ORIGINAL RESEARCH ARTICLE

Changes in Emergency Department Patient Volume and Acuity Associated with Early Stages of the COVID-19 Pandemic in a Unique Environment

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ABSTRACT

Introduction: Hospitals and emergency departments (EDs) faced profound uncertainty during the COVID-19 pandemic. Early concerns regarding demand far exceeding capacity were balanced by anecdotal reports of decreased patient visits, including those for specific high-acuity conditions. This study sought to identify changes in ED volume and acuity, within a specific managed care environment, associated with the onset of the pandemic.

Methods: Data from patient visits to 2 San Diego, California, EDs—within an integrated health-care system—were extracted from the electronic health record. Daily patient visits, hospital admissions from the ED, Emergency Severity Index scores, and mode of arrival were compared between two 28-day periods, with the 28 days following a "stay at home" order issued by the governor of California and a control period of the same dates in 2019.

Results: These EDs observed a significant decrease in daily visits (42% compared to the previous year) associated with the pandemic. An increased rate of hospital admissions (16.6%–21.6%) was suggestive of an overall increase in acuity; however, changes in the distribution of Emergency Severity Index scores were less pronounced. The overall number of admissions declined significantly. Although overall ambulance traffic decreased, the proportion of patients arriving by ambulance was unchanged.

Conclusion: Patient volume in 2 EDs dropped significantly in association with a statewide response to the COVID-19 pandemic. There was also a shift in acuity as measured by the proportion of patients admitted to the hospital, but overall admissions declined, suggesting sicker patients also did not seek care.

INTRODUCTION

The onset of the novel coronavirus (COVID-19) pandemic in the US resulted in profound uncertainty regarding hospital utilization. The first US case was confirmed on January 20, 2020.[1] However, spread of the disease was initially slow and there was minimal public response. As the disease spread more rapidly in other parts of the world, reports of increased demand for emergency and intensive care far exceeding capacity began to emerge.[2] Reports of decreased admissions for specific emergent conditions such as acute coronary syndrome have been reported in Italy.[3] A single tertiary care center in New Jersey reported decreased rates of diagnosis of acute stroke during the pandemic.[4] Anecdotally, physicians reported that daily emergency department (ED) volumes had dropped to 40% to 60% of normal during late March and early April.[5] The Centers for Disease Control and Prevention (CDC) reported that nationwide ED visits during the period from March 29 to April 25, 2020, declined 42% compared to a comparable 4-week period in 2019.[6] Here we describe selected changes in our departments over a 28-day period following the "stay at home" order for all of California issued by Governor Gavin Newsom on March 19, 2020. This study sought to identify changes in ED volume and acuity, within a specific managed care environment, associated with the onset of the pandemic.

METHODS

Kaiser Permanente (KP) operates 2 acute care hospitals in San Diego County that operate under 1 license. San Diego county currently has a population of about 3.3 million people. KP serves more than 630,000 members in San Diego. Annual ED volume was 133,088 in 2019. Ninety-two percent of patients were members of KP. Patients do occasionally seek care at EDs outside of the KP system, and data regarding this use by members were not assessed. Before the study period, 2020 volumes were 6% greater than in 2019. A 28-day study period was selected to coincide with the "stay at home" order issued on March 19, 2020 (March 19–April 15, 2020). A corresponding control period was selected for comparison, the equivalent 28-day period from 2019 (March 19–April 15, 2019). A 28-day period was chosen to control for known variability that occurs based on day of the week. The date of the "stay at home" order was chosen as an objective marker of public recognition of the pandemic and associated behavioral changes. Data from patient visits to EDs in our system are stored automatically in an electronic health record nonrelational database (Chronicles/Epic). The data are then transferred and stored in a distinct relational database (Clarity/Oracle) daily. This

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database was queried for records of daily patient volume, ED disposition, Emergency Severity Index (ESI) score, and arrival mode for the prespecified time periods described. The ESI triage system is a 5-level system that assigns a score based on acuity of illness and expected resource use.[7] ESI scores of 1 and 5 were not included because they occur so infrequently that any comparison during the study time period would not be meaningful.

Each sample was assessed for normality using the Shapiro-Wilk test, with a P value of 0.05. All samples for daily patient visits, absolute number of admissions, admission percentages, absolute number of arrivals by Emergency Medical Services (EMS), and percentage of arrivals by EMS were found to be distributed normally. Samples of ESI scores were noted not to represent normally distributed populations using this test. Means and standard deviations for each time period were calculated using Excel (Microsoft). For the normally distributed data, comparisons between time periods were made using a 2-sample t-test for independent samples. For comparisons of the proportion of ESI scores, the Mann-Whitney test was used. For all tests, $P < 0.05$ was considered statistically significant.

RESULTS

Compared to the equivalent 28-day period from the previous year, daily ED visits decreased by 42%. The absolute number of admissions decreased by 25%; however, the proportion of admitted patients increased by 30% (Table 1).

