Pediatric Emergency Department Visits at US Children's Hospitals During the COVID-19 Pandemic

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abstract

BACKGROUND AND OBJECTIVES: The impact of the coronavirus disease 2019 (COVID-19) pandemic on pediatric emergency department (ED) visits is not well characterized. We aimed to describe the epidemiology of pediatric ED visits and resource use during the pandemic.

METHODS: We conducted a cross-sectional study using the Pediatric Health Information System for ED visits to 27 US children's hospitals during the COVID-19 pandemic period (March 15, 2020, to August 31, 2020) and a 3-year comparator period (March 15 to August 31, 2017–2019). ED visit rates, patient and visit characteristics, resource use, and ED charges were compared between the time periods. We specifically evaluated changes in low–resource-intensity visits, defined as ED visits that did not result in hospitalization or medication administration and for which no laboratory tests, diagnostic imaging, or procedures were performed.

RESULTS: ED visit rates decreased by 45.7% (average 911 026 ED visits over 2017–2019 vs 495 052 visits in 2020) during the pandemic. The largest decrease occurred among visits for respiratory disorders (70.0%). The pandemic was associated with a relative increase in the proportion of visits for children with a chronic condition from 23.7% to 27.8% ($P < .001$). The proportion of low–resource-intensity visits decreased by 7.0 percentage points, and total charges decreased by 20.0% during the pandemic period.

CONCLUSIONS: The COVID-19 pandemic was associated with a marked decrease in pediatric ED visits across a broad range of conditions; however, the proportional decline of poisoning and mental health visits was less pronounced. The impact of decreased visits on patient outcomes warrants further research.

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WHAT'S KNOWN ON THIS SUBJECT: Health care systems were affected by the coronavirus disease 2019 pandemic; however, the impact on pediatric emergency department visits and resource use is unknown.

WHAT THIS STUDY ADDS: Emergency department visits declined in US children's hospitals across a broad range of conditions during the coronavirus disease 2019 pandemic. Vulnerable children were disproportionately affected. The proportion of low–resource-intensity visits decreased, whereas resource use increased during the pandemic period.

ARTICLE

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) emerged in China late in 2019, and the World Health Organization declared the outbreak a pandemic on March 11, 2020.[1,2] The devastating global impact of the coronavirus disease 2019 (COVID-19) pandemic continues to date, but the United States accounts for the highest disease burden and overall number of deaths globally.[3] Although mortality among children is low, >600 000 children in the United States have been affected with a broad spectrum of disease.[4–6]

SARS-CoV-2, and efforts to curb disease transmission, have negatively affected the US health care system.[7] After declaration of a national emergency on March 13,[8] public schools closed,[9] shelter-in-place orders were imposed,[10] and nonemergency, elective, and preventive medical care was deferred.[11] The collective impact of these directives on emergency department (ED) use in the United States was profound: by April 25th, ED visits across a range of practice settings had decreased by 42%.[12] Although respiratory disorders, including viral illnesses, are among the most common reasons children seek ED care,[13] data from the Centers for Disease Control and Prevention revealed that ED visits in the United States for children <14 years of age fell by 70% during the early weeks of the pandemic.[12] Whether this substantial decline in ED visits has persisted over time is unclear. Furthermore, pediatric EDs serve as regional referral centers providing specialized care, but data characterizing the clinical and financial impact of the COVID-19 pandemic on this practice setting are limited.[14–16] Finally, in current studies, researchers do not explore whether the decline in ED visits differentially impacted certain pediatric conditions or whether resource use differed for patients

seeking ED care during the pandemic.[14,15] As SARS-CoV-2 cases continue to rise among children,[4–6] an improved understanding of the clinical and financial impact of the COVID-19 pandemic specifically on pediatric ED care is needed.[14–17] Thus, we describe the epidemiology of pediatric ED visits and resource use at tertiary care children's hospitals in the United States during the first 5 months of the COVID-19 pandemic.

METHODS

Study Design, Setting, and Participants

We conducted a cross-sectional study using data from the Pediatric Health Information System (PHIS), an administrative database including 50 tertiary care children's hospitals in the United States.[18] The PHIS database contains *International Classification of Diseases, 10th Revision, Clinical Modification* (ICD-10-CM) diagnosis and procedure codes, billed services (eg, laboratory studies), and hospital charges. Data integrity is jointly monitored by participating institutions and the Children's Hospital Association.[19] We included all ED visits during the COVID-19 pandemic (March 15, 2020, to August 31, 2020) and a 3-year comparator period (March 15–August 31, 2017–2019) for 27 hospitals with complete administrative and billing data for the study periods. The Wayne State University Institutional Review Board deemed that this study did not qualify as human subject research.

