

Impact of the COVID-19 Pandemic on Pediatric Emergency Department Utilization for Asthma

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Pediatric asthma exacerbations frequently result in Emergency Department (ED) visits¹. In order to mitigate the rapid spread of COVID-19^{1,2}, Massachusetts declared a State of Emergency on March 10th, schools and child-care facilities closed by March 15th and 18th, respectively, and a “stay-at-home” order went into effect on March 24, 2020³. The Boston Children’s Hospital (BCH) ambulatory clinics, ED, and hospital remained open for urgent visits and all other medical care was provided via telehealth. Patients with asthma were advised to adhere to their controller medications⁴. While viral illness is a frequent cause of asthma exacerbation⁵, the effects of social distancing, and school closure on pediatric asthma are unknown. We aimed to determine the impact of these measures on frequency of asthma-related pediatric ED visits. We hypothesized that ED visits would be lower following the 2020 “shut-down”.

Methods

This retrospective cohort study was deemed exempt by the Institutional Review Board. The BCH Data Repository linked to the electronic health record was queried to identify children ages 2-22 years with ED visits for asthma (diagnosis codes J45.XX), who received at least one asthma-related medication (Albuterol, Ipratropium, Levalbuterol or Albuterol-Ipratropium) between January 5-May 23 in 2018, 2019, and 2020. Children with other chronic heart or lung diseases were excluded. Patient characteristics were compared with chi-squared tests. Based on visual inspection of run charts (Figure 1), pre- and post-COVID-19 shut-down was defined as January 5-March 21 and March 22-May 23, respectively, and applied to each year. Interrupted time-series design with a negative binomial regression model assessed weekly ED visits with regard to time (weeks elapsed since January 5), COVID-19 shut-down (pre- versus post-), and year

(2018, 2019, 2020). A three-way interaction term between time, COVID-19, and year indicated no difference in slope in the pre- versus post-COVID-19 time period across years ($p=0.3702$) and was subsequently dropped in favor of a more parsimonious model. Regression coefficients were exponentiated to derive incidence rate ratios (IRR). Results were considered significant for p -values <0.05 (SAS Institute, Cary NC).

Results

Across the three years, 2543 total ED asthma visits occurred between January 5-May 23. There were significantly fewer number and proportion of asthma ED visits in 2020 compared to 2019 and 2018. Only ethnicity varied by year. The percent of asthma exacerbations requiring admission to the hospital was not significantly higher in 2020 compared to 2018, but was higher than 2019 (Table 1).

After adjusting for year, weeks, and time period (pre- or post- shutdown), we found a significantly decreased incidence of ED visits after the shut-down in 2020 compared to 2018 (IRR=0.21, 95% CI [0.11, 0.37], <0.0001), and 2019 (IRR=0.18, 95% CI [0.10, 0.32], <0.0001), but not between 2018 and 2019 ($p=0.6250$) (see online supplement, Table E1). For the week of March 15-March 21, rate of ED visits was similar across years. However, the following week the rate of ED visits decreased 80% (IRR=0.20, 95% CI [0.14, 0.28]) and 82% (IRR=0.18, 95% [0.13, 0.25]) in 2020 relative to 2018 and 2019, respectively ($p<0.0001$), which continued through May 23 (82% and 87% reduction compared to 2018 and 2019, respectively, Figure 2).

Due to significant differences in patient ethnicity by year, the primary model was stratified by Hispanic ($n=420$) and non-Hispanic ($n=1,799$). Each subgroup demonstrated

significantly lower ED rates post COVID-19 in 2020 than previous years, consistent with the overall findings.

Discussion

We observed a significant decrease in pediatric ED visits for asthma during the Massachusetts shutdown in the setting of the COVID-19 pandemic. Additionally, the percent of total ED visits that were due to asthma was lower in 2020 compared with 2018 and 2019 suggesting that the effect was not just due to an overall avoidance of the ED.

ED visits dropped precipitously the week of March 22, days after school and day care closures and coinciding with the state shut-down. There are several potential contributors to this decrease, including increased adherence to asthma medications, avoidance of the health-care setting due to fear of contracting COVID-19, improved air quality due to work-from-home implementation, decreased participation in sports and exercise, decreased exposure to outdoor aero-allergens, and decreased viral exposure due to school/daycare closure. Interestingly, rather than a gradual decline, which would be more indicative of improved medication adherence, there was a dramatic decline, suggestive of a sudden change in exposure, which occurred in conjunction with the stay at home order and school closure. Our findings are consistent with—though more drastic than—asthma exacerbation trends previously noted to decrease during the summer months in association with school vacation^{5, 6}. Furthermore, these results are similar to those recently reported by Kenyon et al.⁷ Similarly, Hatoun et al have demonstrated significant declines in several other pediatric infectious diseases in the setting of social distancing measures, including bronchiolitis and the common cold.⁸ It is also possible

that the decrease in ED visits could be explained by a simultaneous increase in outpatient or home management of asthma exacerbations, including via telehealth which became available at our institution during the State of Emergency.

