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Original Contributions

Six Diagnoses of Separation: Impact of COVID-19 on Pediatric Emergency Department Visits: A Multicenter Study

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Abstract—Background: Coronavirus disease 2019 (COVID-19) arrived in the New York metropolitan area in early March 2020. Recommendations were made to self-quarantine within households and limit outside visits, including those to clinics and hospitals, to limit the spread of the virus. This resulted in a decrease in pediatric emergency department (ED) visits. However, it is unclear how this affected visits for some common diagnoses such as anxiety, appendicitis, asthma, headaches, seizures, and urinary tract infection (UTI). These diagnoses were chosen a priori, as they were felt to represent visits to the ED, for which the diagnoses would likely not be altered based on COVID exposure or quarantine due to their acute nature. **Objectives:** Our goal was to investigate the effect of COVID-19 on common pediatric diagnoses seen in the pediatric ED using a large multihospital database. **Methods:** We conducted a retrospective cohort study of consecutive pediatric patients (age ≤ 21 years) between March 1 and November 30 in 2019 and 2020 in 28 hospital EDs within 150 miles of New York City. We compared the change in the number of visits from 2019 to 2020 for the following diagnoses: anxiety, appendicitis, asthma, headache, seizures, and UTI. **Results:** Our database contained 346,230 total pediatric visits. From 2019 to 2020, total visits decreased by 61%. Decreases for specific diagnoses were 75% for asthma, 64% for headaches, 47% for UTI, 32% for anxiety, 28% for seizures, and 18% for appendicitis (p value for each comparison < 0.0001). **Conclusions:** We found a marked decrease in ED visits for six common pediatric diagnoses after COVID-19 arrived

in our area. We suspect that this decrease was due to recommendations to quarantine and fear of contracting the virus. Further studies on other diagnoses and potential complications due to the delay in seeking care are needed. © 2022 Elsevier Inc. All rights reserved.

Keywords—COVID-19; pediatric; emergency medicine; pandemic

Introduction

The year 2020 started with the spread of coronavirus disease 2019 (COVID-19) across the globe. The World Health Organization declared a pandemic on March 11, 2020. Early on, the northeastern region of the United States was one of the most severely affected areas (1). The virus has had different effects on pediatric and adult populations. A report from the U.S. Department of Health and Human Services reported that only 1.7% of the cases from February 12 to April 2, 2020 were children under the age of 18 years (2). Recommendations were made to self-quarantine within households and limit outside visits, including those to clinics and hospitals, to limit spread of the virus. This resulted in a decrease in pediatric emergency department (ED) visits (3–9). One would surmise that ED visits for certain diagnoses would not be expected to be altered by the quarantine, including conditions such

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as appendicitis, seizures, urinary tract infections (UTIs), asthma, headache, and anxiety. Visits for emergent conditions such as appendicitis, seizures, and asthma would not be expected to be affected by COVID due to their acute nature, but parents might hesitate to bring their children to the ED for anxiety attacks or headaches. The most common significant bacterial infection in children that causes fever is UTI. To see if visits for specific conditions were affected by COVID we chose to examine these specific diagnoses: anxiety, appendicitis, asthma, headaches, seizures, and UTI, as they are commonly seen in pediatric EDs. Our goal was to investigate these using a large multihospital database.

Materials and Methods

We used a retrospective cohort study design in the setting of 28 hospital EDs within 150 miles of New York City. The hospitals were in rural, suburban, and urban areas and were teaching or nonteaching, of which seven had distinct pediatric EDs. The annual pediatric volumes ranged from 3000 to 43,000. We included consecutive pediatric patients (age ≤ 21 years) and we chose to study the following diagnoses: anxiety, appendicitis, asthma, headache, seizures, and UTI, based on relevance in the setting of the pediatric ED. We tallied total visits and visits for the specific diagnoses from March 1 to November 30 in 2019 and 2020, using primary visit codes (International Classification of Diseases, version 10). The proprietary database was obtained from the emergency physician management company and was downloaded to an Excel file (Microsoft, Redmond, Washington). We calculated the percent changes from 2019 to 2020 for total visits and visits for each of these diagnoses. We used chi-square to test for statistical significance for differences in the number of visits from 2019 to 2020. We set alpha at 0.007, using the Bonferroni correction for multiple comparisons. The Atlantic Health System's institutional review board approved the study.

