

## UNDERSERVED POPULATIONS

**Characteristics of asthmatic patients with and without repeat emergency department visits at an inner city hospital**

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**Abstract**

**Objective:** The objective of this study was to document the frequency and clinical characteristics associated with repeat emergency department (ED) visits for asthma in an inner city population with a high burden of asthma. **Methods:** During an ED visit for asthma in an inner city hospital ('index visit'), patients completed a valid survey addressing disease and behavioral factors. Hospital records were reviewed for information about ED visits and hospitalizations for asthma during the 12 months before and the 90 days after the index visit. **Results:** One hundred and ninety-two patients were enrolled; the mean age was 42 years, 69% were women, 36% were black, 54% were Latino, 69% had Medicaid, and 17% were uninsured. 100 patients (52%) were treated and released from the ED, 88 patients (46%) were hospitalized, and 4 patients (2%) left against medical advice. During the subsequent 90 days, 64 patients (33%) had at least one repeat ED visit for asthma and 27 (14%) were hospitalized for asthma. In a multivariate model, more past ED visits (OR 1.7, 95% CI 1.4, 2.1;  $p < 0.0001$ ) and male gender (OR 2.5, 95% CI 1.2, 5.4;  $p = 0.02$ ) remained associated with having a repeat ED visit. Most patients had the first repeat ED visit within 30 days and 18 returned within only 7 days. Among all patients with a repeat visit, those who were not hospitalized for the index visit were more likely to have a repeat visit within 7 days (37%) compared to those who were hospitalized (17%) ( $p = 0.05$  in multivariate analysis). **Conclusions:** Repeat ED visits were prevalent among inner city asthma patients and most occurred shortly after the index visit. The strongest predictors of repeat visits were male gender and more ED visits in the 12 months before the index visit.

**Keywords**

Asthma, asthma quality of life, BRFSS Questionnaire, index visit, mini-AQLQ

**History**

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**Introduction**

Asthma exacerbations resulting in emergency department (ED) visits and hospitalizations are serious events that contribute to morbidity and impair quality of life [1]. In addition to reflecting asthma severity, frequent use of the ED and hospitalizations are important markers of access to care and quality of care [2]. It is estimated that there are 1.1 million ED visits and nearly 300 000 hospitalizations for asthma for adults annually in the United States [3]. Rates are highest among women, and black, Latino and urban patients from lower socioeconomic groups [3–6]. Management of an asthma ED visit entails treatment with inhaled bronchodilators and systemic corticosteroids and then either release to home or admit to the hospital [6]. Although rates vary markedly according to hospital, in general 70–90% of patients are treated and released from the ED and the remaining are hospitalized [3,6].

In addition to high rates of ED use for asthma, repeat use of emergency services for asthma is prevalent and has been found to be associated with lower socioeconomic status in large studies with diverse populations [7,8]. Currently, repeat visits to the ED and repeat hospitalizations for asthma and other chronic conditions are major public health and health policy issues [9]. This is due in part to new federal legislation which considers repeat presentations to acute-based hospital care settings as possible indicators of poor quality of care and discontinuity of care [10]. As such, repeat visits will increasingly be viewed as indicators of ineffective care, with short-term repeat care being particularly scrutinized. Current time intervals of interest for repeat visits are within 7, 30, 60, and 90 days of hospital-based treatment [11,12].

It is estimated that rates of repeat ED visits for asthma are 6–25% within 7–60 days, and are highest among patients from lower socioeconomic groups [2,13,14]. There are several possible reasons for high rates of repeat ED visits for asthma. These include patient factors such as returning to environments that have persistent triggers, not adhering to prescribed self-management plans, not following up in a timely manner with outpatient care, and lack of access to medical insurance

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[2,13–15]. System factors contributing to repeat visits include inadequate treatment in the ED for the index visit, releasing to home instead of admitting to the hospital, lack of patient education before discharge, and lack of arrangements for post-discharge care [2,6,14,16]. Interventions in these areas that have resulted in reduction in repeat visits include improving the quality of care coordination at the time of discharge, obtaining early follow-ups with primary care physicians, and enhancing adherence to prescribed medications [9,17]. However, little is known about aspects of the index visit that may predispose to repeat ED visits and whether different variables influence the occurrence of short-term versus long-term repeat visits.

