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The impact of the COVID-19 pandemic on otolaryngologic emergency department visits at two major NYC hospital systems

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ABSTRACT

Purpose: Since the COVID-19 pandemic began, emergency departments (ED) across the country have seen a significant decrease in patient visits. We aim to evaluate the impact of COVID-19 on ED visits for acute otolaryngologic complaints in New York City, one of the first epicenters of the pandemic in the US.

Materials and methods: We conducted a retrospective study of patients who presented to the ED with a primary diagnosis of an acute otolaryngologic complaint between March 1 and May 31 in 2019 and 2020. This was a multicenter study, including two tertiary care hospital systems encompassing Manhattan, Bronx, Queens, and Long Island.

Results: A total of 10,162 patients were identified. Significantly fewer patients presented to the ED for acute otolaryngologic complaints in 2020 (7332 vs 2830, \(p < 0.001\)). The rate of total otolaryngology-related ED visits was decreased by a factor of 0.635 (95% CI 0.6079 to 0.6634). In a subgroup analysis of each individual diagnosis, there was a significant decrease in rate of ED visits for 13 out of 18 diagnoses, including for life-threatening conditions, such as anaphylaxis. There was no significant difference based on which borough in New York City. Pediatric patients (age 0–17) were more significantly impacted by the pandemic compared to other age groups.

Conclusion: The COVID-19 pandemic has led to a reduction in the utilization of ED for acute otolaryngologic complaints, including those requiring emergent management, and an even more significant reduction in the pediatric population. Healthcare providers should encourage patients to seek appropriate care, particularly for those illnesses with significant associated morbidity and mortality.

1. Introduction

Throughout the Spring of 2020, New York City was the epicenter of the COVID-19 pandemic in the United States [1]. From March to May of 2020, approximately 203,000 laboratory-confirmed COVID-19 cases were reported. The significant resulting increase in COVID-19-related hospitalizations contributed to not only a reorganization of healthcare resources and sharp focus on virus-related care, but also an alteration in the dynamics of diagnosis and treatment for non-COVID-19-related conditions. This is perhaps best illustrated by the growing body of evidence demonstrating significant decreases in the number of patients presenting to emergency departments (ED) during the pandemic as compared to prior [2–6], both for non-acute conditions and urgent and emergent conditions such as myocardial infarction (MI) and stroke [7].

To date, the impact that early stages of the COVID-19 pandemic had on ED visits for otolaryngologic conditions in New York is unknown. This study attempts to fill this void by analyzing the records of two large tertiary healthcare systems in the New York with EDs throughout three boroughs of New York City and Long Island. By comparing the number of patients presenting with select otolaryngologic conditions before and...
during the COVID-19 pandemic, we sought to define whether trends in otolaryngology parallel those among the healthcare system. Improved insight related to this phenomenon is critical in allowing healthcare systems to better prepare for future pandemics.

2. Materials and methods

An observational, multicenter cohort study was conducted using ED visit data from two tertiary care academic hospital systems (Northwell and Montefiore) in New York, with ED sites in Manhattan, Queens, Bronx and Long Island. These sites included Long Island Jewish Hospital, Northshore University Hospital, and Lenox Hill Hospital of Northwell Health, as well as Moses, Weiler and Wakefield divisions of Montefiore Medical Center. Data was collected using Clinical Looking Glass database query software (Montefiore) and hospital billing records (Northwell). All ED visits involving the most common acute otolaryngologic diagnoses as defined by ICD-10 codes were recorded from March 1 to May 31 in both 2019 and 2020. Similar diagnoses were grouped together to prevent overlap with certain acute diagnoses i.e. vertigo and dizziness were combined to just dizziness. Demographic data was collected for each patient, including age, gender, and race where available. Patients were divided into two groups based on time period. The ‘pre-COVID-19’ group presented to the ED between March 1 and May 31 of 2019, whereas the ‘COVID-19’ group presented between March 1 and May 31 of 2020. The study was approved by the respective Institutional Review Boards of Montefiore/Albert Einstein College of Medicine and Northwell Health/Hofstra School of Medicine.

