

## Brief Report

**Cite this article:** Flamm A, Lee A, Mencl F (2022) COVID-19: A comprehensive analysis of the pandemic's effect on an emergency department. *Disaster Med Public Health Prep* 16: 2367–2370. doi: <https://doi.org/10.1017/dmp.2021.182>.

First published online: 8 June 2021

### Keywords:

emergency medicine; emergency medical services; mass casualty incidents; disaster medicine; disaster planning

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# COVID-19: A Comprehensive Analysis of the Pandemic's Effect on an Emergency Department

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## Abstract

**Objective:** Coronavirus disease 2019 (COVID-19, caused by severe acute respiratory syndrome coronavirus 2 [SARS-CoV-2]) is a historic pandemic severely impacting health care. This study examines its early effect on a busy academic emergency department.

**Methods:** A retrospective analysis of patients from an academic tertiary care Level I trauma, cardiac and stroke center's emergency department seeing an average of 54,000 adults and 21,000 pediatric patients per year. Total visits, reasons for patient visits, demographics, disposition, and length of stay were analyzed from January through July 2020 and compared with the same time period in the previous 2 y.

**Results:** From March through July 2020 there were statistically significant decreases in the total number of patient visits (-47%) especially among pediatric (-73%) and elderly (-43%) patients and those with cardiovascular (-39%), neurological (-63%) complaints, headaches (-60%), back pain (-64%), abdominal pain (-51%), and minor trauma (-71%). There was, however, a significant increase in pulmonary complaints (+54%), as well as admissions (+32%), and length of stay (+40%).

**Conclusions:** There was a significant drop in overall patients and select groups early in the pandemic, while admissions and emergency department length of stay both increased. This has implications for future pandemic planning.

In March 2020, the World Health Organization declared coronavirus disease 2019 (COVID-19, caused by severe acute respiratory syndrome coronavirus 2 [SARS-CoV-2]) a global pandemic.<sup>1</sup> As of the writing of this study, the number of confirmed COVID-19 cases has reached 170 million worldwide, including more than 33 million cases recorded in the United States. Over 3.5 million deaths due to COVID-19 have been confirmed worldwide with almost 600,000 deaths having occurred in the United States alone.<sup>2</sup> Due to the rapid spread, morbidity, and mortality of the disease, COVID-19 has significantly affected the global economy and health-care delivery in particular. As COVID-19 continues to evolve, there is an increasing need to understand how this pandemic has affected specific areas of health care.

One setting of particular interest is the impact the pandemic has had on emergency departments (EDs). From 2001 to 2016, the number of visits to EDs in the United States increased from 107.5 million to nearly 150 million.<sup>3</sup> Highlighting the impact of rising annual patient visits, the opinion of Dr. Darren Mareiniss expressed that “the resulting crowding in the ED is likely compromising care.”<sup>4</sup> There is a significant association between ED overcrowding and important clinical outcomes, such as mortality and time to treatment of life-threatening illnesses.<sup>5</sup> With this in mind, we considered the impact of a global pandemic on EDs already exceeding capacity.

Predicting the impact of a historically significant pandemic event like COVID-19 poses considerable challenges. Some assumed COVID-19 would cause massive influxes of patients into EDs, and the resulting increase in volumes would be detrimental to patient care and outcomes. For EDs with no extra capacity to accommodate additional patients, life-saving health-care resources might have to be rationed if the demand were to exceed the supply.<sup>6</sup> However, in reality, the Centers for Disease Control and Prevention (CDC) reported a 42% decrease in the overall number of ED visits during the initial wave of COVID-19.<sup>7</sup> It is, however, unclear if the changes impacted all patients equally or what impact it might have had on other measures of ED operations.

The purpose of our study is to acquire a more comprehensive understanding of COVID-19's impact. We sought to investigate the pandemic's effect on ED patient volumes, patient demographics, reasons for seeking treatment, and other important measures of patient care and ED operations. The results of this study provide valuable insight into ED patterns in response to

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rising COVID-19 cases, possibly reflecting shifting population perspectives on using ED services during a pandemic.