In contrast to Kenyon et al, we found no change in the admission rate⁷. While this might indicate that asthma ED visits during the shut-down were not necessarily more acute, it is also possible that other factors, such as desired avoidance of admission, also contributed to the admission rate remaining the same. Additional exposure to in-home triggers and allergens may have also contributed to the similar admission rate. These findings raise important questions for future studies, such as contribution of viral infection for those requiring admission, and concomitant in home exposures. Additionally, we identified ethnic differences across the study period that did not influence the main findings. Nevertheless, it will be important for future studies to specifically assess racial/ethnic variation in healthcare utilization. While provocative, these findings are limited to a single large pediatric ED and warrant validation in other institutions and ambulatory settings. If true, this phenomenon offers lessons to be learned and several areas for future investigation of this complex issue, serving as a framework for future prevention of childhood asthma exacerbations.

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Table 1. Demographic and clinical characteristics of Emergency Department visits for an asthma exacerbation in 2018, 2019, 2020 (n=2,543)

	January-May, 2018 n=955	January-May, 2019 n=958	January-May, 2020 n=630	P-Value
N (%) of Total ED Visits*	955/17,973 (5.3%)	958/18,626 (5.1%)	630/13,715 (4.6%)	0.0117
*N(%) of total ED visits March -May	526/10,180 (5.2%)	659/11,404 (5.8%)	220/5,675 (3.9%)	<0.0001
N (%) of asthma exacerbations requiring admission	490 (51.3%)	417 (43.5%)	335 (53.2%)	0.0001
Age				
<i>0-4 years</i>	295 (30.9%)	278 (29.0%)	187 (29.7%)	0.3602
<i>5-11 years</i>	378 (39.6%)	399 (41.6%)	235 (37.3%)	
<i>12-18 years</i>	229 (24.0%)	237 (24.7%)	165 (26.2%)	
<i>19+ years</i>	53 (5.5%)	44 (4.6%)	43 (6.8%)	
Ethnicity				
<i>Hispanic</i>	141 (14.8%)	193 (20.1%)	86 (13.7%)	0.0003
<i>Non-Hispanic</i>	713 (74.7%)	635 (66.3%)	451 (71.6%)	
<i>Missing</i>	101 (10.6%)	130 (13.6%)	93 (14.8%)	
Race				
<i>White</i>	261 (27.3%)	225 (23.5%)	168 (26.7%)	0.0636
<i>Black</i>	328 (34.3%)	303 (31.6%)	188 (29.8%)	
<i>Asian</i>	19 (2.0%)	18 (1.9%)	14 (2.2%)	
<i>Other</i>	310 (32.5%)	376 (39.2%)	212 (33.7%)	
<i>Missing</i>	37 (3.9%)	36 (3.8%)	48 (7.6%)	
Insurance				
<i>Private</i>	377 (39.5%)	356 (37.2%)	267 (42.4%)	0.2496
<i>Public (Medicaid)</i>	561 (58.7%)	584 (61.0%)	345 (54.8%)	
<i>International</i>	11 (1.2%)	12 (1.3%)	6 (1.0%)	
<i>Missing</i>	6 (0.6%)	6 (0.6%)	12 (1.9%)	

*Subset of dataset reflecting N(%) of total ED visits for March 1-May 23.