Consistent with authors of a previous report, we defined the start of the pandemic period as the first Sunday (March 15, 2020) after the national emergency declaration on March 13, 2020.[20] To account for yearly variation in ED volume and case mix, we averaged visit numbers for the 3-year comparator period across the same calendar dates as the pandemic period. We also examined ED visits

from January 1, 2020, to March 14, 2020, to characterize ED visit volumes before the defined pandemic period. To contextualize ED visits from January to August 2020, we obtained daily national SARS-CoV-2 case counts for pediatric and adult patients from the Centers for Disease Control and Prevention.[4,21]

Patient Demographic and Clinical Characteristics

Demographic characteristics for each ED visit included age (<1, 1–4, 5–9, 10–14, 15–18, and ≥19 years), sex, race and ethnicity (non-Hispanic white, non-Hispanic Black, Hispanic, or other), insurance coverage (government, private, or other), geographic region (Midwest, Northeast, South, West), distance from the hospital (calculated as the number of miles between the centroids of the patient's and hospital's zip codes), day of the week (weekend versus weekday), and time of arrival to the ED (8 AM–3:59 PM, 4 PM–11:59 PM, and midnight to 7:59 AM). We did not restrict the cohort by age to capture potential epidemiological changes in adult visits to pediatric EDs during the pandemic period. Race and ethnicity were included in the analyses as a social construct that has previously been associated with differences in ED care–seeking behavior.[22,23]

We described patient complexity for each visit using a previously developed 3-tiered categorical variable: (1) no chronic condition, (2) noncomplex chronic condition, or (3) complex chronic condition (CCC).[24–27] First, we characterized patients as having a CCC, defined as any medical condition expected to last at least 12 months with multiorgan or severe single-organ involvement necessitating pediatric subspecialty care and hospitalization, using a previously validated approach.[24,25] For those without a CCC, we used the Agency for Healthcare Research and Quality's (AHRQ) Chronic Condition

Indicator to categorize patients using ICD-10-CM diagnosis codes into 2 groups: with or without a chronic condition.[26]

Diagnoses, Health Services Resource Use, and Associated Charges

We examined primary discharge diagnoses, ED management, disposition, and select quality metrics for each visit.[27] Principal ICD-10-CM discharge diagnosis codes were classified by AHRQ's Clinical Classifications Software Refined.[28] ED management included (1) performing laboratory testing or diagnostic imaging; (2) administering medications (other than ibuprofen or acetaminophen); and (3) performing procedures.[27,29] Laboratory testing, diagnostic imaging, and medications administered for each visit were identified through billed transactions. Any charge within each category was categorized as resource utilization within the ED if the charge occurred on day 0 or before 6 PM on day 1 of hospitalization.[30] Procedures were identified by current procedural terminology codes, with any assigned current procedural terminology code in the range 10 000 to 69 990 considered a procedure.[30] Disposition was categorized as discharged from the hospital, transferred, hospitalized (with "observation" admissions categorized as a hospitalization), or died.[31] Consistent with previous work, ED visits that did not result in hospitalization and in which no laboratory tests, diagnostic imaging, or procedures were performed were defined as a "low–resource-intensity visit."[29] ED visit charges billed to the patient were inflated to the 2020 US dollar (USD) on the basis of the Consumer Price Index for Hospital and Related Services.[32]

Statistical Analyses

Patient demographic and clinical characteristics were summarized by using frequencies for categorical variables and medians with interquartile ranges (IQRs) for numerical variables. Categorical variables were compared with Rao-Scott χ^2 tests, adjusting for clustering at the hospital level. Numerical variables were compared with Wilcoxon rank tests. Year-over-year comparisons of daily volumes were shifted to compare similar days of the week to account for the variation in volume by day of the week. For instance, the daily volume change of January 25, 2020, was compared relative to the most proximal Saturday in previous years: January 26, 2019; January 27, 2018; and January 28, 2017. Total charges and charges stratified by discharge status in 2020 were compared with those in each of 2019, 2018, and 2017 with paired signed rank tests. SAS 9.4 (SAS Institute, Inc, Cary, NC) was used for all analyses.

RESULTS

ED visits across 27 pediatric hospitals revealed a sharp decline starting March 12, 2020, ~1 month before SARS-CoV-2 cases started accelerating (Fig 1). By April 13, 2020, ED visits had declined to a low of 70.5% of previous average years' volume and remained at 27.2% below prepandemic volumes into July 2020. In total, during the pandemic period, ED volume decreased from 911 026 ED visits averaged over 2017–2019 to 495 052 visits in 2020 (45.7% decline). The decline in volume across sites ranged from 36.1% to 69.9%, with average decreases across institutions by geographic region as follows: the Midwest decreased by 49.3%, West by 46.2%, Northeast by 46.0%, and South by 42.8%.

