Factors Associated with an Emergency Department or Urgent Care Visit for Asthma, United States in 2010

Joseph D. Espiritu[1,2], Allemyar Ahmad[1,3], Helwani Mohammed[1,4], Michael Elliot[1] and Pamela Xaverius[1]

[1]*Saint Louis University College for Public Health and Social Justice, St. Louis, Missouri, USA*
[2]*Saint Louis University School of Medicine, St. Louis, Missouri, USA*
[3]*Jamaica Hospital Medical Center, Department of Internal Medicine, Queens, New York, USA*
[4]*Washington University School of Medicine in St. Louis, St. Louis, Missouri, USA*

*Corresponding author: Joseph D. Espiritu, MD, MSPH, SLU Care Sleep Disorders Center, Saint Louis University College for Public Health and Social Justice, 3545 Lafayette Avenue, Salus Center, Suite 1216, Saint Louis, MO, USA 63104, Tel: (314) 977-5337; E-mail: joseph.espiritu@health.slu.edu

Abstract

Background and Objective: To identify the factors associated with asthma-related emergency department (ED)/ urgent care visits and to explore the relationship between ED/urgent care visits and both inhaled corticosteroid (ICS) use and symptom control.

Methods: Cross-sectional design used to analyze whether ED/urgent care visits are associated with ICS use in the Behavioral Risk Factor Surveillance System (BRFSS)-Asthma Call-Back Survey (ACBS) 2010 using complex sample multivariate logistic regression.

Results: Thirty-one percent of asthmatics had uncontrolled symptoms and 9.5% required ED/ urgent care in the previous 12 months. Only 41.1% of those with uncontrolled symptoms were on ICS. Bivariate analysis found women, Blacks and non-Hispanic minorities, those with income below $25,000, ICS users, and those with uncontrolled symptoms during the past 2 weeks were more likely to have visited an ED/urgent care center. Multivariate analysis showed women, low income, being ever taught to recognize signs and symptoms, and the interaction between ICS use and symptom control were all associated with an ED/urgent care visit.

Conclusion: Asthmatics with controlled symptoms on ICS were more likely to have visited an ED/urgent care center compared to controlled asthmatics not on ICS. This implies that ICS use may be a marker of exacerbation risk in symptom-controlled asthmatics. While many asthmatics have uncontrolled symptoms and required emergent/ urgent care, a significant number of uncontrolled asthmatics were not on ICS medications. In order to reduce health care utilization, morbidity, and mortality in asthma patients, preventative and treatment efforts should focus on high-risk groups (i.e., women, low income, and ICS-requiring asthmatics).

Keywords: Control/Management; Epidemiology; Pharmacotherapy; Morbidity and Mortality; Prevention

Introduction

Asthma is a complex respiratory disorder characterized by variable and recurring symptoms, airflow obstruction, bronchial hyper responsiveness, and airway inflammation [1]. Asthma affects 235 million individuals globally and 25.7 million in the United States (US) [2]. Asthma is associated with approximately 10 million ambulatory care visits, two million emergency department (ED) visits, and half a million hospitalizations in 2009 and accounts for roughly 4,000 deaths each year in the US [3]. In 2007, the US spent $56 billion on asthma, with $10 billion for direct health care and $6 billion from lost productivity due to illness and death [4].

In North America and Europe, one of five patients with severe persistent asthma has inadequate symptom control, exposing them to an increased risk of asthma attacks, hospitalization, and death [5]. A review of the prevalence of uncontrolled asthma in Europe reported that out of 2,050 adult asthmatics, 35% had good, 40% had moderate and 25% had poor symptom control [6]. Factors associated with poor symptom control included gaps in asthma knowledge, attitudes, and behavior, lack of pulmonary function testing, lack of instruction on peak flow use, and increased use of rescue bronchodilator therapy. A German study reported that higher initial asthma severity, inadequate adherence, mood disorder, and advanced age were associated with poor control [7]. Studies in the United Kingdom identified rhinitis, smoking, low adherence to inhaled corticosteroid (ICS) therapy, and socioeconomic factors such as higher deprivation and urban practice setting as risk factors for poor symptom control [8,9]. Meanwhile, a US study found symptomatology, increased use of rescue inhaler, smoking, African-American ethnicity, low lung function, and history of severe asthma as predictors of poor symptom control [10].