There was a small, but statistically significant decrease in the proportion of ESI-2 visits as well as a significant increase in ESI-3 visits. These were offset by a significant decrease in ESI-4 visits (Table 2).

The absolute number of arrivals by EMS was significantly less; however, the proportion of patients arriving by EMS was not significantly different (Table 3).

Table 1. Mean daily emergency department patient volumes and admissions

	March 19–April 15, 2020	March 19–April 15, 2019
Daily volume (mean ± SD)	224 ± 30	388 ± 25 ($P < 0.0001$)
Daily admissions (mean ± SD)	48 ± 10	64 ± 8 ($P < 0.0001$)
Daily admission, % (mean ± SD)	21.6 ± 4.4	16.6 ± 1.6 ($P < 0.0001$)

SD = standard deviation.

Table 2. Mean proportion of daily emergency department visits by Emergency Severity Index

	March 19–April 15, 2020	March 19–April 15, 2019
ESI-2, % (mean ± SD)	23.5 ± 4.2	24.9 ± 3.1 ($P = 0.01$)
ESI-3, % (mean ± SD)	67.7 ± 4.6	60.6 ± 2.9 ($P < 0.0001$)
ESI-4, % (mean ± SD)	7.5 ± 3.3	14.0 ± 2.0 ($P < 0.0001$)

ESI = Emergency Severity Index; SD = standard deviation.

Table 3. Mean daily emergency department arrival by emergency medical services

	March 19–April 15, 2020	March 19–April 15, 2019
n (mean ± SD)	41 ± 8.7	66 ± 11.3 ($P < 0.0001$)
Emergency department visits, % (mean ± SD)	18.2 ± 2.9	17.0 ± 2.8 ($P = 0.14$)

SD = standard deviation.

DISCUSSION

Our study shows significant changes in ED patient volume and acuity within an integrated health-care delivery system in San Diego, California. The decrease in daily patient presentations is consistent with nationwide data just reported by the CDC. Although the absolute number of hospital admissions decreased, the proportion of admitted patients increased by 30%. This finding supports concerns that many patients with emergent medical conditions were not seeking care during this phase of the pandemic. It also suggests a shift toward overall higher acuity among patients seeking ED care. Changes in admission rates appeared to be greater in magnitude than shifts in ESI distribution. This likely represents inherent weakness in the ESI system in the ability to discriminate patient acuity accurately. Previous research has suggested poor accuracy and high variability with use of the ESI system.[8] Our department does not assign ESI-1 or ESI-5 scores with sufficient frequency to make any valid comparisons between time periods.

It is very interesting that local changes in volume closely matched nationwide data reported by the CDC. More than 90% of our patient visits are from insured patients within the KP system. It might be expected that because this population has access to many options for lower acuity care, the impact of the pandemic on ED volume would be blunted in comparison if patients are not as dependent on the ED to access care on a regular basis. Many of our outpatient clinics closed or decreased services dramatically during this time period, so it might be expected that patients would actually increase use of the ED when other venues for care were less available. These trends would suggest that other factors were likely more influential in patients' decisions to seek urgent or emergent care.

Defining the study period and comparison periods was challenging because the pandemic does not have a well-