Compared with previous years, the demographic characteristics of children visiting the ED differed during the 2020 pandemic (Table 1). The proportion of children 15 to 18 years of age increased from 10.3% to 12.9%, and the proportion of adults aged ≥19 years increased from 4.1% to 6.3% during the pandemic ($P <$ .001 for both). The proportion of children with a chronic condition increased from 23.7% to 27.8%, and there was an increase in the proportion of visits among non-Hispanic white children (32.3%–35.9%), those with private insurance (29.8%–32.0%), and patients residing >10 miles from the hospital (43.7%–47.3%) ($P <$ .001 for all).

There were changes in the distribution of the types of encounters during the pandemic, as shown in Table 2 (Supplemental Table 5). The most notable were decreases in the overall number of visits among children with respiratory illnesses (70.0%), including respiratory infections and asthma (69.6% and 73.9%, respectively). Sharp declines in ED visits were observed for less urgent conditions, such as otitis media and upper respiratory infection (75.1% and 69.6% decreases, respectively). Less pronounced decreases were observed for ED visits resulting from injuries and/or poisoning (33.1%) and mental health disorders (29.0%) and among pregnant patients (23.0%). Within the injuries and/or poisoning diagnostic chapter, the weighted average decrease in diagnostic codes related to poisoning (20.2%) was less pronounced than the decline in diagnostic codes related to injury (34.6%) (Supplemental Table 5). The most frequent poisoning-related diagnosis (poisoning by drugs, initial encounter) in the comparator period (n = 2414) declined 8.1% in the pandemic period (Supplemental Table 5). Among the mental health disorders, visits for depressive disorders decreased 38.8%, whereas visits for suicidal ideation or attempt declined 4.0% and stimulant-related disorders were unchanged (2.0%) (Supplemental Table 5).

ED visits during the COVID-19 pandemic were associated with increased resource use, revealed by
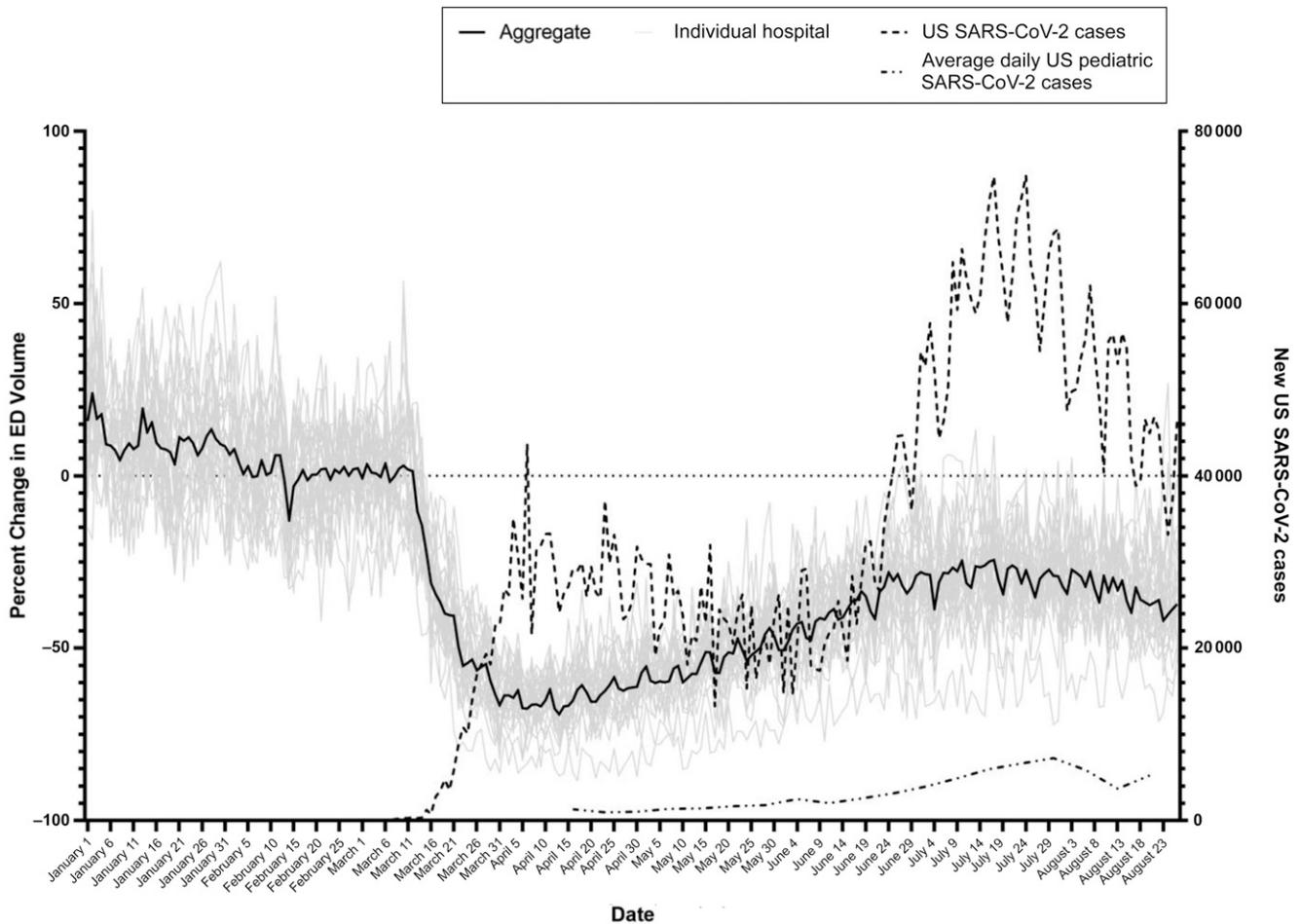
FIGURE 1
Overall change in pediatric ED visits during the COVID-19 pandemic. The primary y-axis displays the number of ED visits at each individual hospital (gray) and aggregate number (black) in 2020 relative to average ED volume in 2017–2019. The secondary y-axis displays the incidence of SARS-CoV-2 cases and the average daily pediatric SARS-CoV-2 cases in the United States.[4,20]