Factors related with increased ED visits in asthmatics include socio-demographic factors, comorbid disorders, asthma severity, and inadequate controller medication use [11-13]. Ginde and colleagues identified women, African-Americans, Hispanics, and Northeastern US residents as socio-demographic groups at higher risk for an ED visit [11]. Patients with moderate to severe asthma in Harlem, New York were about four times more likely to be frequent ED users compared to those with mild disease [12]. Comorbid disorders and self-reported global health problems in the year preceding the ED visit

were also associated with frequent ED use [12]. Inadequate adherence to ICS therapy has been widely known to be associated with poor asthma control and increased morbidity [13]. A Canadian study of 1293 asthmatic patients who visited the ED found that ICS users have 45% fewer relapse ED visits than nonusers regardless of ICS dose [14]. A US study of health care claims found that delaying the initiation of a controller medication from the time of ED discharge triples the risk of a recurrent asthma-related visit [15]. Despite globally-disseminated guidelines on the education, prevention, and management of asthma [16] only 60% of those visiting the ED three or more times in the past year in Canada were using ICS [17]. Another Canadian study reported that the prescription rate of any ICS in the ED at discharge was only 51% [18].

To our knowledge, population-based studies on the association between ED/urgent care visits and ICS use have not been reported for the US. Identifying the factors associated with increased ED/urgent care visits in asthmatics may direct public health interventions towards high risk groups or behaviors and help reduce health care costs. Thus, the aims of this cross-sectional analysis of the US Behavioral Risk Factor Surveillance System (BRFSS)-Asthma Call-Back Survey (ACBS) 2010 [19] are to identify the factors associated with asthma-related ED/urgent care visits in adults and to determine whether these visits are associated with ICS use.

Research Methodology

Study design

This study is a cross-sectional analysis of BRFSS-ACBS conducted in the US in 2010 [19]. The ACBS, a sub-study of BRFSS respondents with asthma, contains extensive information on demographics, symptoms, medication prescription and adherence, exacerbations, health care utilization (e.g., ED/urgent care visits) among others [19]. Institutional Review Board approval was requested but not required for public use data.

Participant selection

The participants are adults, 18 year or older, who responded "Yes" to the question "Have you ever been told by a doctor, nurse, or other health professional that you had asthma?", [20] resulting in a total unweighted sample size of 17,753 and a total weighted sample size of 2,694,9585.

Variables analyzed

The dependent variable is the occurrence of an ED/urgent care visit during the past 12 months [20]. The primary independent variable, ICS use, was a recoded binary variable, with a count of 0 being "Non-ICS User" while any count from 1-14 being an "ICS User". The covariates were socio-demographic factors [age, race, gender, and income level], health care coverage, ever taught to recognize early asthma signs or symptoms, influenza and pneumococcal vaccinations, symptom control, and cigarette smoking [21]. Race was recoded into 4 categories: White Non-Hispanic, Black Non-Hispanic, Hispanic, and Other Races. Annual income was recoded into 3 categories: <$25,000, ≥ $25,000 to <75,000, and ≥ $75,000. The number of symptom-free days corresponds to the question, "During the past two weeks, on how many days were you completely symptom-free, that is no coughing, wheezing, or other symptoms of asthma?" [20]. The number of symptom-free days was recoded into a binary variable, with a response

of 12-14 being "Controlled Asthma" and 0-11 being "Uncontrolled Asthma", as per the National Asthma Education and Prevention Program guidelines [1]. Since cigarette use is well-known to be associated with uncontrolled asthma symptoms [22], smoking was included as a covariate.

