

Smoking status and smoking cessation intervention among U.S. adults hospitalized for asthma exacerbation

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ABSTRACT

Background: In a previous multicenter study during 1999–2000, we found a high prevalence of smoking among patients hospitalized for asthma exacerbations (35%) and suboptimal smoking cessation efforts. There have been no recent multicenter efforts to examine the smoking status and implementation of smoking cessation efforts among patients hospitalized for asthma exacerbation.

Objective: To investigate the prevalence of cigarette smoking and the proportion and characteristics of patients who received an inpatient smoking cessation intervention.

Methods: We conducted a secondary analysis of a 25-center observational study, which included 597 U.S. adults hospitalized for asthma exacerbation during 2012–2013.

Results: Among the analytic cohort, 215 (36%) were current smokers. In the multivariable model, compared with patients with private health insurance, those with public health insurance (odds ratio [OR] 1.71 [95% confidence interval {CI}, 1.06–2.77]) or no health insurance (OR 1.75 [95% CI, 1.02–2.99]) were more likely to be current smokers. By contrast, patients with a previous evaluation by an asthma specialist in the past 12 months (OR 0.49 [95% CI, 0.28–0.86]) and use of inhaled corticosteroids (OR 0.63 [95% CI, 0.43–0.93]) were less likely to be current smokers. Among current smokers, only 55% received smoking cessation interventions during their hospitalization. In the multivariable model, current smokers who had public health insurance (OR 0.25 [95% CI, 0.07–0.82]) or no health insurance (OR 0.26 [95% CI, 0.07–0.94]) were less likely to receive inpatient smoking cessation interventions compared with those with private health insurance.

Conclusion: Our findings showed a persistently high prevalence of smokers among U.S. patients hospitalized for asthma exacerbations and an underutilized opportunity to provide this at-risk population with smoking cessation interventions.

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Asthma is an important public health problem in the United States, which affects 26 million Americans.¹ Although cigarette smoke is a known airway irritant associated with more severe chronic asthma, accelerated decline in lung function, and more frequent exacerbations,^{2,3} the prevalence of smoking is higher in individuals with asthma than in the general population (21% versus 17%).⁴ Furthermore, in a previous multicenter study of adults hospitalized for asthma exacerbation

during 1999–2000, we found an even higher prevalence of smoking (35%), with a suboptimal inpatient smoking cessation effort among the smokers.⁵ Hospitalization is an opportune setting to initiate a smoking cessation intervention.^{6,7} In 2012, The Joint Commission added smoking cessation as a core measure set for performance and quality care in U.S. hospitals.^{8,9} Despite the public health and policy importance, there have been no recent multicenter efforts to examine the smoking status and implementation of smoking cessation efforts among patients hospitalized for asthma exacerbation, a population at high risk. In this context, we used the data from a multicenter observational study of patients hospitalized with asthma exacerbation to investigate the prevalence of smoking and the proportion and characteristics of these patients who received an inpatient smoking cessation intervention.

METHODS

Design, Setting, and Participants

This was a secondary analysis of data from the 37th Multicenter Airway Research Collaboration, a multi-

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center chart review study that characterized U.S. patients hospitalized for asthma exacerbation. This study was coordinated by the Emergency Medicine Network, a collaboration of 235 participating hospitals.¹⁰ The design, setting, and methods of data collection used in the study have been reported previously.^{11–14}

Briefly, we recruited hospitals by primarily inviting sites that had participated in the University HealthSystem Consortium Asthma Clinical Benchmarking Project that evaluated patients hospitalized for asthma exacerbation during 1999 to 2000.⁵ A total of 25 urban teaching hospitals across 18 U.S. states completed the current 37th Multicenter Airway Research Collaboration study (Supplemental Table E1). By using a principal discharge diagnosis of asthma, we identified all hospitalizations for asthma exacerbation during 2012–2013, among patients ages 2 to 54 years with a history of physician-diagnosed asthma. We excluded hospitalizations made by patients with a history of physician-diagnosed chronic obstructive pulmonary disease.

Data Measurement

Onsite chart abstractors, which numbered 2–3 per site, underwent reviewer training (lecture, practice charts, and certification), before reviewing medical records (emergency department, inpatient, primary care physician, and/or specialist records) of 40 patients who were randomly selected by the Emergency Medicine Network Coordinating Center. By using a standardized form, the investigators abstracted data, including patient demographics, median household income, smoking status, primary care physician and specialty care status, asthma history, presentation and asthma management in the emergency department or clinic, inpatient asthma management (including smoking cessation interventions), and disposition from the hospital (sent home, died in the hospital, or others [transfer to another facility, left against medical advice]). The median household income was estimated by linking home zip codes to income data from the Esri Business Analyst Desktop (2013/2018 Esri's US Updated Demographics; Esri, Redlands, CA).

Esri uses multiple sources, including the 2007–2011 American Community Survey and national surveys, to estimate the median household incomes each year.¹⁵ Chart reviewers located a patient's home zip code on the Esri-generated table and reported the corresponding median household income. Specialty care was defined as outpatient asthma care by a pulmonologist, allergist/immunologist, or other physician specifically focused on asthma care. All chart reviewers had access to the procedure manual, frequently asked questions, and training slides, which contained detailed breakdowns of each question, along with decision rules for reviewing charts. The institutional review board of each participating center approved the study.