relative increases in laboratory testing (11.1% [95% confidence interval (CI): 10.9 to 11.2]), diagnostic imaging (5.5% [95% CI: 5.3 to 5.6]), medication administration (2.2% [95% CI: 2.0 to 2.3]), and performance of procedures (3.2% [95% CI: 3.1 to 3.3]). Among the laboratory tests performed, testing for SARS-CoV-2 accounted for 5.2% (26 809 of 490 052) of tests during the pandemic period. Compared with previous years, hospitalizations increased 3.3 and intensive care admissions increased 0.4 percentage points between the comparator and pandemic periods (Table 3). Low–resource-intensity

visits decreased from 30.7% of all ED visits in the prepandemic period to 23.7% during the pandemic period (−7.0% [95% CI: −7.1 to −6.9]).

Overall, total charges from cases originating in the ED decreased from an average of $5.7 billion in 2017–2019 to $4.6 billion in 2020. This represents a 20.0% decrease in total charges during the pandemic period. Hospitals experienced a median (IQR) change in charges from 2017–2019 to 2020 of −$35.1 million (−17.8 to −63.8) (P < .001; Table 4). In terms of percentage decreases, the hospitals saw charges decrease by a median (IQR) percent

of −33.7% (−26.7 to −38.2) from patients who were discharged from the ED and −16.0% (−6.5 to −23.2) from patients who were admitted (both P < .001).

DISCUSSION

In this large multicenter study of 495 000 visits across 27 US EDs, we found that the COVID-19 pandemic profoundly impacted pediatric EDs. The overall number of ED visits declined rapidly and consistently across 27 pediatric hospitals, even before SARS-CoV-2 infections began to rise in the United States. It is suggested in our data that although

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TABLE 1 Demographic Characteristics