## Methods

A retrospective analysis of de-identified patient datasets was performed at a Level I trauma tertiary care academic ED that sees an average 54,000 adults and 21,000 pediatric patients per year. All patients from the datasets were included in the study. There were no exclusions. An evaluation of total visits, reasons for patient visit, demographics, disposition, and length of stay was collected for the period of January through July 2020 and compared with the same time period in the previous 2 y (2018-2019). In each category, the mean of 2018 and 2019 was compared with 2020.

Reasons for visit were categorized by organ system to facilitate efficient analysis. Complaints grouped into the following categories were selected for final analysis: cardiovascular, pulmonary, neurologic, gastrointestinal, nonemergent headaches, musculoskeletal back pain, and minor trauma. Infrequent complaints or those that did not appropriately fit into 1 specific system were grouped into a General category but not selected for final analysis. All data were organized in Microsoft excel, and descriptive statistical analysis was completed using SAS software, version 9.42., Cary, NC. The study was approved by our institutional review board.

## Results

From 2018 to 2019, there was a 5.7% increase in total ED patient volume. This trend continued in the first 2 mo of 2020 (pre-COVID) when January volume increased by 13% and February by 10.4%. From March until July, this trend reversed (Figure 1). April demonstrated the largest statistically significant decreases in multiple areas of interest when compared with previous years (Figure 2). The total number of ED visits decreased 47% (rate ratio = 1.88; 95% confidence interval [CI]: 1.81-1.95;  $P < 0.001$ ). The number of patients aged  $\leq 10$  y old decreased 73% (rate ratio = 3.65; 95% CI: 3.27-4.07;  $P < 0.001$ ). The number of patients aged  $\geq 65$  y old decreased 43% (rate ratio = 1.74, 95% CI: 1.61-1.89;  $P < 0.001$ ). In terms of gender, there was no significant difference between the decreases in male and female patient volumes. The significant decrease in total patient volumes was equally distributed among males and females.

Cardiovascular complaints reported by the patients decreased 39% (rate ratio = 1.64; 95% CI: 1.44-1.86;  $P < 0.001$ ). Neurological complaints reported by the patients decreased 63% (rate ratio = 2.70; 95% CI: 2.28-3.20;  $P < 0.001$ ). Nonemergent headaches reported by the patients decreased 60% (rate ratio = 2.47; 95% CI: =1.85-3.30;  $P < 0.001$ ). Musculoskeletal back pain complaints reported by the patients decreased 64% (rate ratio = 2.74; 95% CI: 2.06-3.64;  $P < 0.001$ ). Abdominal pain complaints reported by the patients decreased 51% (rate ratio = 2.02; 95% CI: 1.85- 2.21);  $P$ -value  $< 0.001$ ). Minor trauma complaints reported by the patients decreased 71% (rate ratio = 3.30; 95% CI: 2.85-3.81);  $P < 0.001$ ).

April also demonstrated the largest statistically significant increases in select measures of interest when compared with previous years (Figures 3 and 4). The percentage of total patients with pulmonary complaints rose 54% (odds ratio = 1.22; 95% CI: 1.07-1.40);  $P = 0.004$ ). The admission rate percentage rose 32% (odds ratio = 1.14; 95% CI: 1.06-1.22;  $P = 0.001$ ). The average length of ED stay rose 40% ( $P = 0.0001$ ).