Among urban patients from lower socioeconomic groups, the objectives of this longitudinal study were to describe clinical characteristics of ED visits and repeat ED visits for asthma at set time intervals within 90 days. This study adds to current research in that it focused on short-term repeat visits and queried patients with standardized questions that are used in large national surveys.

## Materials and methods

### Study design and setting

This longitudinal study was approved by the Institutional Review Board at Lincoln Medical and Mental Health Center (LMMHC) in the South Bronx in New York City and all patients were provided written informed consent.

Patients presenting to the LMMHC ED from March 2012 to September 2012 for an asthma exacerbation between 8 AM and 5 PM Monday to Friday or patients who had been admitted to the hospital for asthma were eligible for this study if they were 18 years of age or older, spoke English or Spanish, had a self-reported ED visit or hospitalization for asthma within the past 12 months, and could provide informed consent. Patients were excluded if they had other pulmonary diagnoses or if they were incarcerated or were living in an institution.

Patients were approached while they were receiving treatment in the ED or inpatient service. If they agreed to participate, they were interviewed at that time in person at the bedside in either English or Spanish. Patients were asked to complete the Center for Disease Control and Prevention 2008 Behavioral Risk Factor Surveillance System (BRFSS) Adult Asthma Questionnaire and the Mini Asthma Quality of Life Questionnaire (Mini-AQLQ). The interviewer wrote down patients' responses on the BRFSS and Mini-AQLQ forms and recorded any additional comments verbatim in field notes.

The BRFSS was designed to gather information about behavioral risks and chronic diseases, and has been used extensively during state-based telephone surveys to characterize the US population [18]. The module devoted to asthma consists of nine sections addressing: history of asthma symptoms and episodes; recent symptoms; health care utilization, including ambulatory care, ED visits, and hospitalizations; knowledge of asthma and asthma management plans; effects of the environment on asthma, such as home allergens; medications for asthma; costs of asthma care; work related asthma; and comorbidity, primarily concurrent pulmonary diagnoses. Each section is composed of several

questions with various response options, which include dichotomous and multiple choice options, as well as actual values, such as the number of ED visits and hospitalizations for asthma in the past 12 months.

The Mini-AQLQ is a valid self-report questionnaire composed of 15 items addressing four domains: symptoms, activities, and emotional and environmental aspects of asthma [19]. Patients are asked to report their condition from the past two weeks. Scores for each domain as well as an overall score can range from 1 to 7, with higher scores indicating better asthma-related quality of life.

Demographic and clinical data were obtained directly from patients, such as age, race, ethnicity, duration of asthma, and past resource utilization for asthma. Medical charts were reviewed to obtain information about the current ED visit and if admitted about the current hospitalization. This included presenting symptoms, physical examination findings, medications prescribed, physicians' assessments of severity of asthma, and length of stay for hospitalized patients. Patients were released from the ED or discharged from the hospital based on whether they attained a combination of improvements in symptoms, peak flow rates, and respiratory rate, and had stable oximetry. Social issues also were considered to ensure safe disposition. All patients were provided with a follow-up outpatient appointment and asthma action plans were reinforced in those patients who already had them and introduced to those who did not.

Electronic outpatient records were then subsequently prospectively reviewed to determine whether patients had a LMMHC follow-up outpatient visit within 90 days of the index visit. Electronic hospital records were also prospectively reviewed to track return visits within 90 days to the LMMHC ED and any subsequent hospitalizations. Dates of repeat emergency resource utilization were recorded and the time interval from the initial visit was calculated.

The electronic hospital record also was used to obtain information about past resource utilization, specifically ED visits and hospitalizations for asthma in the 12 months before the index visit. The majority of patients enrolled in this study lived near (i.e. had the same zip code as) LMMHC which is the major hospital and ED in the area, and received their care at LMMHC; however, patients may have received medical care from other providers in the neighborhood. We did not have pharmacy information regarding filling prescriptions and patients were asked what medications they were actually taking as opposed to which medications were prescribed.