2.1. Statistical methods

The number of ED visits for subjects in each group was determined for 24 different diagnoses, as well as the incidence rate out of all ED visits. The incidence rate ratio (IRR) was calculated for pre- vs post-COVID time points, using the ‘exact Poisson method’ [8]. The incidence rate in the two groups with their Poisson 95% confidence interval is presented. The IRR was defined as IR_{2020}/IR_{2019}; the IR and its 95% CI and associated p-value are included. p-Values were considered statistically significant if p < 0.05. The overall IRR statistic was calculated including all 24 diagnoses, using the MedCalc statistical software (MedCalc Statistical Software version 19.4.1, MedCalc Software Ltd., Ostend, Belgium; https://www.medcalc.org; 2020) [9]. Subgroup analysis was conducted on diagnoses that had incidences of 1 in 5000 ED visits or greater in 2019. However, we included angioedema (1 in 5197 ED visits) due to its high acuity and associated morbidity and mortality. In total, 18 diagnoses were included for this type of analysis.

In order to identify any statistically significant changes in the incidence trend over time, we performed jointpoint regression analysis using the software developed by the Surveillance Research Program of National Cancer Institute (NCI). In brief, the jointpoint analysis identifies possible points where a change in the linear slope of a trend is detected over a specified period of time. Several regression lines may be fitted to the model by connecting different ‘joinpoints,’ which are chosen at points in which the rate changes significantly. The analysis began with fitting a model with zero joinpoints (a straight line), and subsequently tested whether the addition of more joinpoints (up to three) would be statistically significant. The tests of significance used a Monte Carlo Permutation method. To describe the linear trends by time period, the analysis estimated the percentage change (APC) for each respective time period. This is done by fitting a regression line to the natural logarithm of the rates using the year as a regressor variable. Jointpoint analysis was performed by Joinpoint Regression Program, Version 4.8.0.1 [10]. Additionally, we conducted a pairwise comparison of the two similar timepoints from the first week of March and last week of May in 2019 and 2020 [11].

3. Results

3.1. Demographic characteristics of study patients

Overall, a total of 10,162 patients presented to the ED in both time periods combined (Table 1). In both groups, the majority of patients were female (57.7%), and of African American (34.4%) or Hispanic (20.9%) origins. Out of the entire population, 21.7% of patients were under the age of 18 years. The mean age of the adults presenting to the ED in 2019 and 2020 for otolaryngologic and allergic complaints was similar (49.2 ± 19.3 years, vs 49.4 ± 18.8 years, p = 0.538). The same trend was found for the pediatric population (7.2 ± 5.4 years, vs 7.2 ± 5.7 years, p = 0.9885). The highest proportion of patients included in the study presented to a hospital in Queens/Long Island (46.8%), followed by the Bronx (34.0%) and Manhattan (19.2%).

3.2. Significant decrease in incidence rate ratios for otolaryngologic diagnoses in the post-COVID-19 group, compared with the pre-COVID population

There was a total of 7,332 patients who presented to the ED with otolaryngologic or allergic complaints in the pre-COVID-19 group and a total of 2,830 patients to the ED in the COVID-19 group, representing a 61.4% decline as compared to the previous year (Table 1, p < 0.001). In an analysis of patient-specific factors, there was no significant difference in regard to age, gender, or ethnicity.