Results

Our database contained 346,230 total pediatric visits. The mean ages (\pm standard deviations) in 2019 and 2020 were 9 ± 7 and 10 ± 7 years, respectively; females comprised 47% and 48%, respectively, as shown in Table 1. From 2019 to 2020, total visits and visits for specific diagnoses decreased, as shown in Figure 1. Total ED visits decreased by 61%. The diagnosis with the greatest decrease was asthma (75%), followed by headache (64%), UTI (47%), anxiety (32%), seizures (28%), and appendicitis (18%). The p value for each comparison was < 0.0001 .

Discussion

We found a marked decrease in total ED visits after COVID-19 arrived in our area. Others have also reported on this. When comparing periods of the pandemic with the same periods in the previous 1-4 years, three studies in Italy and one each in Hong Kong, United States, Canada, and Australia found that pediatric ED visits decreased an average of 62% (range: 47% to 76%) (3-9). Others have reported similar findings during an infectious outbreak. During the peak of the severe acute respiratory syndrome (SARS) outbreak in Toronto in 2003, visits to a pediatric ED decreased 48% (10).

We found a decrease in visits for six common pediatric diagnoses after COVID-19 arrived in our area in 2020. The greatest decreases for specific diagnoses were for asthma, followed by headache, UTI, anxiety, seizures, and appendicitis.

Asthma is one of the most common conditions leading to hospitalization related to respiratory condition-related visits (11). We found a marked decrease in asthma visits of 75%. Similar to our result, others have found decreases in ED asthma visits of 75% and 81% (12,13). The pandemic arrived in our area in the spring of 2020, a season with high pollen levels and typical increased spread of respiratory viruses, both of which can exacerbate asthma symptoms (14,15). During the pandemic, social isolation would have reduced exposure to outdoor seasonal allergens and person-to-person transmission of respiratory viruses. In addition, air pollution, which can provoke asthma exacerbations, decreased in the pandemic period due to less automobile traffic (16,17). These factors likely reduced the incidence of asthma exacerbations in the population, and this could have contributed to the decrease in ED asthma visits that we observed.

The number of ED visits for anxiety decreased by 32%. Pediatric mental health ED visits increased 35% in an Australian study, but decreased 57% and 58% in a U.S. and Irish study, respectively (9,18,19). In our study, visits for headache and UTI decreased from 2019 to 2020. However, we found no other studies on children that examined the effect of COVID-19 specifically on visits for anxiety, headache, or UTI.

We found a 28% decrease in visits of patients with seizures, which was unexpected, as parents usually bring their children to the ED after a seizure (20). Others in Italy and Hong Kong have found decreases in ED visits for seizures of 38% and 62%, respectively (5,6). Others have reported seizures in patients with COVID-19 (21,22). However, our data demonstrated a decrease, not an increase in seizures.

Visits for appendicitis decreased 18% from 2019 to 2020. A number of studies have compared pediatric appendicitis patients in the pandemic period with either the

Table 1. Comparison of Visits in 2019 to 2020 for the Six Common Diagnoses with Percentage of Females and Median Age.

	Year	Visits	Percent Female	Media Age (y) [Interquartile Range]
Total visits	2019	211,018	47%	6.5 [2.3-12.6]
	2020	89,609	48%	7.5 [2.5-13.7]
Asthma	2019	5618	40%	6.2 [3.3-10.4]
	2020	1403	43%	8.1 [4.3-12.7]
Headache	2019	2574	55%	13.2 [9.5-15.8]
	2020	926	57%	13.5 [9.8-16.1]
UTI	2019	2377	88%	7.1 [3.2-14.7]
	2020	1262	86%	6.9 [2.5-14.9]
Anxiety	2019	814	59%	15.1 [12.8-16.7]
	2020	557	66%	15.4 [13.2-16.9]
Seizures	2019	962	44%	8.8 [3.7-14.1]
	2020	695	43%	8.2 [3.5-13.9]
Appendicitis	2019	1038	39%	11.4 [8.7-14.7]
	2020	853	39%	11.9 [8.7-14.8]

UTI = urinary tract infection.

