



# Factors Associated with Decreased Emergency Department Utilization after Written Asthma Action Plans

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## Abstract

**Objective:** The objective of this study was to analyze the factors associated with decreased use of the Emergency Department (ED) after patients receive a written asthma action plan (WAAP) as a component of a disease management program.

**Materials and methods:** Data from the medical records of 373 adult patients with asthma who had a completed WAAP were retrospectively reviewed. Patients were evaluated for the effect of the receipt of a WAAP and ED utilization. We also identified the impact of the WAAP on ED use in the setting of various comorbid health conditions and prednisone inclusion in WAAPs. SPSS was used to analyze the data with Pearson chi square statistics, paired samples t tests, and odds ratio analyses.

**Results:** This cohort was predominantly female (n = 230, 61.7%) and Black (n = 323, 86.6%). A significant difference in decrease was shown in women compared to men (p < 0.0001) as well as Black compared to white (p < 0.0236). A statistically significant decrease was seen in all comorbidities listed except in those patients with congestive heart failure (n = 18, p = 0.499) and alcohol use disorder (n = 27, p = 0.60). In addition, a prednisone inclusion in the WAAP demonstrates an average decrease of 0.569 visits (n = 114 p = 0.006), notwithstanding the number of comorbidities.

**Conclusion:** This study reveals an association of decrease in emergency room visits in patients with asthma who receive a WAAP as part of a disease management program. This decrease is seen in patients with comorbidities except for those with congestive heart failure or alcohol use disorder. Additionally, having prednisone inclusion in the WAAP was shown to decrease ED use in patients regardless of comorbidity burden.

## Introduction

Over 20 million adults have been diagnosed with asthma which has resulted in a high asthma burden on the healthcare system in the United States [1-3]. Of the adults in the US diagnosed with asthma, there is a higher prevalence in minority populations, Black being more heavily affected in comparison to their White counterparts [4,5]. Unfortunately, Black adults are more likely to be hospitalized due to asthma than White American adults and are two to three times more likely to die from asthma complications than any other racial group [2]. This disparity in outcomes can be attributed to Black patients having barriers to access to adequate care [2,6]. Lower socioeconomic status and barriers to quality care include difficulties obtaining necessary childcare, work obligations and financial burden associated with cost

of disease management [3,5]. In addition to decreased medication adherence and difficulties [6,7]. As a consequence of these factors, asthma has a major effect on the quality of life

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for patients due to utilization of sick days for exacerbations, time spent receiving care, and avoidance of triggers which can be difficult for many patients who face insurmountable structural and process barriers to care [8].

A key aim for improving asthma disease management is to empower patients to take control of their condition. This provides them with the tools necessary to regain control of their condition during an asthma exacerbation. A written asthma action plan (WAAP) allows patients to recognize signs of an asthma exacerbation and provides guidance of symptom management which improves outcomes and reduces hospitalizations and ED, improve adherence, reducing the rate of asthma exacerbations in children and adults [9-11]. Furthermore, by including recommendations for oral corticosteroids use in the WAAP, this treatment plan can reduce the need for urgent care, prevention of hospitalization, and shortened hospitalization [8,12,13].

In addition to the structural barriers to care, comorbid conditions play a significant role in asthma outcomes and has been associated with poor disease control and high utilization of healthcare resources in patients with asthma [3,14,15]. There are several comorbidities that have been identified which impact asthma, including: Obesity, rhinitis, smoking, COPD, respiratory infections, atopy, bronchiectasis, obstructive sleep apnea, GERD, and psychopathologies [14,16,17].

In this study, we evaluated how these factors are associated with emergency department (ED) use in patients with asthma after they received a written asthma action plan.

## Materials & Methods

### Patient population & data collection

This retrospective study was conducted with 373 adult patients with a documented diagnosis of asthma (*International Classification of Diseases* [ICD]-9 code 493) who received a written asthma action plan at the Medical Center of Louisiana New Orleans (MCLNO) as part of a disease management program, between January 1<sup>st</sup>, 2007 and December 31, 2008, after Hurricane Katrina. Data assessed included patient demographics (e.g., age, race, insurance status), inclusion of prednisone in the WAAP, number of emergency department visits, and comorbidities. This study was approved by the institutional review board (IRB) at Tulane University School of Medicine and Louisiana State University New Orleans School of Medicine.

### Statistical analysis

Data cleaning and all statistical tests were performed using SPSS (IBM Corp., Armonk, NY, USA). Descriptive statistics were performed and included means and standard deviations for all variables including the primary outcome (ED utilization), and covariates (age, sex, race, insurance type, number of comorbid conditions) as appropriate. Crude relationships between categorical variables were examined using Pearson chi-square test statistics. Continuous variables were examined using paired samples t-test. Odds ratios were calculated.