### Statistical analysis

The ED visit at the time of enrollment was defined as the index visit; ED visits within the 12 months before the index visit were defined as past visits, and ED visits during the 90 days after the index visit were defined as repeat visits. Similarly, admissions to the hospital at the time of the index ED visit were defined as hospitalizations, admissions within the 12 months before the index ED visit were defined as past hospitalizations, and admissions during the 90 days after the index ED visit were defined as subsequent hospitalizations.

Descriptive analyses were carried out for demographic and clinical characteristics and comparisons among variables

were made with *t* tests for continuous variables and the chi square tests for categorical variables. Patients were dichotomized as having or not having a repeat ED visit. Bivariate analyses and multivariate logistic regression were carried with having a repeat ED visit as the dependent variable. Independent variables were selected based on their known association with ED visits, such as demographic characteristics (age, gender, race, ethnicity, insurance status), asthma characteristics (medications, having an action plan, smoking status, asthma-related quality of life, and environmental triggers), and prior resource utilization (specific number of ED visits and hospitalizations in the past 12 months) [7,14]. Whether the patient was hospitalized for the index visit also was included in the model.

Numbers of patients having repeat ED visits were tabulated according to when the first repeat visit occurred. The time intervals selected were based on standard time frames typically used to report repeat resource utilization, specifically within 7 days, within 8–30 days, or within 31–90 days [9,10]. For patients who were not hospitalized (i.e. released from the ED or who left against medical advice) the time interval was calculated as the number of days between the index and repeat visit, and for hospitalized patients the time interval was calculated as the number of days between discharge from the hospital and the repeat visit. Patients who had a repeat ED visit within 7 days were further compared in a multivariate model according to whether they had been hospitalized for the index visit controlling for clinical characteristics that are pertinent after an exacerbation, such as the role of environmental triggers (measured by the environmental domain of the AQLQ) and the use of medications. Similar analyses were performed for repeat visits within 30 days. Data analysis was performed using Stata version 9 [20] and SAS version 9.3 [21].

## Results

During the period of enrollment there were 1820 visits to the LMMHC ED for asthma and 240 admissions for asthma. Totally 456 patients were screened for this study, 116 were not eligible, and 340 were eligible. Of the 340 eligible, 84 refused to participate and 205 agreed to participate and were enrolled. Thirteen were subsequently excluded because they had chronic obstructive pulmonary disease instead of asthma. Thus, 192 patients were included in this analysis; 121 (63%) were enrolled while they were in the ED and 71 (37%) were enrolled while on the inpatient service. All hospitalized patients were admitted directly from the LMMHC ED; there were no admissions from other hospitals or clinics.

The mean age was of  $42 \pm 14$  years and 69% were women (Table 1). Most patients were black (36%) or Latino (54%, and of these 87% were Puerto Rican). Most patients were unemployed at the time of the study (69%); 25 patients (13%) reported that current symptoms were either caused by or made worse by irritants in the workplace. Most patients had Medicaid insurance (69%), with a lapse in insurance in the past 12 months before the index visit in approximately one third of patients. Approximately one quarter of patients reported their access to physicians and asthma medications was limited in the past 12 months before the index visit by

Table 1. Demographic characteristics at index ED visit ( $N = 192$ ).

| Characteristic                                     | Value       |
|----------------------------------------------------|-------------|
| Age, years (mean $\pm$ SD)                         | $42 \pm 14$ |
| Women                                              | 69%         |
| Race                                               |             |
| white                                              | 10%         |
| black                                              | 36%         |
| Latino                                             | 54%         |
| Body mass index, kg/m <sup>2</sup> (mean $\pm$ SD) | $33 \pm 9$  |
| Current smoker                                     | 33%         |
| Employment status ( $n = 189$ )                    |             |
| full time                                          | 21%         |
| part time                                          | 10%         |
| unemployed                                         | 69%         |
| Ever employed                                      | 88%         |
| Insurance (self report)                            |             |
| Medicaid                                           | 69%         |
| Medicare                                           | 2%          |
| private                                            | 12%         |
| none                                               | 17%         |
| In past 12 months                                  |             |
| Lost insurance ( $N = 161$ )                       | 37%         |
| Could not see physician due to cost                | 27%         |
| Could not see specialist due to cost               | 24%         |
| Could not buy medications due to cost              | 29%         |

cost. One third of patients were current smokers and 56% were obese.