Characteristic	Comparator Period		Pandemic Period	P
	March 15 to August 31, 2017–2019 (N = 2 733 078)		March 15 to August 31, 2020 (N = 495 052)	
	3-y Average (n = 911 026)			
Age, y				<.001
<1	130 196 (14.3)		71 054 (14.4)	—
1–4	296 436 (32.5)		144 968 (29.3)	—
5–9	198 732 (21.8)		97 703 (19.7)	—
10–14	154 662 (17.0)		86 319 (17.4)	—
15–18	93 410 (10.3)		63 901 (12.9)	—
19+	37 591 (4.1)		31 107 (6.3)	—
Age, median (IQR), y	5 (1–11)		6 (1–13)	<.001
Sex				<.001
Male	475 396 (52.2)		253 052 (51.1)	—
Female	435 514 (47.8)		241 902 (48.9)	—
Chronic condition[a]				<.001
None	694 988 (76.3)		357 416 (72.2)	—
Noncomplex chronic condition[b]	144 052 (15.8)		86 624 (17.5)	—
CCC[c]	71 986 (7.9)		51 012 (10.3)	—
Race and/or ethnicity				<.001
Non-Hispanic white	293 966 (32.3)		177 617 (35.9)	—
Non-Hispanic Black	203 039 (22.3)		105 830 (21.4)	—
Hispanic	304 273 (33.4)		148 274 (30.0)	—
Other	109 748 (12.0)		63 331 (12.8)	—
Payer				<.001
Government	570 523 (65.2)		295 464 (62.0)	—
Private	260 865 (29.8)		152 602 (32.0)	—
Other	43 596 (5.0)		28 182 (5.9)	—
Geographic region				<.001
Midwest	208 038 (22.8)		105 445 (21.3)	—
Northeast	68 185 (7.5)		36 823 (7.4)	—
South	332 011 (36.4)		189 820 (38.3)	—
West	302 791 (33.2)		162 964 (32.9)	—
Distance from hospital, median (IQR), miles	8.7 (4.6–17.6)		9.4 (4.9, 19.1)	<.001
Distance from hospital				<.001
<5 miles	252 208 (27.7)		126 856 (25.6)	—
5–10 miles	258 314 (28.4)		133 079 (26.9)	—
10–20 miles	208 501 (22.9)		117 958 (23.8)	—
20+ miles	189 737 (20.8)		116 571 (23.5)	—
Missing	2267 (0.2)		588 (0.1)	—
Time of day				<.001
8 AM to 3:59 PM	325 576 (35.7)		181 923 (36.8)	—
4 PM to 11:59 PM	458 097 (50.3)		246 248 (49.8)	—
Midnight to 7:59 AM	127 117 (14.0)		66 613 (13.5)	—
Day of week				.257
Weekday	646 921 (71.0)		351 144 (70.9)	—
Weekend	264 105 (29.0)		143 908 (29.1)	—

—, not applicable.

[a] Diagnoses reported during all ED encounters were used to categorize patients by chronic condition.

[b] These children had a chronic condition, identified with the AHRQ's Chronic Condition Indicator system but did not have a CCC, identified with Feudtner's diagnosis list.[24–26]

[c] These children had a CCC identified with the diagnosis list from Feudtner et al.[24,25]

this widespread decline impacted a broad range of pediatric conditions, pediatric EDs continued to care for higher-acuity patients during the pandemic period.

Notably, pediatric ED visits began to decrease steadily before the surge of SARS-CoV-2 cases, suggesting that public health measures, including emergency declarations to control the spread of disease, likely influenced health care–seeking behaviors.[17] SARS-CoV-2 circulated with marked regional differences across the United States,[3,21] but the timing of the impact on pediatric ED volumes was uniform, with all 27 sites experiencing an immediate decrease in the overall number of visits. These declines are consistent with smaller international studies of pediatric hospitals, which revealed rapid declines in ED visits and hospitalizations around the time of each country's emergency declarations, well before peaks in SARS-CoV-2 cases.[33–35] Yet, it is unclear from our data analysis and the current literature whether visits for SARS-CoV-2 or other common acute and nonacute pediatric conditions contributed most substantially to ED volume recovery.[14,15,33–35]

Although our results highlight that ED volumes are revealing slow recovery, our analysis underscores that the marked decline in pediatric ED visits and subsequent hospitalizations had a notable financial impact for children's hospitals in the United States. Although numerous factors contribute, cancelled nonurgent and elective care visits coupled with the rising costs associated with disrupted medical and equipment supply chains led to a financial crisis for many US health care systems.[36] By the end of 2020, the Children's Hospital Association projects that losses for pediatric hospitals will reach $10 billion,[16] but with our data, we are the first to quantify the true financial impact of the COVID-19 pandemic on pediatric EDs.

Our data reveal the impact of public health initiatives to curb disease spread and directives to avoid nonessential care[11]: low–resource-intensity visits dropped significantly during the COVID-19 pandemic. As the low–resource-intensity visits

TABLE 2 Three Most Frequent Diagnoses in the Comparator Period for Each ICD-10-CM Diagnosis Chapters With Visit Frequency and Percent Change During the Pandemic Period