## Measures

We analyzed patient demographics, comorbidities, prednisone inclusion in WAAP and the change of emergency department visits from one year prior to and after receiving a WAAP. We defined low ED use as having one or no asthma-related visits to the ED and we defined high ED usage as having 2 or more asthma-related visits. We identified comorbid conditions diagnosed in patients using ICD-9 coding and chart review for various diseases documented during their first encounter which may be implicated in affecting asthma, specifically: Hypertension, diabetes, rhinitis, gastroesophageal reflux disease, obesity, congestive heart failure, tobacco usage, alcohol abuse, illicit drug use, chronic obstructive pulmonary disease, obstructive sleep apnea, atopy, and depression. We also evaluated WAAPs which specifically included prednisone compared to plans without any documentation of steroid use guidance.

## Results

The mean age of this 373 patient cohort was  $42 \pm 14.6$ -years-old, with a predominance of female patients ( $n = 230$ , 61.7%). The majority of the patients identified as Black ( $n = 323$ , 86.6%). The rest of the demographic information for this cohort is detailed in Table 1. A decrease in ED use, (statistically significant associations) was observed in women ( $p < 0.001$ ) and in black patients ( $p = 0.0236$ ). There was no statistically significant difference for insurance type in regard to decreased ED visits. Of note, there was a trend for an association for non-smokers and a decrease in ED use compared to smokers ( $p = 0.056$ ).

In Table 2, it is shown that when a patient has 1 comorbidity or less, there is no significant association from the ED decrease to the action plan, the same applies when there is 4+. Although as shown in the table, there is more of a decrease in ED visits in those patients with 0-1 comorbidities and 4+ comorbidities than there is a decrease in those with 2-3 comorbidities, our analysis shows the association with the decrease and our action plan is stronger.

In our cohort of patients with asthma, 13 comorbid conditions were identified and analyzed as it relates to ED usage, which is shown in Table 3. The most common comorbid conditions were hypertension which consisted of 176 patients (47.2%), 166 with obesity (44.5%), 144 smoking and tobacco (38.6%) use as well as 112 rhinitis (30.2%). Of note, 42 (11.3%) patients had chronic obstructive pulmonary disease (COPD), 13 patients (3.5%) had obstructive sleep apnea (OSA) and 18 patients (4.8%) had CHF. Statistically significant relationships were observed between ED utilization after receiving a WAAP in patients with hypertension, obesity, tobacco use, rhinitis, gastroesophageal reflux disease, diabetes, atopy, illicit drug use, COPD, and depression. The presence of alcohol use or congestive heart failure were the only comorbidities that were not associated with statistically significant decrease in ED visits after receiving a WAAP.

Lastly, a chi-square analysis revealed a statistically significant association with decreased ED visits with an average of 0.569 decrease in ED visits when prednisone was

**Table 1:** Demographics of Study Patients, n (%) or Mean ± Standard Deviation.

| Characteristic        | Overall Sample N = 373 (%) | Change in ED Visits | Low ED Users | High ED Users | p-VALUE  |
|-----------------------|----------------------------|---------------------|--------------|---------------|----------|
| <b>Sex</b>            |                            |                     |              |               | < 0.0001 |
| Female                | 230 (61.66)                | -0.485              | 213 (92.61)  | 17 (7.39)     |          |
| Male                  | 143 (38.34)                | -0.293              | 103 (72.03)  | 40 (27.97)    |          |
| <b>Age</b>            |                            |                     |              |               | 0.133    |
| 18-40                 | 149 (39.95)                | -0.575              | 124 (83.22)  | 25 (16.78)    |          |
| 41-93                 | 224 (60.05)                | -0.385              | 172 (76.79)  | 52 (23.21)    |          |
| <b>Race</b>           |                            |                     |              |               | 0.0236   |
| Black                 | 322 (86.33)                | -0.527              | 253 (78.57)  | 69 (21.43)    |          |
| WHITE                 | 46 (12.33)                 | -0.347              | 40 (86.96)   | 6 (13.04)     |          |
| Other                 | 5 (1.34)                   |                     | 3 (60.00)    | 2 (40.00)     |          |
| <b>Smoking Status</b> |                            |                     |              |               | 0.056    |
| Smoker                | 144 (38.6)                 | -0.125              | 107 (74.31)  | 37 (25.69)    |          |
| Non-Smoker            | 229 (61.4)                 | -0.677              | 189 (82.53)  | 40 (17.47)    |          |
| <b>Insurance Type</b> |                            |                     |              |               | 0.346    |
| Free Care             | 142 (38.1)                 |                     | 118 (83.10)  | 24 (16.90)    |          |
| Medicaid/Medicare     | 68 (18.2)                  |                     | 54 (79.41)   | 14 (20.59)    |          |
| Private               | 130 (34.9)                 |                     | 101 (77.69)  | 29 (22.31)    |          |
| Unknown               | 33 (8.8)                   |                     | 23 (69.70)   | 10 (30.30)    |          |

This table illustrates the characteristics of the 373 patients in the study. Low ED usage was defined as ≤ 1 asthma-related ED visits and High ED usage was defined as ≥ 2 asthma-related ED visits after receiving the written asthma action plan (WAAP). Change in ED visits represent the average decrease in ED visits one year before the WAAP to one year after.