Most patients were diagnosed with asthma as a child or as a young adult, with 44% being diagnosed before age 5, and the mean duration of asthma was 28 years (Table 2). Overall, 80% reported taking any type of maintenance asthma medication, including inhaled corticosteroids, mast cell stabilizers, long-acting beta agonists, and leukotriene modifiers, and most reported having a nebulizer at home. Forty percent reported not having all prescribed medications. Regarding knowledge of asthma, over 80% reported having received instructions about managing asthma from a health care provider including recognizing early warning signs and using a peak flow meter and an inhaler, and 58% reported having an asthma action plan. About one third described home environmental conditions that were detrimental to asthma, such as the presence of mold, furry or feathered pets, rodents, and carpets. Regarding activity limitations due to asthma, most patients (54%) had moderate to a lot of limitations in the past 12 months and most patients (60%) had few ( $\leq 5$ ) symptom-free days in the prior two weeks.

According to electronic hospital records, 98% of patients had been in the ED for asthma at least once within the past 12 months at LMMHC (median 2 visits, interquartile range 1–3) and in total there were 611 ED visits for the entire sample; 54% of patients had been hospitalized for asthma at least once within the past 12 months at LMMHC (median 0, interquartile range 0–1) and in total there were 167 hospitalizations. According to self report, fewer patients recalled an ED visit (83%) or a hospitalization (43%) for asthma during this same time period.

As anticipated, on arrival to the ED most patients reported marked symptoms and limitations due to asthma and this was reflected by their low scores on the Mini-AQLQ (Table 3). According to attending physicians' reports in the medical charts for those patients who were admitted, 50% of patients

Table 2. Asthma characteristics and resource utilization within past 12 months (*N* = 192).

| Characteristic                                                                  | Value   |
|---------------------------------------------------------------------------------|---------|
| Age at diagnosis, years (mean ± SD)                                             | 14 ± 16 |
| <5 years old                                                                    | 44%     |
| 5–21 years old                                                                  | 27%     |
| >21 years old                                                                   | 29%     |
| Duration of asthma, years (mean ± SD)                                           | 28 ± 15 |
| Current medications                                                             |         |
| None                                                                            | 14%     |
| Inhaled short-acting beta-agonist only                                          | 7%      |
| Any maintenance medication                                                      | 80%     |
| Inhaled corticosteroid                                                          | 58%     |
| Mast cell stabilizer                                                            | 0%      |
| Theophylline                                                                    | 1%      |
| Leukotriene modifiers                                                           | 47%     |
| Inhaled long-acting beta-agonist                                                | 50%     |
| Currently has nebulizer at home                                                 | 63%     |
| Takes over-the-counter medications for asthma                                   | 43%     |
| Has an asthma action plan                                                       | 58%     |
| Recalls being instructed by a health care provider in managing an asthma attack | 81%     |
| According to electronic hospital records for the past 12 months:                |         |
| Had an ED visit for asthma <sup>a</sup>                                         | 98%     |
| Was hospitalized for asthma <sup>b</sup>                                        | 54%     |
| Had a clinic visit for asthma <sup>c</sup>                                      | 30%     |
| According to self report for the past 12 months                                 |         |
| Had an ED visit for asthma                                                      | 83%     |
| Was hospitalized for asthma                                                     | 43%     |
| Had a clinic visit for asthma ( <i>n</i> = 177)                                 | 59%     |
| According to self report for past 3 months                                      |         |
| Had at least one other asthma attack                                            | 85%     |

<sup>a</sup>Total of 611 ED visits by 189 patients.<sup>b</sup>Total of 167 hospitalizations by 103 patients.<sup>c</sup>Total of 184 visits by 57 patients.

had moderate persistent asthma and 25% had severe persistent asthma. In total, 100 patients (52%) were treated and released from the ED, 4 patients (2%) left against medical advice, and 88 patients (46%) were hospitalized (we over-sampled hospitalized patients to ensure we captured the perspectives of the sickest patients). One hospitalized patient died after 40 days due to respiratory complications. Excluding the patient who died, the mean length of stay was 3 days (median 2, range 1–11) and 75% had a length of stay ≤3 days.