Diagnosis	Comparator Period March 15 to August 31, 2017–2019	Pandemic Period March 15 to August 31, 2020	Percent Change	Absolute Change
	n	n		
Injury, poisoning, and certain other consequences of external causes	205 098	137 217	−33.1%	−67 881
Superficial injury; contusion, initial encounter	37 005	19 403	−47.6%	−17 602
Other unspecified injury	27 929	14 667	−47.5%	−13 262
Open wounds of head and neck, initial encounter	26 738	22 026	−17.6%	−4712
Symptoms, signs, and abnormal clinical and laboratory findings, not elsewhere classified	158 123	86 746	−45.0%	−71 377
Abdominal pain and other digestive or abdomen signs and symptoms	37 384	19 246	−48.5%	−18 138
Fever	36 087	23 745	−34.2%	−12 342
Nausea and vomiting	25 743	8781	−65.9%	−16 962
Diseases of the respiratory system	157 649	47 079	−70.0%	−110 570
Other specified upper respiratory infections	92 103	28 015	−69.6%	−64 088
Asthma	23 950	6245	−73.9%	−17 705
Acute bronchitis	11 565	2571	−77.8%	−8994
Diseases of the digestive system	76 613	38 782	−49.0%	−37 831
Other specified and unspecified gastrointestinal disorders	16 636	9548	−42.6%	−7088
Noninfectious gastroenteritis	12 844	3357	−73.9%	−9487
Diseases of mouth, excluding dental	11 144	3039	−72.7%	−8105
Diseases of the ear and mastoid process	43 286	13 747	−68.0%	−29 539
Otitis media	33 551	8342	−75.1%	−25 209
Other specified and unspecified disorders of the ear	8716	5008	−42.5%	−3708
Diseases of middle ear and mastoid (except otitis media)	865	300	−65.3%	−565
Diseases of the skin and subcutaneous tissue	41 084	21 584	−47.0%	−19 500
Skin and subcutaneous tissue infections	19 621	11 446	−41.7%	−8175
Other specified inflammatory condition of skin	10 404	4894	−53.0%	−5510
Other specified and unspecified skin disorders	5998	2796	−53.4%	−3202
Certain infectious and parasitic diseases	33 024	23 720	−28.0%	−9304
Viral infection	26 361	12 658	−52.0%	−13 703
Fungal infections	1897	798	−57.9%	−1099
Parasitic, other specified and unspecified infections	1877	765	−59.2%	−1112
Diseases of the nervous system	32 976	18 989	−42.0%	−13 987
Headache, including migraine	14 451	6840	−52.7%	−7611
Epilepsy, convulsions	13 546	9071	−33.0%	−4475
Nervous system pain and pain syndromes	1069	484	−54.7%	−585
Diseases of the genitourinary system	27 503	20 489	−26.0%	−7014
Urinary tract infections	12 548	9158	−27.0%	−3390
Other specified male genital disorders	3669	3057	−16.7%	−612
Inflammatory conditions of male genital organs	2192	1655	−24.5%	−537
Diseases of the musculoskeletal system and connective tissue	27 389	14 794	−46.0%	−12 595
Musculoskeletal pain, not low back pain	14 287	7377	−48.4%	−6910
Spondylopathies or spondyloarthropathy (including infective)	3083	1660	−46.2%	−1423
Other specified bone disease and musculoskeletal deformities	2181	1226	−43.8%	−955
Mental, behavioral and neurodevelopmental disorders	22 668	16 107	−29.0%	−6561
Depressive disorders	5684	3476	−38.8%	−2208
Suicidal ideation or attempt or intentional self-harm	3918	3760	−4.0%	−158
Anxiety and fear-related disorders	2626	2124	−19.1%	−502
Factors influencing health status and contact with health services	19 999	16 159	−19.0%	−3840
Encounter for observation and examination for conditions ruled out (excludes infectious disease, neoplasm, mental disorders)	6086	3477	−42.9%	−2609
Other specified status	5770	1917	−66.8%	−3853
Other aftercare encounter	3462	2306	−33.4%	−1156
Diseases of the eye and adnexa	16 893	5687	−66.0%	−11 206
Cornea and external disease	12 749	3481	−72.7%	−9268
Other specified eye disorders	2187	1043	−52.3%	−1144
Oculofacial plastics and orbital conditions	1101	555	−49.6%	−546
Diseases of the circulatory system	13 077	9085	−31.0%	−3992
Nonspecific chest pain	8382	5846	−30.3%	−2536
Other specified diseases of veins and lymphatics	1813	1057	−41.7%	−756