Statistical Analysis

For the purpose of this analysis, we analyzed the data of the adults in the 37th Multicenter Airway Research Collaboration (age range, 18–54 years) who were classified into three groups based on their smoking status: never smoker, former smoker, and current smoker.^{16,17} Never smokers were defined as patients who had never smoked cigarettes. Former smokers were defined as patients who were regular smokers in the past but who had stopped smoking for at least 28 days before their hospitalization. Current smokers were defined as those who reported the current use of cigarettes or had stopped smoking during the previous 28 days. To identify independent predictors of the two outcomes, (1) current smoking status and (2) provision of inpatient smoking cessation intervention (*i.e.*, brief counseling and/or pharmacotherapy), we fit a mixed-effects model with a binomial response by using random intercepts for hospitals to account for the clustering of patients within hospitals. A set of variables was chosen based on *a priori* knowledge and potential clinical significance (age, sex, race or ethnicity, insurance status, estimated median household income, primary care physician status, evaluation by an asthma specialist in the past 12 months, history of intubation, hospitalizations for asthma in the past 12 months, current use of inhaled corticosteroids, and concomitant medical disorders).^{16,18} All analyses were performed with SAS 9.4 (SAS Institute, Cary, NC).

RESULTS

Of 615 adults hospitalized for asthma exacerbations, 18 patients had no data on smoking status and were excluded from the current analysis. Of the 597 patients in the analytic cohort, the median age was 38 years (interquartile range, 30–46 years) and 64% were women; 23% were non-Hispanic white, 53% were non-Hispanic black, and 15% were Hispanic. In addition, 215 patients (36% [95% confidence interval {CI}, 32–40%]) were current smokers.

Patient demographics differed by smoking status (Table 1). Compared with patients who were never or former smokers, current smokers were more likely to be non-Hispanic black and less likely to have private health insurance, to have been seen by an asthma specialist in the past 12 months, and to use asthma controller medications (*e.g.*, inhaled corticosteroids) (all, $p < 0.05$) (Table 1). By contrast, the presentation and in-hospital course did not differ across the groups (Table 2).

In the multivariable model, patients with public health insurance (odds ratio [OR] 1.71 [95% CI, 1.06–2.77]) or no health insurance (OR 1.75 [95% CI, 1.02–2.99]) had increased odds of being a current smoker, whereas those with an evaluation by an asthma spe-

Table 1 Demographic characteristics and asthma history, according to smoking status, of U.S. adults hospitalized for asthma exacerbation

Patient Characteristics	Never Smoker (n = 265 [44%])	Former Smoker (n = 117 [20%])	Current Smoker (n = 215 [36%])	p Value
Demographics				
Age, median (IQR), y	38 (29–46)	39 (31–46)	38 (31–46)	0.90
Female sex, no. (%)	178 (67)	69 (59)	134 (62)	0.26
Race or ethnicity, no. (%)*				0.02
Non-Hispanic white	61 (23)	27 (23)	47 (22)	
Non-Hispanic black	126 (48)	60 (51)	131 (61)	
Hispanic ethnicity	56 (21)	15 (13)	20 (9)	
Others	9 (3)	5 (4)	8 (4)	
Health insurance, no. (%)*				0.008
Private	85 (32)	23 (20)	41 (19)	
Public	99 (37)	59 (50)	93 (43)	
No insurance	70 (26)	27 (23)	62 (29)	
Estimated median household income, median (IQR), \$	40,657 (29,542–52,336)	40,604 (31,346–52,851)	38,617 (30,714–51,058)	0.55
Having a primary care physician, no. (%)	175 (66)	78 (67)	141 (66)	0.92
Seen by asthma specialist in the past 12 mo, no. (%)	43 (16)	29 (25)	23 (11)	0.002
Chronic asthma factors, no. (%)				
Ever intubated for asthma	67 (25)	33 (28)	49 (23)	0.55
ED visit for asthma in the past 12 mo	144 (54)	71 (61)	119 (55)	0.51
Hospitalization for asthma in the past 12 mo	97 (37)	49 (42)	81 (38)	0.44
Chronic asthma management, no. (%)				
Current asthma medications				
Current use of oral corticosteroids	77 (29)	44 (38)	55 (26)	0.07
Current use of ICS	146 (55)	76 (65)	101 (47)	0.007
Current use of ICS and/or LABA	101 (38)	59 (50)	69 (32)	0.008
Current use of leukotriene modifiers	57 (22)	36 (31)	25 (12)	<0.001

IQR = interquartile range; ED = emergency department; ICS = inhaled corticosteroid; LABA = long-acting β -agonist.