Electronic hospital records were reviewed for repeat ED visits and hospitalizations and follow-up outpatient visits for asthma during the subsequent 90 days. For patients released from the ED, the time to repeat ED visit was calculated from the day of the index visit. For patients hospitalized at the index visit this was calculated from the day of discharge from the hospital. Overall, 64 patients (33%) had at least one repeat ED visit for asthma during this time interval (Table 4), and of these many had multiple visits. In total, 138 repeat ED visits were made during the subsequent 90 days. Hospitalizations for asthma occurred in 27 patients, with a total of 39 hospitalizations during the subsequent 90 days. Twenty patients were hospitalized at the first repeat ED visit. Most patients (73%) did not have outpatient follow-ups in the clinic during the 90 days after the index visit.

Demographic and clinical variables possibly associated with having a repeat ED visit for asthma were assessed in

Table 3. Status on arrival to ED for index visit and disposition (*N* = 192).

| Status on arrival                                      | Value      |
|--------------------------------------------------------|------------|
| Asthma quality of life scores (mean ± SD) <sup>a</sup> |            |
| Symptoms                                               | 2.6 ± 1.3  |
| Activity limitations                                   | 4.0 ± 1.8  |
| Emotional impact of asthma                             | 2.7 ± 1.7  |
| Environmental impact of asthma                         | 2.8 ± 1.6  |
| Overall                                                | 3.0 ± 1.2  |
| ED treatment and disposition                           |            |
| Treated with intravenous corticosteroids               | 44%        |
| Treated with oral corticosteroids                      | 46%        |
| Disposition                                            |            |
| Released from ED                                       | 52%        |
| Hospitalized                                           | 46%        |
| Left against medical advice                            | 2%         |
| For released patients ( <i>N</i> = 100)                |            |
| Given prescription for oral corticosteroids            | 88%        |
| For hospitalized patients ( <i>n</i> = 88)             |            |
| 7 patients admitted to ICU                             |            |
| 1 patient died after 40 days                           |            |
| 1 patient left against medical advice                  |            |
| Length of stay, days (mean) (range) <sup>b</sup>       | 3.0 (1–11) |

<sup>a</sup>Based on Mini Asthma Quality of Life Questionnaire, possible range 1–7, higher is better status.<sup>b</sup>Does not include patient who died.Table 4. Repeat ED visits and hospitalizations for asthma within 90 days of index ED visit (*N* = 192).

| Event                                                       | Value    |
|-------------------------------------------------------------|----------|
| Had at least one repeat ED visit <sup>a,b</sup>             | 64 (33%) |
| Had 1 visit                                                 | 29 (15%) |
| Had 2 visits                                                | 12 (6%)  |
| Had 3 visits                                                | 15 (8%)  |
| Had ≥ 4 visits                                              | 8 (4%)   |
| Hospitalized for asthma at first repeat ED visit            | 20 (10%) |
| Hospitalized for asthma at any repeat ED visit <sup>c</sup> | 27 (14%) |
| Had 1 hospitalization                                       | 18 (9%)  |
| Had 2 hospitalizations                                      | 6 (3%)   |
| Had 3 hospitalizations                                      | 3 (2%)   |

<sup>a</sup>Includes 1 patient who returned to ED 1.5 hours after discharge from hospitalization.<sup>b</sup>Total of 138 repeat ED visits during 90 days.<sup>c</sup>Total of 39 hospitalizations after repeat ED visits during 90 days.

unadjusted bivariate analyses (Table 5). Patients were not more likely to have a repeat ED visit based on age, race, ethnicity, work-related symptoms, current insurance status, lapse in insurance during the year prior to the index visit, or whether they had a clinic follow-up within 90 days after the index visit. However, men and those who had a diagnosis of asthma for a longer duration were more likely to have a repeat visit. No differences were found for variables associated with medication use or Mini-AQLQ severity of asthma at the time of the index visit. The variables most strongly associated with having a repeat visit were having more ED visits and more hospitalizations for asthma during the 12 months before the index visit. In a multivariate model, more past ED visits (OR 1.7, 95% CI 1.4, 2.1; *p* < 0.0001) and male gender (OR 2.5, 95% CI 1.2, 5.4; *p* = 0.02) remained associated with having a repeat ED visit. The same results were found when using median values for prior ED visits and hospitalizations. Mini-