| Table 1 | Demographic characteristics of patients seen in the emergency department for all diagnoses. |
|---------|------------------------------------------------------------------------------------------------|
| Characteristic | All patients | Pre-COVID-19 era | COVID-19 era | p-Value |
| Number of patients, n (%) | 10,162 | 7332 (72.1) | 2830 (27.9) | <0.001<sup>a</sup> |
| Male sex, n (%) | 4299 (42.3) | 3103 (41.1) | 1196 (41.8) | 0.0039<sup>b</sup> |
| Mean age, years ± SD | 40.1 ± 24.4 | 39.5 ± 24.6 | 41.8 ± 23.7 | <0.001<sup>c</sup> |
| Age group, n (%) | | | |
| 0–17 | 2202 (21.7) | 1689 (23.0) | 513 (28.1) | <0.001<sup>c</sup> |
| 18–39 | 2848 (28.0) | 2059 (28.1) | 789 (27.8) | |
| 40–64 | 2663 (26.2) | 1836 (25.0) | 827 (29.2) | |
| ≥65 | 2449 (24.1) | 1748 (23.8) | 701 (24.8) | |
| Race/ethnicity (N, % of total) | | | 0.2609<sup>c</sup> |
| White/Caucasian | 987 (14.7) | 729 (15.0) | 258 (13.9) | |
| African American | 2309 (34.4) | 1659 (34.2) | 650 (35.1) | |
| Hispanic/Latino | 1403 (20.9) | 1026 (21.1) | 377 (20.3) | |
| Asian | 491 (7.3) | 365 (7.5) | 126 (6.8) | |
| Native American | 46 (0.7) | 39 (0.8) | 7 (0.3) | |
| Other/Unknown | 1467 (21.9) | 1034 (21.3) | 433 (23.4) | |
| Total | 6703 | 4852 | 1851 | 0.372<sup>c</sup> |
| NYC borough, n (%) | | | |
| Bronx | 3458 (21.9) | 2499 (34.1) | 959 (33.9) | |
| Manhattan | 1953 (19.2) | 1397 (19.1) | 556 (19.6) | |
| Queens/Long Island | 4751 (46.8) | 3436 (46.9) | 1315 (46.4) | |

<sup>a</sup> Ethnicity data was available for Montefiore (Bronx) and Long Island Jewish hospital systems only. Percentages are proportion of total patients per group.

<sup>b</sup> Student’s t-test.

<sup>c</sup> Chi-square test.
The IR for total Otolaryngology and Allergy related ED visits (including all 24 diagnoses) in 2020 was 0.0289 (95% CI 0.02785 to 0.2999) and the IR for total Otolaryngology and Allergy related ED visits in 2019 was 0.04551 (95% CI 0.04447 to 0.4656). The combined IRR for all visits was 0.6351 (95% CI 0.6079 to 0.6634), which was statistically significant \((p < 0.001)\) (Fig. 1). This result shows not only that there was a decrease in the absolute number of ED visits, but also that the proportion of Otolaryngology and Allergy related ED visits decreased by even more than the number of ED visits overall. Subgroup analyses were completed for 18 of the 24 different otolaryngologic and allergic diagnoses based on incidence. The number of patients presenting to the ED decreased across all diagnoses, however, only 13 of the 18 diagnoses showed statistical significance based on the IRR: dizziness \((p < 0.001)\), rash \((p < 0.001)\), otalgia \((p < 0.001)\), otitis media \((p < 0.001)\), epistaxis \((p = 0.003)\), facial trauma \((p < 0.018)\), head and neck mass \((p = 0.001)\), tinnitus/PTA \((p = 0.024)\), anaphylaxis \((p = 0.001)\), sinusitis \((p = 0.086)\), allergic rhinitis \((p = 0.002)\), otitis externa \((p = 0.131)\), peri-orbital cellulitis \((p = 0.155)\), salivary gland/salivary lithiasis \((p = 0.025)\), angioedema \((p = 0.259)\) (Fig. 1).

**Fig. 1.** Incidence rate ratios of otolaryngology diagnoses in the ED in 2020 versus 2019 (March–May).

Abbreviations: CI = confidence interval; ED = emergency department. Incidence rate was calculated as number of specific ED diagnosis divided by the total number of ED visits for that same time-period. Ratio of the two rates (the IRR) \(R_1/R_2\). *p-values <0.05 were considered statistically significant.
Additionally, we conducted a joinpoint analysis to generate trend lines of rate of Otolaryngology and Allergy related visits for similar time intervals in 2019 and 2020. The analysis showed that there was a \(-16.19\% \ (25.1\% \text{ to } -6.1\%, \ p < 0.05)\) decrease in rate of Otolaryngology and Allergy related visits in March–April 2020 compared to a similar timeframe in 2019 where there was a linear increase in \(+1.81\% \ (0.7\% \text{ to } 0.9\%, \ p < 0.05)\) (Fig. 2). We also conducted a pairwise comparison test, which shows the regression lines in 2019 and 2020 were significantly different (parallelism test, \(p = 0.006\)).