TABLE 2 Continued

Diagnosis	Comparator Period	Pandemic Period	Percent Change	Absolute Change
	March 15 to August 31, 2017–2019	March 15 to August 31, 2020		
	n	*n*		
Cardiac dysrhythmias	654	455	−30.5%	−199
Endocrine, nutritional and metabolic diseases	11 347	7451	−34.0%	−3896
Fluid and electrolyte disorders	5552	2740	−50.6%	−2812
Diabetes mellitus with complication	3681	3274	−11.1%	−407
Other specified and unspecified endocrine disorders	577	381	−34.0%	−196
Certain conditions originating in the perinatal period	9404	6956	−26.0%	−2448
Other specified and unspecified perinatal conditions	2667	1950	−26.9%	−717
Neonatal digestive and feeding disorders	2030	1508	−25.7%	−522
Hemolytic jaundice and perinatal jaundice	1928	1640	−14.9%	−288
Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	7413	4779	−36.0%	−2634
Sickle cell trait or anemia	3975	2515	−36.7%	−1460
Coagulation and hemorrhagic disorders	1108	563	−49.2%	−545
Diseases of white blood cells	1052	808	−23.2%	−244
Congenital malformations, deformations and chromosomal abnormalities	2515	1810	−28.0%	−705
Digestive congenital anomalies	772	651	−15.7%	−121
Cardiac and circulatory congenital anomalies	413	292	−29.3%	−121
Musculoskeletal congenital conditions	305	180	−41.0%	−125
Neoplasms	2466	1947	−21.0%	−519
Leukemia: acute lymphoblastic leukemia	502	368	−26.7%	−134
Conditions due to neoplasm or the treatment of neoplasm	496	389	−21.6%	−107
Benign neoplasms	496	365	−26.4%	−131
Pregnancy, childbirth, and the puerperium	2079	1599	−23.0%	−480
Other specified complications in pregnancy	1044	756	−27.6%	−288
Early, first, or unspecified trimester hemorrhage	492	400	−18.6%	−92
Spontaneous abortion and complications of spontaneous abortion	152	114	−24.8%	−38

Diagnosis chapters are listed in descending order of visit frequency during the comparator period.

declined during the COVID-19 pandemic, our data suggest a disproportionate decline in pediatric ED visits for potentially vulnerable children, characterized by race and ethnicity, insurance status, and proximity to the hospital. Although initiatives exist to encourage nonurgent visits in the primary care setting,[37] the decline in these visits in the context of the pandemic is concerning because pediatric practices also saw marked decreases in routine patient visits, caring for only 30% of their typical clinic volume.[38] Health care–seeking behavior is multifactorial, influenced both positively and negatively by public health strategies to contain SARS-CoV-2, but our results draw attention to the fact that health care

avoidance may be mediated by various sociodemographic factors.

With our results, we also provide initial insight into care delivery for pediatric patients coming to the ED during the COVID-19 pandemic. As expected, ED care for nonurgent conditions such as acute otitis media and upper respiratory infection declined; however, conditions commonly requiring ED care also had a steep decline in visits, including asthma, injuries, mental health conditions, and child abuse. Stay-at-home orders and school closures may have altered the epidemiology of other viral infections that commonly lead to asthma exacerbations requiring acute care.[33] These same directives contributed to a decline in motor vehicle travel, playground

closure, and cancellation of sporting events, partly explaining a decrease in acute injuries and fractures.[39–41] Public health measures to control SARS-CoV-2 may have had unintended benefits for children by mitigating the need for medical care for common childhood conditions.

On the other hand, our findings also support that there may be negative unintended consequences arising from mitigating public health measures that disrupt normal social interactions. First, our data reveal that ED visits related to poisoning and substance use disorders were not as profoundly impacted by the pandemic. Our findings align with reports that calls to poison control centers rose during the COVID-19

TABLE 3 Resource Use for Pediatric ED Visits in the Study Periods

	Comparator Period	Pandemic Period	Percent Change (95% CI)
	March 15 to August 31, 2017–2019	March 15 to August 31, 2020	
	n (%)	n (%)	
ED management			
Laboratory test performed	312 886 (34.3)	224 861 (45.4)	11.1% (10.9 to 11.2)
Imaging study performed	285 558 (31.3)	182 315 (36.8)	5.5% (5.3 to 5.6)
Medication administered	395 535 (43.4)	225 796 (45.6)	2.2% (2.0 to 2.3)
Procedure performed	85 614 (9.4)	62 404 (12.6)	3.2% (3.1 to 3.3)
Disposition from the ED			
Discharged	795 723 (87.3)	414 588 (83.7)	−3.6% (−3.7 to −3.5)
Hospitalized	103 881 (11.4)	72 947 (14.7)	3.3% (3.2 to 3.4)
ICU	11 271 (1.2)	8115 (1.6)	0.4% (0.4 to 0.4)
Died in ED or during hospitalization	524 (0.1)	504 (0.1)	0% (0 to 0.1)
Transfer out of the ED	10 897 (1.2)	7013 (1.4)	0.2% (0.2 to 0.3)
Other metrics			
ED length of stay, median (IQR), h[a]	2 (1–3)	2 (1–4)	—
Hospital length of stay, median (IQR), d[a]	2 (1–3)	2 (1–4)	—
Low–resource-intensity visit[b]	279 455 (30.7)	117 259 (23.7)	−7.0% (−7.1 to −6.9)
Charges for discharged ED patients, median (IQR), USD[a]	1296 (666–2261)	1647 (950–3004)	—
Charges for hospitalized ED patients, median (IQR), USD[a]	20 524 (12 137–37 098)	24 531 (14 480–43 995)	—

—, not applicable.