\*p-values for difference in ED use were calculated with Pearson chi-square test for categorical variables and paired samples t test for continuous variables.

**Table 2:** Effects of Total Number of Comorbidities on Decrease ED Visits after WAAP.

| Total No. of Comorbidities Per Patient* | Overall Sample | Change in ED visits | Low ed Users | High ed Users | p-value |
|---|----------------|---------------------|--------------|---------------|---------|
| 0-1 Comorbidities                       | 129 (39.57)    | -0.884              | 104 (80.06)  | 25 (19.93)    | 0.067   |
| 2-3 Comorbidities                       | 112 (30.03)    | -0.134              | 86 (76.79)   | 26 (23.21)    | 0.001   |
| 4+ Comorbidities                        | 85 (26.15)     | -0.741              | 63 (74.12)   | 22 (25.89)    | 0.364   |

This table demonstrates the relation of decrease in ED visits after WAAP and number of comorbidities present.

\*p-value signifies whether that range of comorbidity had a relation to the decrease in ED visit, value was calculated with Pearson Chi-square test

included as a recommendation for use in the WAAP (Table 4). This association was observed for patients regardless of comorbidities.

## Discussion

Our study identified a novel gender disparity in an inner-city asthma population that women and black patients were more likely to have decreased ED use after receiving a WAAP. Interestingly, our study included a largely female Black population, two demographics that have a high prevalence of asthma, as well as the highest death rates for asthma [18-20]. A previous study in the same hospital showed increased adherence to physician counseling by women compared to

men [21]. A similar observation of improved outcome in Black women, based on increased likelihood of achieving asthma control, was reported recently in a larger multi-hospital asthma disease management in Louisiana that used a similar approach and leadership to this program [22].

In this study we found that receiving a written asthma action plan (WAAP) was correlated with decreased ED use when patients have hypertension, obesity, tobacco use, rhinitis, gastroesophageal reflux disease, diabetes, atopy, illicit drug use, COPD, and depression. Current smoking status showed a strong trend of decrease despite not being statistically significant when tested. Congestive heart failure (CHF) and alcohol use were the only comorbid conditions

**Table 3:** Comorbidities, N (%).

| Comorbidity      | Overall Sample | ≤ 1 ED visits After WaaP | ≥ 2 ED Visits After WaaP | P*      |
|------------------|----------------|--------------------------|--------------------------|---------|
| Hypertension     |                |                          |                          |         |
| Yes              | 176 (47.2)     | 153 (47.4)               | 23 (46.0)                | < 0.001 |
| No               | 197 (52.8)     | 170 (52.6)               | 27 (54.0)                |         |
| Obesity          |                |                          |                          |         |
| Yes              | 166 (44.5)     | 145 (44.9)               | 21 (42.0)                | < 0.001 |
| No               | 207 (55.5)     | 178 (55.1)               | 29 (58.0)                |         |
| Tobacco Use      |                |                          |                          |         |
| Yes              | 144 (38.6)     | 114 (35.3)               | 30 (60.0)                | < 0.001 |
| No               | 229 (61.4)     | 209 (64.7)               | 20 (40.0)                |         |
| Rhinitis         |                |                          |                          |         |
| Yes              | 112 (30.0)     | 101 (31.3)               | 11 (22.0)                | < 0.001 |
| No               | 261 (70.0)     | 222 (68.7)               | 39 (78.0)                |         |
| GERD             |                |                          |                          |         |
| Yes              | 72 (19.3)      | 65 (20.1)                | 7 (14.0)                 | < 0.001 |
| No               | 301 (80.7)     | 258 (79.9)               | 43 (86.0)                |         |
| Diabetes         |                |                          |                          |         |
| Yes              | 66 (17.7)      | 59 (18.3)                | 7 (14.0)                 | < 0.001 |
| no               | 307 (82.3)     | 264 (81.7)               | 43 (86.0)                |         |
| Atopy            |                |                          |                          |         |
| YES              | 36 (9.7)       | 30 (9.3)                 | 6 (12.0)                 | < 0.001 |
| NO               | 337 (90.3)     | 293 (90.7)               | 44 (88.0)                |         |
| Illicit Drug Use |                |                          |                          |         |
| YES              | 35 (9.4)       | 27 (8.4)                 | 8 (16.0)                 | < 0.001 |
| NO               | 338 (90.6)     | 296 (91.6)               | 42 (84.0)                |         |
| COPD             |                |                          |                          |         |
| YES              | 42 (11.3)      | 32 (9.9)                 | 10 (20.0)                | 0.02    |
| NO               | 331 (88.7)     | 291 (90.1)               | 40 (80.0)                |         |
| Depression       |                |                          |                          |         |
| YES              | 14 (3.8)       | 13 (4.0)                 | 1 (2.0)                  | 0.049   |
| NO               | 359 (96.2)     | 310 (96.0)               | 49 (98.0)                |         |
| OSA              |                |                          |                          |         |
| YES              | 13 (3.5)       | 11 (3.4)                 | 2 (4.0)                  | 0.010   |
| NO               | 360 (96.5)     | 312 (96.6)               | 48 (96.0)                |         |
| Alcohol Use      |                |                          |                          |         |
| YES              | 27 (7.2)       | 22 (6.8)                 | 5 (10.0)                 | 0.60    |
| NO               | 346 (92.8)     | 301 (93.2)               | 45 (90.0)                |         |
| CHF <sup>1</sup> |                |                          |                          |         |
| YES              | 18 (4.8)       | 16 (5.0)                 | 2 (4.0)                  | 0.499   |
| NO               | 355 (95.2)     | 307 (95.0)               | 48 (96.0)                |         |