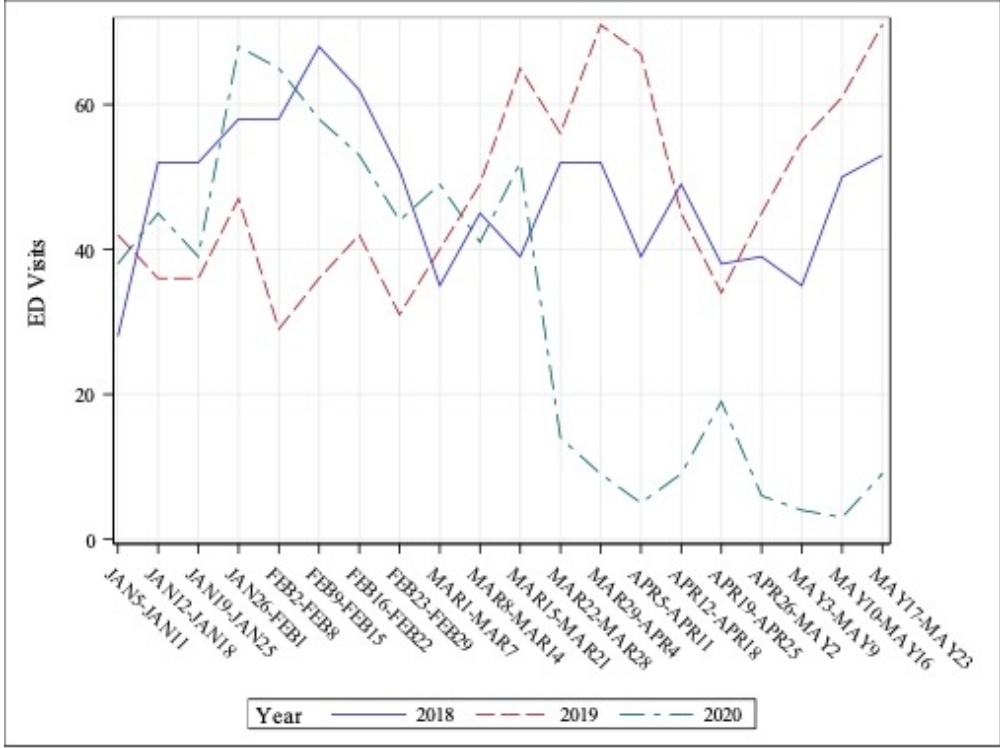
Figure Legends:

Figure 1. Run chart of asthma ED visits from January 5-May 23 in 2018, 2019, and 2020

(n=2,543)

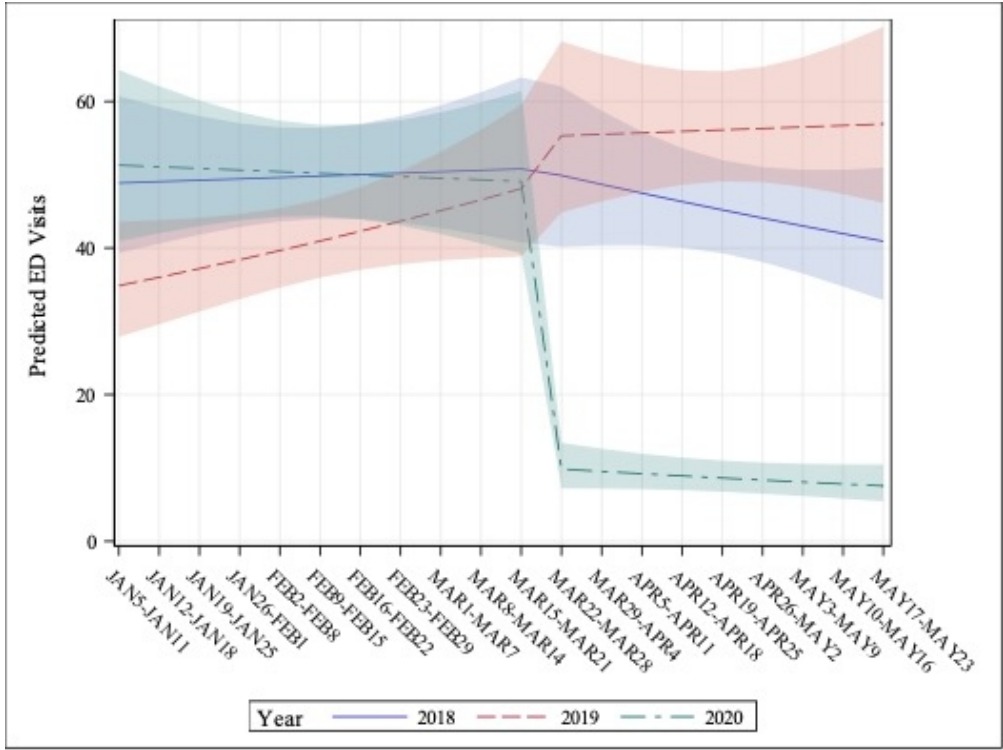
Figure 2. Multivariable model of weekly incidence of asthma ED visits from January 5-May 23 in

2018, 2019, and 2020 (n=2,543)



Run chart of asthma ED visits from January 5-May 23 in 2018, 2019, and 2020 (n=2,543)

178x134mm (72 x 72 DPI)



Multivariable model of weekly incidence of asthma ED visits from January 5-May 23 in 2018, 2019, and 2020 (n=2,543)

185x138mm (72 x 72 DPI)