[a] Comparisons were statistically significant to <.001 by using Wilcoxon rank tests.

[b] Low–resource-intensity visit was defined as a visit in which the patient was not hospitalized and in which no laboratory tests, diagnostic imaging, or procedures were performed.[29]

pandemic, driven by accidental exposures to various household substances including disinfectants.[42] Substance use disorders are more common among adolescents,[43] who increasingly sought ED care during the pandemic period. Second, social isolation and familial socioeconomic struggles resulting from public health measures may have negatively affected children's mental health, particularly for adolescents.[44] Yet, while 40% of adults reported declining mental health by June 2020,[45] pediatric ED visits for depression, anxiety, and suicide declined. The longer-term impact of decreased mental health visits to pediatric EDs remains unclear. Finally, we note a decrease in visits during the pandemic for child maltreatment and abuse, aligning with documented decreases in child protection reports. Experts are concerned that child abuse is occurring without intervention from medical and legal authorities[46]; thus, it is possible that in the context of the COVID-19 pandemic, the pediatric ED as a safety net may have inadvertently failed.

This study has several important limitations. First, our data reflect the experience of 27 US children's hospitals, which limits national and international generalizability. However, our results align with previous US and international studies suggesting that similar trends regarding ED volumes and visit intensity exist for general EDs.[14,15,33–35] Second, children transferred to the PHIS hospital were not excluded, and reported charges may not reflect overall health care expenditures because diagnostic testing that may have been performed before the ED visit is not included. Third, ED visit acuity cannot be characterized in PHIS by using measures such as the emergency severity index. Thus, proxy measures were used, including hospitalization and intensive care admission, which may not accurately reflect ED visit

TABLE 4 Median Charges for Pediatric ED Visits During the Study Periods

	Comparator Period		Pandemic Period	
	2017	2018	2019	2020
	March 15 to June 30	March 15 to June 30	March 15 to June 30	March 15 to June 30
Total charges, median (IQR)[a]	169.3 (112.3–275.8)	192.8 (111.8–294)	201.3 (122.2–330.6)	142.9 (87.8–238.1)[b]
ED discharges, median (IQR)	48.5 (31.6–69)	47.2 (29.4–78.1)	47.2 (32.6–90.7)	32.8 (17.2–48.9)[b]
ED admissions, median (IQR)	134.8 (73.4–207.9)	129.6 (78.8–221.2)	134.4 (78.2–264.6)	116.9 (60.3–197.1)[b]

[a] Millions, adjusted to 2020 USD.

[b] Comparisons were significant to P < .001 by using paired signed rank tests, except for 2017 vs 2020 ED admissions, which is significant to P = .001.

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acuity. Our results, however, note an increase in acuity, which aligns with a single-center US report in which emergency severity index was included in the analysis.[15] Fourth, PHIS is an administrative data set and does not contain detailed clinical data. As such, we are unable to characterize the reason for the ED visit or the clinical course, limiting our ability to examine potential escalations in ED clinical care or increased morbidity for visits occurring during the pandemic period. Given the large number of children included in PHIS, many comparisons were statistically significant but may not be clinically meaningful. Finally, our data do not account for alternative care availability, such as visits occurring in the primary care setting. Thus, we are unable to comment on the exact impact of the decline in ED visits on children's overall access to health care, but outpatient visits also declined.[38]

CONCLUSIONS

Pediatric EDs in the United States saw a dramatic decline in visits for both acute and nonacute conditions during the COVID-19 pandemic. Although visits declined across a broad range of pediatric conditions, the proportional decline for poisoning and mental health visits was less pronounced. Because low–resource-intensity visits decreased and resource use increased, further study is needed to determine if patient outcomes were influenced by care-seeking behaviors during the COVID-19 pandemic.

ABBREVIATIONS

AHRQ: Agency for Healthcare Research and Quality
CCC: complex chronic condition
CI: confidence interval
COVID-19: coronavirus disease 2019
ED: emergency department
ICD-10-CM: *International Classification of Diseases*, 10th Revision, *Clinical Modification*
IQR: interquartile range
PHIS: Pediatric Health Information System
SARS-CoV-2: severe acute respiratory syndrome coronavirus 2
USD: US dollar

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