Statistical analysis

Student's t-test, Chi-square tests, and binary logistic regression analysis for continuous and categorical variables, respectively, were performed to explore the association between ED/urgent care visit during the past 12 months and each of the independent variables using SPSS Complex Samples 21˚ Cross-tabs [IBM Corp. Released 2012. IBM SPSS Complex Samples for Windows, Version 21.0. Armonk, NY: IBM Corp.] A multivariate complex sample logistic regression model predicting ED/urgent care visit during the past 12 months, based on ICS use, symptom control, clinically and statistically significant covariates, plus an interaction term between ICS use and symptom control was fitted. The interaction term was included in the model since the level of asthma control might influence relationship between ED/urgent care visit and ICS use [13-18]. In order to make statistically valid population inferences from the sample data, the stratum variable, the primary sampling unit, and the record weights were incorporated in our analyses, as recommended in the BRFSS ABCS 2010 History and Analysis Guidance [19,23]. The best fitting model was selected via stepwise backward elimination with Likelihood Ratio (G^2) testing [24]. Since Likelihood Ratio (G^2) testing returned a significant G^2 statistic with dropping any one of the covariates, the full model was retained.

Results

Demographics and asthma control of the BRFSS ACBS 2010 participants

There were 17,753 (weighted N=26,949,585) adults in the BRFSS who responded "Yes" to the question "Have you ever been told by a doctor, nurse, or other health professional that you had asthma?". The participants had a weighted mean age of 45.42±0.32 years and were mostly women (57.71%) and White (72.8%). Thirty-one percent had uncontrolled symptoms during the past 2 weeks while 9.5% have visited the ED/urgent care center in the past 12 months prior to the survey. Only 41.4% of participants with uncontrolled symptoms during the past 2 weeks were on 1 or more ICS medications.

Bivariate comparison by ED/Urgent care visit

Of the 26 million participants in the weighted sample, 9.5% had visited the ED/urgent care center in the past 12 months while 90.5% had not. In the unadjusted analysis, women [crude odds ratio (cOR)=2.44, 95% CI: 1.89-3.26], Blacks [cOR=2.34, 95% CI: 1.68-3.26], non-Hispanic minorities [cOR=1.81, 95% CI: 1.12-2.92] and those with income below the poverty level (<$25,000) [cOR=2.31, 95% CI: 1.66-3.23] were approximately twice as likely to have visited the ED/urgent care center in the past 12 months. While pneumococcal vaccination was associated with increased odds of an ED/urgent care visit [cOR=1.40, 95% CI: 1.11-1.77], influenza vaccination was not. Use of 1 or more ICS medications [cOR=2.90, 95% CI: 2.31-3.63], uncontrolled symptoms in the past 2 weeks [cOR=4.46, 95% CI: 3.51-5.66], and being ever taught to recognize signs and symptoms [cOR=1.64, 95% CI: 1.27-2.12] were associated with one or more ED/urgent care visit in the past 12 months. On the other hand, age, health

insurance coverage, and smoking were not associated with ED/urgent care visits (Table 1).

Weighted N=26,862#	Visited ED/Urgent Care (N=2,552#; 9.5%)		Did Not Visit ED/Urgent Care (N=24,310#; 90.5%)		Crude Odds Ratio	95% Confidence Limits
	n#	%	n#	%		
Age, in years						
Mean(± SEM)	46.33 (0.81)		45.38 (0.35)		1.00	0.99-1.01
Gender						
Male	6218	24.4	10,757	44.3	0.41	0.31-0.53*
Race						
White	1550	61.6	17,832	73.9	1	Reference
Black	414	16.4	2038	8.4	2.34	1.68-3.26*
Hispanic	314	12.5	2725	11.3	1.33	0.91-1.94
Other	239	9.5	1525	6.3	1.81	1.12-2.92*
Annual Income						
>$75,000	485	21.4	7027	32.2	1	Reference
≥ 25,000-75,000	820	36.3	8802	40.3	1.35	0.96-1.91
<25,000	957	42.3	5998	27.5	2.31	1.66-3.23*
Health care coverage						
Yes	2233	87.9	20,663	85.3	1.25	0.88-1.78
Ever taught to recognize early signs/symptoms						
Yes	1871	73.8	15,049	63.3	1.64	1.27-2.12*
Inhaled corticosteroid use						
Yes	1146	45	5323	22	2.9	2.31-3.63*
Symptom control						
Yes	1599	63	6662	27.7	4.46	3.51-5.66*
Influenza vaccine						
Yes	1290	50.8	11,391	47.2	1.15	0.92-1.45
Pneumococcal vaccine						
Yes	1184	49.8	8914	41.4	1.4	1.11-1.77*
Smoker						
Yes	537	42.5	6443	41.1	1.06	0.78-1.44
Note: #Weighted data are used; all N's and n's are in thousands. *Significant 95% confidence limits.						