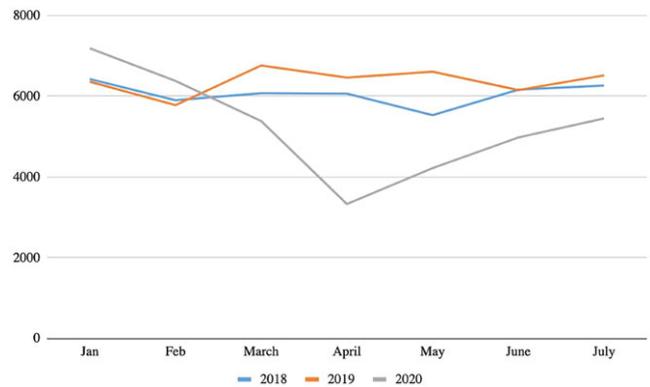


Figure 1. Comparison of ED Visits January through July, 2018-2020.

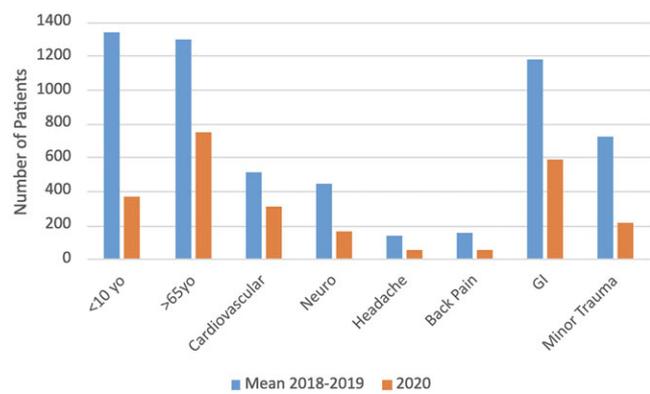


Figure 2. Significant decreases during early COVID-19 period - April 2020.

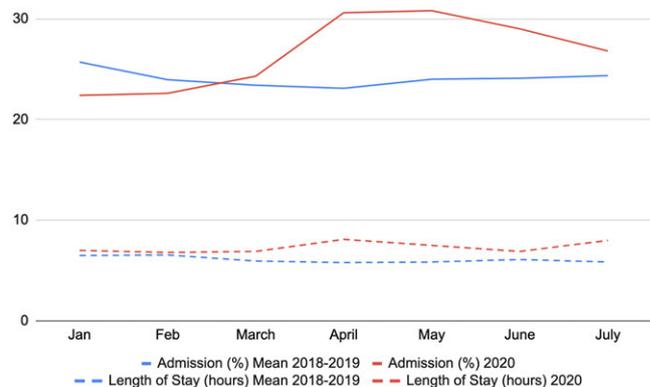
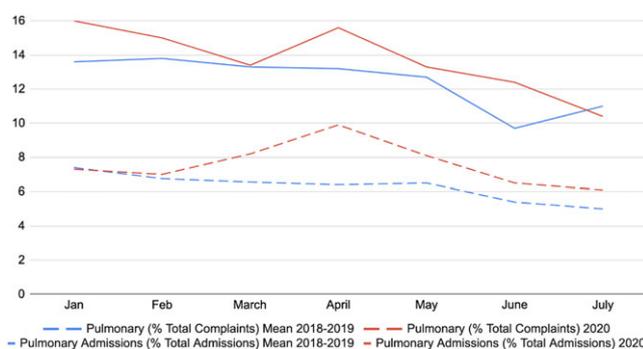


Figure 3. Comparison of admissions and length of stay during the early COVID-19 period.

## Discussion

The significant effect of the pandemic on emergency departments is evidenced by the dramatic drop in patient volumes, especially among pediatric and elderly populations. A poll conducted by the American College of Emergency Physicians (ACEP) showed nearly one-third of adults avoided seeking medical care due to COVID-19 concerns.<sup>8</sup> Additionally, a poll from Gallup found 42% of adults felt “very concerned” about being exposed to SARS-CoV-2 while seeking emergency care.<sup>9</sup> Furthermore,



**Figure 4.** Comparison of % pulmonary complaints and admissions due to pulmonary cases during the early COVID-19 period.