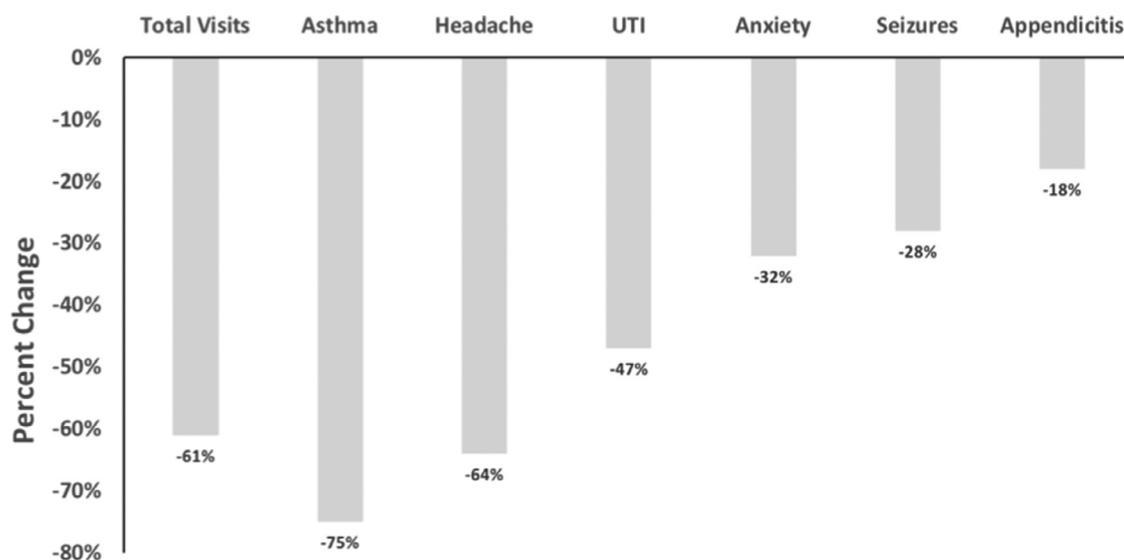


Figure 1. The percent change in emergency department visits and specific diagnoses comparing 2020 vs 2019 for the months of March 1 to Nov 30. Each p -value < 0.0001. UTI = urinary tract infection.

prepandemic period or the same periods in the previous 1–3 years. In other studies, the change in average daily cases during the pandemic compared with prepandemic periods were -17% , -2% , -2% , $+17\%$, and $+29\%$ (23–27). Studies reporting complications showed increases in abscess formation ranging from 11% to 40% and of perforation, from 17% to 34%, comparing the pandemic period with the prepandemic period (23–28). In four studies, the interval from symptom onset to diagnosis ranged from 0.0 to 2.0 days longer during the pandemic period.

One factor that could have contributed to the decreases in pediatric ED visits is the use of other resources during the pandemic, such as primary care providers and virtual visits. During the SARS outbreak in Canada in 2003, calls for pediatric illnesses to registered nurse telephone advice lines increased by 40% (10).

Since the start of the pandemic, there have been multiple studies that have looked into the effect of pediatric ED visits due to the pandemic (7–9). However, our study differs from other studies in the larger size of our database and the number of hospitals included. Many hospitals in

our database serve densely populated areas. In addition, we included the changes in visits for six diagnoses in our study. Others have described their experiences either with the total number of ED visits or a few specific diagnoses, but none as comprehensive as our study. Finally, we found no other studies that examined changes in visits specifically for anxiety, headache, or UTI.

Limitations

Our study has a number of limitations. We performed a retrospective study, which has innate problems and shortcomings (29). We may have undercounted or overcounted the number of ED visits for specific diagnoses, although we believe this effect to be small and, in any case, would be unlikely to have changed over the course of the study. We analyzed data only for hospital ED visits. We do not have information on visits to primary care offices or urgent care clinics that occurred in person or virtually. We analyzed data from 28 hospitals within 150 miles of New York City. This may not be representative of other areas in the United States or, indeed, other countries. Finally, retrospective studies such as ours can imply only association, not causation (29).

Conclusion

We found a decrease in total ED visits and visits for six common pediatric diagnoses after COVID-19 arrived in our area. We require further studies to determine if these decreases were due to recommendations for quarantine as well as fear of exposure to COVID-19. In addition, patients may have chosen other care venues such as urgent care or virtual visits as an alternative to the ED. Further studies on other diagnoses and potential complications due to the delay in seeking care are needed.

Supplementary Materials

Supplementary material associated with this article can be found, in the online version, at doi:[10.1016/j.jemermed.2022.09.008](https://doi.org/10.1016/j.jemermed.2022.09.008).

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ARTICLE SUMMARY**1. Why is this topic important?**

After arrival of COVID-19, pediatric emergency department (ED) visits dropped precipitously.

2. What does this study attempt to show?

We attempted to see which visits for selected common ED diagnoses dropped and by how much.

3. What are the key findings?

Decreases for specific diagnoses were 75% for asthma, 64% for headaches, 47% for urinary tract infections, 32% for anxiety, 28% for seizures, and 18% for appendicitis (p value for each comparison < 0.0001).

4. How is patient care impacted?

We speculate that delays in bringing children to the ED resulted in those patients being sicker and requiring more treatment and, possibly, even hospital admission, than would have occurred had they arrived earlier in the course of their disease.