Table 5. Demographic and clinical variables and repeat ED visits within 90 days<sup>a</sup>.

| Variable                                                   | No repeat visit<br>(n = 128) | Had repeat visit<br>(n = 64) | p Value |
|------------------------------------------------------------|------------------------------|------------------------------|---------|
| Age, years (mean)                                          | 41                           | 44                           | 0.13    |
| Men                                                        | 24%                          | 44%                          | 0.006   |
| Black                                                      | 36%                          | 36%                          | 1.0     |
| Latino                                                     | 56%                          | 52%                          | 0.61    |
| No health insurance at time of index visit                 | 14%                          | 22%                          | 0.18    |
| Lapse in health insurance in prior 12 months               | 37%                          | 36%                          | 0.91    |
| Duration of asthma, years (mean)                           | 27                           | 31                           | 0.08    |
| Currently smokes                                           | 36%                          | 27%                          | 0.21    |
| Takes asthma maintenance medications                       | 79%                          | 81%                          | 0.70    |
| Has an asthma action plan                                  | 54%                          | 64%                          | 0.20    |
| Mini-AQLQ total score (mean)                               | 3.0                          | 3.1                          | 0.37    |
| Number ED visits in prior 12 months (>median of 2)         | 23%                          | 70%                          | <0.0001 |
| Number hospitalizations in prior 12 months (>median of 0)  | 48%                          | 64%                          | 0.04    |
| Hospitalized at index ED visit                             | 46%                          | 45%                          | 0.92    |
| Did not have outpatient clinic follow-up after index visit | 73%                          | 72%                          | 0.73    |

<sup>a</sup>All comparisons are unadjusted bivariate analyses.

Table 6. Time to first repeat ED visit according to disposition at index ED visit (N = 192).

| Disposition at index ED visit | No repeat ED visit<br>N = 128 | Had repeat ED visit within <sup>a</sup> |                     |                      |
|-------------------------------|-------------------------------|-----------------------------------------|---------------------|----------------------|
|                               |                               | 0–7 days<br>N = 18                      | 8–30 days<br>N = 17 | 31–90 days<br>N = 29 |
| Released                      | 66 (52%)                      | 12 (67%)                                | 7 (41%)             | 15 (52%)             |
| Hospitalized                  | 69 (46%)                      | 5 (28%)                                 | 10 (59%)            | 14 (48%)             |
| Left against medical advice   | 3 (2%)                        | 1 (5%)                                  | 0 (0%)              | 0 (0%)               |

<sup>a</sup>For hospitalized patients, interval is time since discharge from the hospital.

AQLQ severity of asthma, asthma duration, lapse in insurance status, and not having an outpatient follow-up visit were not associated in the multivariate model.

Finally, the time interval to the first repeat ED visit was assessed with respect to disposition from the index visit. Over half of patients who had a repeat visit (35 of 64) had the first repeat ED visit soon after the index visit, i.e. within 30 days, and of these 18 patients returned within only 7 days (Table 6). Patients who returned within 30 days were more likely to be men and to have had more ED visits for asthma during the 12 months before the index visit. Patients who returned within 7 days did not differ from other patients in terms of age, sex, race, ethnicity, smoking status, or duration of asthma. However, among all patients with a repeat visit, those who were not hospitalized were more likely to return within 7 days (37%) compared to those who were hospitalized (17%). This association persisted after controlling for gender, ED visits in the prior 12 months, history of environmental triggers (based on the environmental domain of the AQLQ) and not using maintenance medications ( $p = 0.05$ ).

## Discussion

This study focused on patients from an inner city socio-economically suppressed area of New York City with a high prevalence of ED use for asthma. Patients in our study were mostly black or Latino, not working, had Medicaid or no health insurance, and approximately one quarter cited cost as a barrier to medical care and medication. Repeat ED visits were common in this sample with 33% having at least one repeat ED visit for asthma within 90 days. Most repeat visits occurred within 30 days and 9% of patients had the first repeat visit within 7 days. The cumulative resource utilization was high with 138 repeat ED visits and 39 hospitalizations for asthma during 90 days. The strongest predictor of repeat ED visits was more frequent ED visits in the past year. Also, men were more likely than women to have a repeat visit.

