and treatments provided that would directly affect our primary outcome were not assessed in this analysis.

Though most of the acute COVID-19 cases are classified as mild, 19.7% of those patients came back to the emergency department and mirrored the symptomatology of their severe counterparts who returned at a rate of 46.1%. As emergency department volumes continue to return to pre-pandemic levels, understanding the prevalence of symptoms and characteristics of these patients will provide a foundation for optimizing management, conducting relevant research and distributing resources.

Declarations

Conflict of Interest The authors declare that they have no conflict of interest.

Human and animal rights This article does not contain any studies directly involving human participants, as it is a review of data already collected in a COVID database.

Informed consent For this type of retrospective study, formal consent is not required.

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