Table 1: Bivariate comparison of asthmatics stratified based on emergency department (ED) or urgent care visit during the previous 12 months.

Multivariate logistic regression model predicting ED or Urgent care visit

In the multivariate analysis, adjusting for all the clinically important and statistically significant covariates, female gender [adjusted odds ratio (aOR)=1.54, 95% CI: 1.09-2.17], income below poverty level [aOR=2.09, 95% CI: 1.25-3.47], being ever taught to recognize early signs and symptoms [aOR=1.93, 95% CI: 1.38-2.71], and the interaction between ICS use and symptom control [p<0.01] were significantly associated with an ED/urgent care visit. Based on the

Nagelkerke's R^2, the full model explained approximately 19% of the variance in the outcome (ED/urgent visit) (Table 2).

Variables	Adjusted Odds Ratio	95% Confidence Limits
Age	0.99	0.98-1.00
Gender (Male)	0.65	0.46-0.92*
Race - White non-Hispanic	1	Reference
Black non-Hispanic	1.39	0.90-2.16
Hispanic	1.14	0.64-2.03
Other	0.86	0.47-1.57
Income - (US$) ³ 75,000	1	Reference
³ 25,000 – 75,000	1.45	0.87-2.42
<25,000	2.09	1.25-3.47*
Health care coverage	1.4	0.81-2.44
Ever taught to recognize signs and symptoms	1.93	1.38-2.71*
Inhaled corticosteroid (ICS) use	1.36	0.90-2.05#
Asthma symptom control (controlled)	1.8	1.12-2.90#
Pneumonia Vaccine	1.19	0.79-1.81
Flu Vaccine	1.12	0.78-1.62
Smoking	0.85	0.59-1.23

Note: *Significant 95% confidence limits #There was a statistically significant interaction between ICS use and asthma control (p<0.01). Nagelkerke R^2=0.19.

Table 2: Asthma call-back survey 2010 multivariate logistic regression model predicting ED or urgent care visit during the previous 12 months.

ED/Urgent care visit and ICS use stratified by asthma symptom control

Since asthma symptom control during the past 2 weeks was an effect modifier of the association between ED/urgent care visit and ICS use, separate multivariate logistic regression models (to determine the association between ED/urgent care visit and ICS use) were fitted for the controlled vs. uncontrolled symptom strata, respectively. In asthmatics with controlled symptoms during the past 2 weeks, ICS use was significantly greater in those who have visited an ED/urgent care center in the past 12 months than in non-visitors [aOR=4.58, 95% CI: 2.61-8.06]. On the other hand, in asthmatics with uncontrolled symptoms, ICS use was not significantly associated with ED/urgent care center visit [aOR=1.43, 95% CI: 0.99-2.06] (Table 3).

Variables	Adjusted Odds Ratio# of ED or Urgent Care Visit	95% Confidence Limits
Controlled symptoms (on inhaled corticosteroids)	4.58	2.61-8.06*
Persistent symptoms (on inhaled corticosteroids)	1.43	0.99-2.06

Note: #Adjusted for age, gender, race, income, health care coverage, ever taught to recognize signs and symptoms, pneumococcal and influenza vaccination, and smoking. *Significant 95% confidence limits.

Table 3: Association between inhaled corticosteroid use and Emergency Department (ED) or urgent care visit stratified by asthma symptom control.