Our study confirms prior reports conducted in other inner city EDs that showed high resource utilization for asthma after an index ED visit. In one study from Chicago the repeat ED visit rate within 7 days was 6% [2] and in another study from Cleveland 25% of ED patients had either a repeat ED visit or an urgent office visit within 3 weeks [13]. Additional reports examining repeat ED visits have confirmed that repeat visits are closely associated with patterns of prior use, either more frequent ED visits or more hospitalizations for asthma in the months before the index visit [2,13,22]. Also, although ED visits generally are more common in women, rates of repeat visits according to gender have not been reported in many studies [6]. We found men were more likely to have a repeat visit and this finding persisted in the multivariate model. Additional studies are needed to confirm this finding and to ascertain why rates may differ between men and women.

Reasons for repeat visits for asthma probably vary and are associated with different clinical scenarios. For example, for some patients a repeat visit within 7 days may represent persistence of the exacerbation that precipitated the index visit. For these patients, there may have been improvement after their release from the ED or discharge from the hospital, but they never returned to their baseline and their repeat visit is due to a relapse [7]. For other patients with a repeat visit after 7 days of the index visit, symptoms may have resolved and the repeat visit represents a new episode due to a new exacerbation [7]. The distinction between these two groups is important because the former group with repeat visits within 7 days may represent patients who did not receive adequate post-ED management whereas the latter group most likely reflects more severe disease and typifies the usual risk and exacerbation profile for ED visits which includes few self-management skills and limited access and use of preventive care. In our study this reasoning may explain the higher rate of short-term repeat visits in patients released from the ED as opposed to those who were admitted to the hospital, i.e. more patients who were hospitalized recuperated from the initial exacerbation because they received directly observed standard asthma therapy and had respite from home and workplace environmental triggers. Future studies should explore additional reasons for repeat short- and long-term visits, such as non-optimal ED management, waning compliance with medications, and decreased avoidance of triggers.

Despite having had at least one ED visit in the prior 12 months and thus clinical evidence of persistent asthma, nearly half of our patients reported not taking maintenance inhaled corticosteroids. This may be due to restricted access to physicians and medications because of cost as well as to the desire to avoid chronic corticosteroids and to rely on rescue corticosteroids instead. This perspective is supported by the high prevalence and use of home nebulizers in our sample.

Our study has certain limitations. First, the sample was predominately a homogeneous group of patients with lower socioeconomic status; thus we were unable to tease out differences based on typical socioeconomic variables. Also, a larger sample would have made it possible to uncover other potentially modifiable reasons for repeat visits. We also lacked information about comorbidity because other concurrent pulmonary diagnoses were exclusion criteria for our study and we did not query patients about other medical conditions. Second, patients were enrolled if they presented to the ED during weekday and daytime hours; thus the results may not be generalizable to patients who use the ED at nighttime and during weekends when access to other health care settings are most limited. Third, because our enrollment period was from March through September we did not capture index visits during winter months, and because our follow-up period was 90-days we could not completely account for within-patient seasonal variations in asthma. Fourth, we did not record the specific reasons for the repeat asthma ED visits, which may have included acute symptoms, need for reassurance, and medication refills. Each of these scenarios would require a different strategy to prevent future repeat visits. Fifth, although most patients in our sample received all their care from this medical center, patients may have had ED visits or hospitalizations for asthma elsewhere; this would have resulted in our under reporting rates of repeat visits and hospitalizations.

## Conclusions

Among patients presenting to an inner city ED for asthma, this study found high rates of repeat ED visits and hospitalizations for asthma within 90 days. Most repeat visits occurred shortly after the index visit and many patients had multiple repeat visits. The strongest predictors of repeat visits were male gender and more ED visits in the 12 months before the index visit. Future work should consider possible reasons for repeat visits, such as relapses versus new exacerbations and time interval to repeat visit.

## Declaration of interest

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