ACEP reported an increasing public worry about overstressing the health-care system and overcrowding hospitals during the pandemic.<sup>8</sup> This avoidance of seeking health care puts the public at high risk, especially those with chronic medical conditions. Furthermore, as April demonstrated the largest significant decrease in ED visits, this could be attributed to the implementation of nonpharmaceutical interventions, lockdown measures, and social restrictions directly impacting ED traffic and patient volume.

This study provides valuable insight into possible public perceptions on using emergency care services that is demonstrated by the shifts in reasons for visit, ie, “chief complaint.” The decline in nonemergency complaints (eg, nonemergent headaches, back pain, minor trauma) likely reflects patients re-prioritizing what they believe necessitates an ED visit. Those who normally use EDs for less acute concerns may have sought care elsewhere or possibly none at all to avoid exposure to SARS-CoV-2. The decrease in cardiovascular and neurological visits raises an alarming concern that a fear of SARS-CoV-2 exposure deterred patients from seeking emergency care in potentially life-threatening situations. A study reported in *JAMA Cardiology* showed a significant increase in out-of-hospital cardiac arrests and deaths in New York during the early months of the pandemic.<sup>10</sup> It is imperative for the public to understand the symptoms associated with the most severe pathologies seen in the ED, including myocardial infarction and stroke. These situations always necessitate immediate emergency care, regardless of concerns of COVID-19. Efforts to educate high risk populations on safely seeking emergency care during the pandemic should reinforce the importance of timely care for acute health conditions while assuring the public that EDs are implementing infection prevention and control guidelines to ensure the safety of patients and health-care personnel.<sup>7</sup>

The marked rise in admissions (+32%) from the ED and length of stay (+40%) in the ED is concerning. This may be due to more extensive work ups, lengthy SARS-CoV-2 testing, interventional procedures, and infection control protocols prolonging ED patient stays. It is particularly concerning as it happened in the face of, or despite, significantly reduced patient volumes, and it is hard to imagine if volumes had remained high. Recognizing these shifts is crucial to better prepare hospital’s ability to ensure adequate supplies, beds, and personnel to accommodate both higher admission rates and longer stays.

Of note, a steady rise in ED visits was seen in June and July 2020. Relaxation of previously implemented nonpharmaceutical interventions, lockdown measures, and social restrictions could explain this uptick in ED patient volume. During this time, it could be

reasoned the perception of public safety shifted and many felt more comfortable seeking care in EDs. The rise in the number of pediatric and elderly patients, cardiovascular and neurological visits, nonemergent headaches, back pain, abdominal pain, and minor trauma visits are also consistent with this finding. It should be noted, however, although these variables showed increasing numbers, they were still significantly lower when compared with previous years.

Finally, SARS-CoV-2 is first and foremost a respiratory virus. Not surprisingly, the pandemic has resulted in higher percentages of patients with pulmonary complaints. Evaluation, treatment, and isolation practices as well as the resources required were all dictated by this. Conceivably an enteric virus or one with hematologic effects would likely produce a different pattern of complaints and surges in different patient populations.

### Limitations

This was a retrospective chart review that relied on the accuracy of data entry. Multiple terms and interpretations are often used when coding or entering a chief complaint. Sometimes, the chief complaint entered is not consistent or related to the patient’s final diagnosis. Other patient complaints were infrequent, and we attempted to sum them with similar complaints. This was sometimes the object of disagreement. However, the differences in numbers from pre-COVID-19 to COVID-19 are so large for many of the complaints that where these were placed was unlikely to have a meaningful impact.

### Conclusions

There was a significant drop in overall patient volume seen during the early stages of the pandemic. Moreover, the avoidance of emergency department care was quite pronounced among select patient groups, including the pediatric population and those with neurologic complaints. There was also a smaller but still significant drop in cardiovascular complaints as well as in the numbers of elderly patients. This raises concern for patients with potentially life-threatening conditions who are avoiding emergency care due to a fear of SARS-CoV-2 exposure. This needs to be factored into future pandemic planning.

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