Discussion

Despite widely published asthma management guidelines, almost a third (31.1%) of adults with asthma in the ACBS 2010 had uncontrolled symptoms and almost a tenth (9.5%) required an ED/ urgent care visit over a one-year period. Only a minority (41.1%) of those with uncontrolled symptoms were on ICS medications. Our bivariate analysis of the BRFSS-ACBS 2010 found women, Blacks and non-Hispanic minorities, those with income below the poverty level, ICS users, and those with uncontrolled symptoms during the past 2 weeks were approximately twice more likely to have visited an ED/ urgent care center in the past 12 months. On the other hand, the multivariate analysis revealed that female gender, income below the poverty level, being ever taught to recognize early signs and symptoms were associated with an ED/urgent care visit. While asthmatics with controlled symptoms on ICS were more likely to have required ED/ urgent care in the past year, ICS use was not significantly associated with increased ED/urgent care visit in uncontrolled asthmatics.

The low rate of ICS use in BRFSS ACBS 2010 mirrors the well-established low controller medication adherence rates among asthmatic patients, who may have concerns about potential and perceived adverse effects of ICS [24]. These low adherence rates may be compounded by the suboptimal prescription of controller medications by emergency and hospital-based physicians treating patients with asthma exacerbations [25]. A prospective observational study of patients with asthma exacerbations reported that 89% of patients did not start or increase their ICS use even after an ED visit [26]. A direct clinician-to-patient feedback discussion about misconceptions related to the side effects of ICS via may be the key to improving adherence in less informed patient subpopulations [27].

Women with asthma in this current analysis were more likely to have visited an ED/urgent care center for asthma symptoms in the past 12 months. This is consistent with a population-based cross-sectional survey in Canada, which reported an increased frequency of urgent care visits in the preceding year in women with asthma compared to men (50% vs. 36%) [28,29]. The increased likelihood of ED/urgent care in the ACBS 2010 participants with income below the poverty level ($25,000) is also congruent with the well-known association between low socioeconomic status and poor asthma health outcomes [9].

Our finding of an increase in ED/urgent care visits in controlled asthmatics on ICS contradicts expectations that ICS use reduces the need for ED/ urgent care. Because of the cross-sectional design of this study, we believe that temporal bias may be responsible for this paradoxical increase in ED/urgent care visits in ICS users. Given the discrepancy between the 12-month interval for ED/urgent care visit and the 2-week interval for symptom control ascertainment prior to the BRFSS-ACBS interview, there is a high likelihood that ICS therapy was started after the participants visited an ED/urgent care center for an asthma exacerbation (Figure 1). We also suspect that the initiation of ICS therapy during an ED/urgent care visit might have been responsible for the symptom control achieved 2 weeks prior to the

ACBS interview in symptom-controlled asthmatics. This same temporal bias may also explain the apparent increase in ED/urgent care visit in those who had been taught to recognize the early signs and symptoms - i.e., participants received their asthma education during or after an ED/urgent care visit rather than before. On the other hand, we postulate that the statistically insignificant increase in ICS use pre-vs. post-ED/urgent care visit in uncontrolled asthmatics might be due to the higher baseline use of ICS in uncontrolled asthmatics (42.86% pre-ED/urgent care visit) (Figure 2), suboptimal prescription of ICS by ED/urgent care physicians, and other unidentified confounding factors (e.g., prescription of oral corticosteroids).
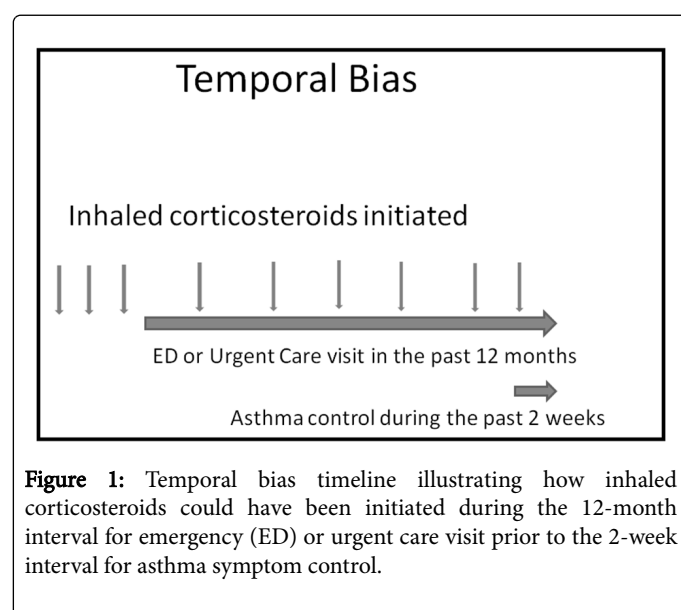