This table illustrates the comorbidities that exist in our patient population and their relationship with DECREASE in ED use.

\*p-values were calculated using Pearson chi-square to indicate statistical significance of the relation of the acomorbidity to decreased ED visits.

**Table 4:** Effect of prednisone in the WAAP in relation to emergency room visits.

|   | Prednisone  |             |
|---|-------------|-------------|
|   | Yes         | No          |
| Number of Patients  | 114 (30.5%) | 259 (69.4%) |
| Significance (P)  | 0.006       |             |
| Average ED visits 1 year before WAAP in those with Prednisone inclusion   | 1.13        |             |
| Average ED visits 1 year after WAAP in those with Prednisone inclusion  | 0.561       |             |
| Average reduction of ED visits after WAAP in those with Prednisone inclusion  | 0.569       |             |
| This table shows the results of the Pearson chi square analysis on prednisone inclusion as part of the WAAP and the effects on ED visits. |             |             |

that were found to not be associated with decreased ED use as it relates to asthma ED utilization. This is similar to previously published studies that identified patients with CHF as being associated with a decreased likelihood of achieving asthma control [22]. Currently, CHF and alcohol use are not recognized as significant comorbidities for patients with asthma [16,17]. Our results suggest that patients with asthma and CHF are at increased risk for poor clinical outcomes and higher healthcare-related costs. Furthermore, addressing heart function and alcohol use may help improve their quality of life.

While all patient comorbidity groups showed decrease in ED visits before and after WAAP, those with 2-3 comorbid conditions did show a significant relation in decrease in ED visits. This is likely because patients with 0-1 comorbidities often had a minimal amount of visits. Those with 4+ comorbidities, our smallest sample size, showed a decrease in ED but were not found to be statistically significant which suggests that having more comorbidities will require continued ED utilization.

We found an association between prednisone inclusion in the WAAP and decreased ED utilization. Only 30.5% of patients had prednisone inclusion in their WAAP. Patients with prednisone inclusion in the WAAP had an observed reduction of 0.569 ED visits per year following receipt of a WAAP. Based on this data, our findings suggest that prednisone should be incorporated as an actionable intervention in asthma education, whenever possible [8,12,13]. Although there is still utilization of emergency departments, the significant reduction would be beneficial to decreasing cost of care and improve quality of life for patients with any number of disease burden.

### Limitations and Strengths

There are some limitations in this study. First, this was conducted in single inner city safety net hospital, post hurricane Katrina that had a disease management program. The data was obtained in the period post-Katrina by reviewing paper charts with limited electronic data which impaired our ability to know the WAAP given. The study was limited by a small sample size in regards to some comorbidities like alcohol use disorder (n = 27) and CHF (n = 18). This data represents the resurgence of an asthma disease management program following a major natural disaster and before Medicaid expansion. Our real life retroactive study allows for

identification of associations with decrease in ED use after WAAP in a largely underrepresented Black population in asthma studies.

### Conclusion

Our study demonstrates that the use of a WAAP can be associated with a statistically significant decrease in ED use in black and women patients. In addition, on average, patients in all comorbid disease cohorts (0-1, 2-3, 4+) with a WAAP showed decreased ED use in the following year. Our results support the need for inclusion of prednisone in the WAAP for asthma patients to improve disease outcomes as this decreased ED visits. Our results also suggest that asthma patients with concomitant diagnosis of congestive heart failure need to have both conditions addressed to reduce emergency department use. Future prospective studies would benefit from investigating how to decrease the gender disparity and heart failure as it relates to asthma health outcomes.

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