3.3. Pediatric population had the greatest decrease in ER visits for otolaryngologic and allergic complaints

In a subgroup analysis, we found that the difference in age distribution between the two groups was statistically significant, and that the percent reduction in ER visits was greatest in the pediatric population, as compared with other age groups (69.6% vs 58.9%) (Table 1). We did not find any difference in number of patients presenting to the ED by borough of New York City (Table 1).

4. Discussion

This study demonstrates that there was a 61.4% decrease in the number of patients who presented with otolaryngologic complaints during the COVID-19 pandemic as compared to the year prior, including significant decreases for dizziness, rash, asthma, otalgia, otitis media, epistaxis, allergy, facial trauma, head & neck mass, tonsillitis & PTA, anaphylaxis, allergic rhinitis, and salalodinitis. These findings illustrate that the field of otolaryngology has been affected by the pandemic in much the same way as the broader healthcare system. The rate of decrease across otolaryngologic ED complaints shown in our study exceeded the rate of decrease in total ED visits from other studies, which ranged from 16 to 49% [2–6]. Boserup et al., recently demonstrated a 31–45% decrease in total ED visits per week across all regions in the U.S. during the COVID-19 pandemic, including a 35% reduction in visits in specific regions including New York, New Jersey and Puerto Rico [12]. Interestingly, this study noted that the precipitous decline in the number of patients presenting to the ED began around March 8, which correlated with increased public awareness of COVID-19 as indicated by Google search interest.

Beyond the detrimental physical effects of the virus, COVID-19 has changed behavioral patterns and challenged the psychological health of many individuals. Given fear for viral transmission, a significant proportion of patients were reluctant to present to hospital settings such as the ED. In a poll conducted by Kaiser Family Foundation, more than half of respondents reported being fearful about being exposed to COVID-19 due to inability to stay home and miss work [13]. The same poll demonstrated that 82% of respondents were also concerned that they would be unable to obtained needed medical care due to the healthcare system being overrun. Both these sentiments may have been even more prevalent in New York City in the Spring, given the rapid spread of COVID-19 and inundation of hospitals in the area.

Importantly, analyses such as this may allow for the identification of subsets of the population that are particularly vulnerable to the impact...
of COVID-19. For example, our data demonstrated a significant decrease in ED presentation among the pediatric patient population (age 0–17). This parallels the findings from a report from the National Syndemic Surveillance Program (NSSP), which found that children <14 years of age demonstrated the most significant decline in ED visits in the early pandemic period (March–April 2020) when compared to a similar period in 2019 [14]. The NSSP study also found a significant decrease in female patients presenting to ED compared to male patients. Although our data also demonstrated a decrease in presentations of female patients, this decrease was not statistically significant.

Concern for the variable impact of the pandemic of certain ethnic groups and underserved communities has also received significant focus [15–19]. The diverse nature of the New York City population was captured in this analysis with a majority of patients whom were African American, followed by Hispanic/Latino, White/Caucasian, Asian, and Native American. While this study offers an important potential lens through which to study certain healthcare disparities, the data did not demonstrate significant differences in visits based on race/ethnicity. We are currently in the process of more closely analyzing the data to better understand the nuances in care and potential differences in presentation among these different groups.

A particularly interesting finding was that presentations for acute diagnoses requiring urgent management, such as anaphylaxis, decreased in similar proportions to presentations for less urgent diagnoses. We believe there are several possible explanations for this phenomenon. First, public health measures and stay-at-home orders may have contributed to a decrease in such medical conditions. Second, in the case of anaphylaxis, a decreased proportion of patients may have sought care in an emergency room setting and, instead, either presented to alternative medical settings (i.e. physician office, urgent care) or did not seek medical care at all. The latter consideration raises the possibility of increased home fatalities that may have resulted from lack of adequate treatment.