Figure 1: Temporal bias timeline illustrating how inhaled corticosteroids could have been initiated during the 12-month interval for emergency (ED) or urgent care visit prior to the 2-week interval for asthma symptom control.
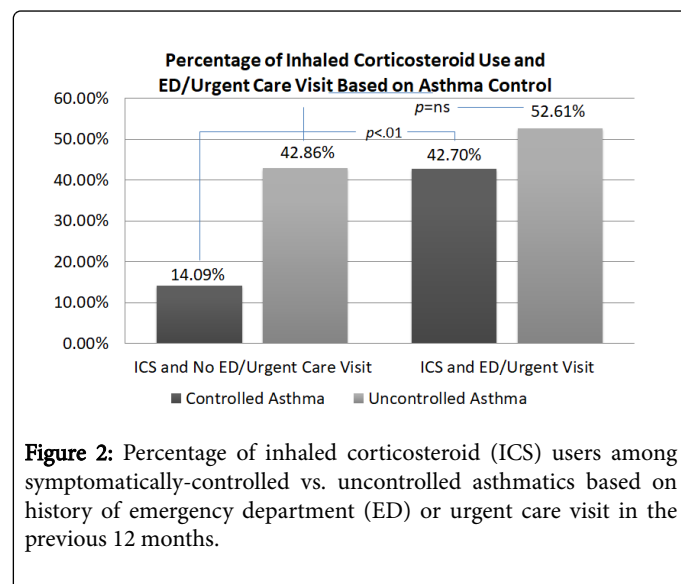

Figure 2: Percentage of inhaled corticosteroid (ICS) users among symptomatically-controlled vs. uncontrolled asthmatics based on history of emergency department (ED) or urgent care visit in the previous 12 months.

In our multivariate analysis, influenza and pneumococcal vaccinations were not associated with ED/urgent care visit. Although, the US Preventive Services Task Force recommends immunization against influenza and Pneumococcus in patients with asthma, [30] the evidence supporting these recommendations is sparse. A randomized, placebo-controlled trial on 128 patients with asthma in Turkey found no significant difference in frequency of upper respiratory tract infection or frequency of asthma exacerbations in those who received the influenza vaccine [31]. The EVAN-65 study prospectively evaluated the effectiveness of the 23-valent pneumococcal polysaccharide vaccine in 1298 older Spanish adults with chronic respiratory disease including asthma and found statistically insignificant reductions in community-acquired pneumonia risk, hospitalization, and mortality [31].

The limitations of our study (i.e., temporal bias and recall bias) are inherent in cross-sectional surveys. Temporal bias precludes us from concluding any cause and effect relationship between ED/urgent care visit and ICS use. Self-reporting may be limited by recall bias, with uncontrolled asthmatics being more likely to report ED/urgent care visits, symptoms, and medication use than well-controlled asthmatics. Lack of objective measures of lung function can result in inclusion of participants with other lung diseases (e.g., COPD). Given that the BRFSS-ACBS was a population-based study conducted in the United States, our findings may not be generalizable to other countries with different demographic characteristics or health care systems.

Future analysis of the BRFSS-ACBS should longitudinally investigate the trends and evolving factors associated with asthma health-related outcomes. e.g., ED/urgent care visit, asthma exacerbations, hospitalizations, etc.

Conclusion

Asthmatics with controlled symptoms on ICS were more likely to have visited an ED/urgent care center than controlled asthmatics not on ICS. This implies that ICS use may be a marker of an exacerbation risk in asthmatics with controlled symptoms. While many asthmatics have uncontrolled symptoms and required emergent/urgent care, a significant number of uncontrolled asthmatics were not on ICS medications. In order to reduce health care utilization, morbidity, and mortality in asthma patients, preventative and treatment efforts should focus on high-risk groups, i.e., women, low income, and ICS-requiring asthmatics.

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