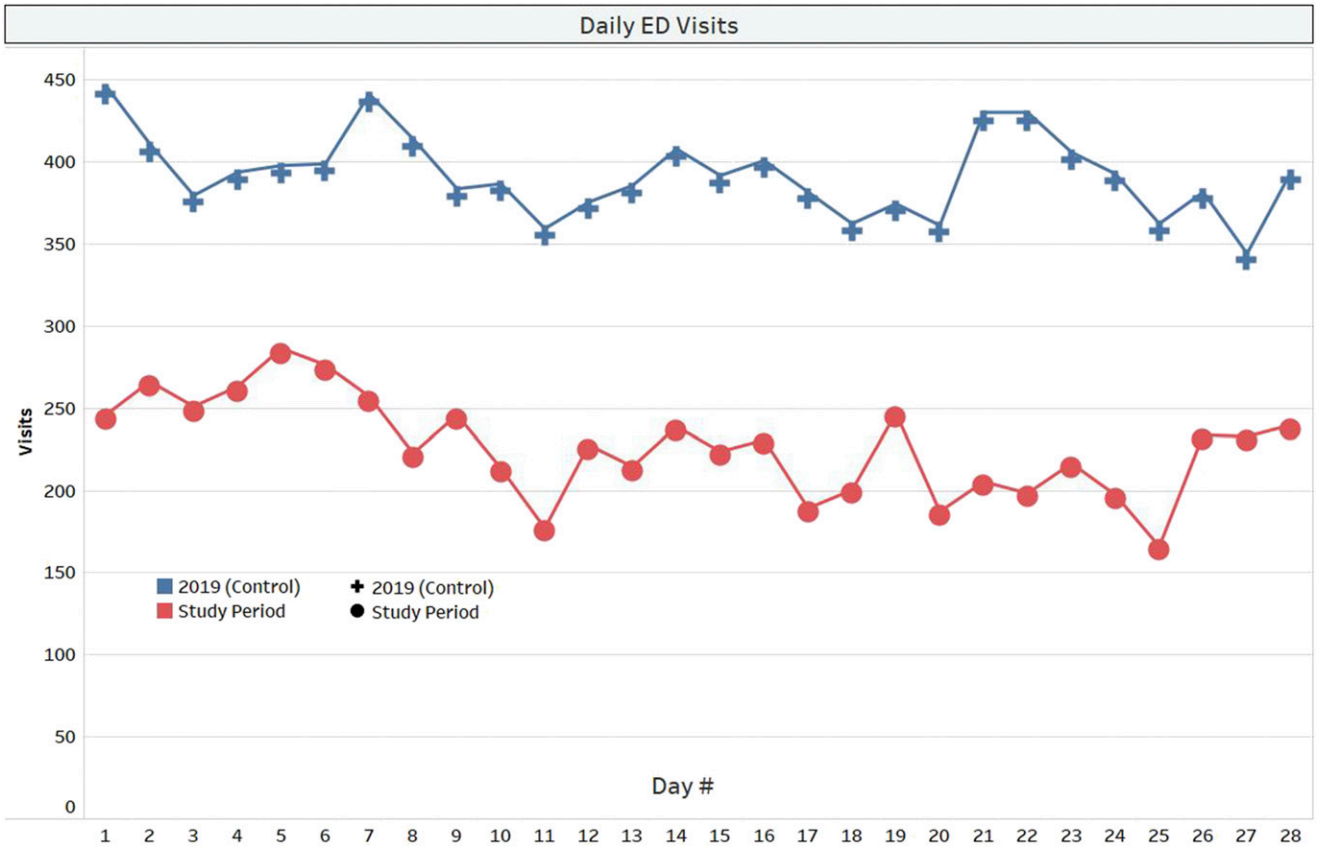

Figure 1.

defined start date. We chose the California "stay at home" order as an objective measure. This was 6 days after a national state of emergency was declared on March 13. However, California was the first state in the country to issue a "stay at home" order. Behavioral changes, including medical care delivery and decisions to seek care, likely happened progressively over a poorly defined time frame. The true decrease in patient volume is likely underestimated by this analysis, as January and February ED volumes were greater in 2020 when compared to 2019.

Compared to many other areas of the country and state, San Diego County has been less impacted by severe acute respiratory syndrome-associated corona virus 2. As of June 2, 2020, there were 7674 reported cases and 276 deaths in a county with a population of approximately 3.3 million people.[9] Our data demonstrate that, even in a geographic area with a low prevalence of disease, patients did not seek medical care in our EDs at a rate consistent with historical norms. Further research is needed to identify more accurately the reasons for these behavioral changes. Fear of exposure to disease in the acute care environment is one possible explanation.

Approximately 92% of our ED patients are members of an integrated health-care delivery system with consistent access to care. Consequently, routine use of the ED for lower acuity conditions might be expected to be less than in other environments. However, the observed decline in patient volume associated with the pandemic was in line with national averages. We did observe a significant decrease in the small proportion of patients triaged as clearly lower acuity as ESI-4. This does suggest that a significant number of patients, who might have used the ED for nonemergent care, chose to defer care or receive it in an alternate setting in response to the pandemic.

Limitations

Our data are from EDs that function as part of an integrated health-care delivery system that sees mostly well-insured patients, so the findings may not be generalizable to other environments. However, overall changes in patient volume are in line with national data reported by the CDC. Defining an appropriate study period was challenging given the gradual evolution of the pandemic, and subsequent response by federal and local authorities. Comparisons may have been different depending on the selected time frames. Our data use ESI level as a marker of acuity, which may not be a reliable or accurate indicator of actual acuity. Similarly, although an increased rate of hospital admissions might

suggest increased acuity, other factors may have contributed to decisions regarding admission to the hospital.

CONCLUSIONS

Our data show a large decrease in patient visits to the ED within an integrated health-care delivery system in association with a statewide response to the severe acute respiratory syndrome-associated corona virus 2 pandemic. Surrogate markers of ESI distribution and percentage of patients admitted to the hospital suggest a shift toward higher acuity and a decrease in low-acuity visits. Overall arrivals via EMS decreased similarly to all patient visits without a proportional increase in EMS traffic. ❖

Disclosure Statement

The authors have no conflicts of interest to disclose.

Authors' Contributions

Brent Lorenzen, MD, and Adan Schwartz, MD, MS, contributed equally to the study design, data collection, data analysis, and manuscript preparation. They were not assisted.

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