While authors have demonstrated the impact of fear contributing to decreased ED visits for non-emergent conditions [20], this study adds to a growing body of literature demonstrating that this same force may have similarly impacted behavior for urgent, even life-threatening conditions. A large multicentric study focused on non-COVID-19 emergencies, for example, demonstrated a significant reduction in ED visits for emergency conditions including myocardial infarctions (MI) and stroke during the pandemic [7]. In a separate analysis from another NYC healthcare system, Blecker et al. demonstrated a reduction in patients presenting with exacerbations of chronic conditions such as chronic obstructive pulmonary disease (COPD) and heart failure, as well as for acute conditions such as MI and appendicitis. Of note, hospitalizations for these conditions increased in the later stages of the pandemic but did not return to normal levels [21]. Moreover, Garcia et al. demonstrated a 38% reduction in monthly catheterization lab activations for ST-segment elevation myocardial infarctions (STEMI) in the U.S. from March 1 to March 31, as compared to January 1, 2019 to February 29, 2020 [22]. Similarly, studies have demonstrated a significant reduction in hospitalizations for acute MI during this time period [23,24]. Importantly, this trend appears to be present on a global level as studies from health systems across Europe have demonstrated similar reductions [25–27]. Mehta et al. found an increased case fatality rate among patients with cancer who are infected with COVID-19 [28].

There is also emerging evidence that the pandemic has contributed to patients presenting with more acute or advanced pathology as compared to prior. In a multicenter retrospective cohort study of adult patients admitted for acute cerebral infarction, Ortega-Gutierrez et al. found a significant increase in the proportion of patients presenting with severe stroke during the COVID pandemic as compared to the same period in 2019, with a similar decrease in the proportion of patients presenting with strokes of mild severity [29]. Similarly, a different study in Canada found that there was a 20% decrease in the number of code strokes in 2020 compared to 2019, however, did not find a decrease in stroke admissions, suggesting that the patients with TIAs or very mild strokes are the ones that stayed home [30]. Little work has been done to understand if this trend is present in regard to otolaryngology. Fastenberg et al. observed the presentation of more advanced orbital emergencies related to underlying otolaryngologic conditions such as acute sinusitis during the pandemic [31]. We are currently in the process of analyzing the data to better understand if there was a similar phenomenon with diagnoses such as epistaxis and, if present, whether it contributed to alterations in management.

In an effort to adapt to the evolving confines of the pandemic, it is imperative that physicians not only understand the changing dynamics of patient presentation but also those factors contributing to it. Future studies are needed to better understand the impact of public health messaging, widespread office closure and reduction in patient schedules, as well as the increased utilization of telehealth, among other areas of uncertainty. Furthermore, development of proactive strategies to provide care to patients with non-COVID-19 related conditions without neglecting vigilance for viral transmission is necessary.

There are several limitations to this study, including those inherent to retrospective studies. We were also limited in our ability to distinguish the level of acuity within each diagnosis. Given the extent to which the New York City-area was inundated with COVID-19 cases in the spring, the generalizability of our results may also be limited. Furthermore, a larger sample size including different healthcare systems with different COVID-19 burden may have demonstrated different trends.

5. Conclusion

There has been a significant decrease in the number of patients presenting with otolaryngologic conditions to the ED during the COVID-19 pandemic, including for those with life-threatening diagnoses such as anaphylaxis. This decrease in ED utilization more significantly impacted the pediatric population. Further investigation is needed to better establish how we can provide care for patients with non-COVID-19 diagnoses during pandemic conditions.

CRediT authorship contribution statement

Viraj M. Patel: Conceptualization, Methodology, Validation, Writing – Original draft. Evan Kominsky: Methodology, Data curation, Writing – Review & editing. Tristan Tham: Formal analysis, Data curation, Visualization. Danielle Bottalico: Conceptualization. Michael Setzen: Writing – Review & editing. Denisa Ferastrau: Conceptualization, Validation, Writing – Review & editing. Nadeem Akbar: Conceptualization, Writing – Review & editing. Judd H. Fastenberg: Conceptualization, Validation, Writing – Review & editing, Supervision.

Declaration of competing interest

The authors of this manuscript have no conflicts of interest to disclose.

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All authors contributed to the study design. VMP, EK, and TT contributed to data collection and analysis. Husneara Rahman, PhD is not included as an author of this manuscript, but also contributed to the data analysis. VMP and EK wrote the initial version of the manuscript and all authors reviewed and approved the final version. The authors have no financial conflicts of interest to disclose. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.
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