*Percentages are not equal to 100 because of missing data.

cialist (OR 0.49 [95% CI, 0.28–0.86]) and current inhaled corticosteroid use (OR 0.63 [95% CI, 0.43–0.93]) had decreased odds (Table 3). Conversely, having a primary care physician did not significantly affect the odds of being a current smoker ($p = 0.14$). Among the current smokers, only half (55% [95% CI, 48–62%]) received smoking cessation interventions during their hospitalizations (Table 2). The rate of provision of smoking cessation interventions at the hospital level varied (median, 50% [interquartile range, 43–86%]). In the multivariable model, current smokers who had public health insurance (OR 0.25 [95% CI, 0.07–0.82])

or no health insurance (OR 0.26 [95% CI, 0.07–0.94]) were less likely to receive smoking cessation interventions (Table 3).

DISCUSSION

In this multicenter study of 597 U.S. adults hospitalized for asthma exacerbation, we found a high prevalence of cigarette smoking (36%). Analysis of our data also demonstrated that public health insurance or no health insurance was associated with current smoking status, whereas a previous evaluation by an asthma

Table 2 Presentation and in-hospital management of U.S. adults hospitalized for asthma exacerbation, according to smoking status

Variable	Never Smoker (n = 265 [44%])	Former Smoker (n = 117 [20%])	Current Smoker (n = 215 [36%])	p Value
Presentation and ED; clinic course				
Duration of symptoms ≤24 hr, no. (%)	78 (29)	32 (27)	50 (23)	0.29
Vital signs				
Initial respiratory rate, median (IQR), breaths/min	22 (19–28)	24 (20–28)	22 (20–27)	0.14
Initial oxygen saturation, median (IQR), %	96 (93–99)	95 (92–98)	95 (92–98)	0.31
Initial PEF, median (IQR), L/min*	195 (150–250)	160 (130–250)	175 (150–250)	0.74
Concomitant medical disorders, no. (%)#	70 (26)	37 (32)	72 (33)	0.23
Acute asthma treatment, no. (%)				
Systemic corticosteroids	231 (87)	108 (92)	193 (90)	0.27
Inhaled anticholinergics	170 (64)	77 (66)	148 (69)	0.55
Noninvasive positive pressure ventilation	16 (6)	12 (10)	17 (8)	0.34
Intubation	11 (4)	4 (3)	4 (2)	0.36
Inpatient course				
Initial admission location, no. (%)				0.45
ED observation unit	53 (20)	17 (15)	41 (19)	
Hospital ward	160 (60)	69 (59)	136 (63)	
Stepdown unit	15 (6)	11 (9)	12 (6)	
ICU	37 (14)	20 (17)	26 (12)	
Acute asthma treatment, no. (%)				
Systemic corticosteroids	250 (94)	112 (96)	201 (94)	0.70
Noninvasive positive pressure ventilation	10 (4)	8 (7)	11 (5)	0.43
Intubation	9 (3)	6 (5)	12 (6)	0.49
Received smoking cessation intervention, no. (%)§	—	—	119 (55)	—
Received individualized written asthma action plan, no. (%)	122 (48)	59 (52)	99 (48)	0.70
Hospital length of stay, median (IQR), days	2 (1–4)	2 (1–4)	2 (1–3)	0.79
Disposition, no. (%)				0.76
Sent home	256 (97)	113 (97)	206 (96)	
Died in the hospital	2 (1)	1 (1)	1 (<1)	
Other (e.g., transferred to another facility)	7 (2)	3 (2)	8 (4)	

ED = emergency department; IQR = interquartile range; PEF = peak expiratory flow; ICU = intensive care unit.

*Analyzed for 193 adults with initial PEF available.

#Defined by pneumonia, congestive heart failure, pneumothorax, arrhythmia, and others.

§Analyzed for 215 adults who were current smokers at the time of the index hospitalization.

specialist was associated with a decreased risk of current smoking status. Furthermore, we found that, among these current smokers, only 55% received inpatient smoking cessation interventions and that patients with public health insurance or no health insurance were less likely to receive these interventions during their hospitalization course.

In a previous multicenter study in the late 1990s, we reported that 228 of the 689 U.S. adults (33%) hospitalized for asthma exacerbation were smokers.⁵ Fifteen years later, we found that the proportion of current smokers remained high (36%).⁵ With the use of a sim-

ilar study design (e.g., chart review, inclusion and exclusion criteria, and definition of outcomes) and the same participating hospitals across the two studies, our observations likely reflect a persistently high prevalence of cigarette smoking between the late 1990s and 2013.

The persistently high prevalence of smoking likely highlights the inadequacy of prevention-oriented chronic asthma care (e.g., less self-management education, limited access to prevention-oriented care) in this high-risk population. Indeed, we found that the proportion of smokers who had received an evaluation by

Table 3 Multivariable predictors of outcomes among U.S. adults hospitalized for asthma exacerbation*

Variable	Current Smoking		Smoking Cessation Intervention#	
	OR (95% CI)	p Value	OR (95% CI)	p Value
Age				
18–29 y	1 [reference]	—	1 [reference]	—
30–39 y	1.39 (0.85–2.27)	0.19	4.44 (1.43–13.8)	0.01
40–54 y	1.07 (0.67–1.69)	0.78	1.05 (0.38–2.93)	0.92
Female sex	1.01 (0.69–1.47)	0.97	0.76 (0.32–1.81)	0.53
Race or ethnicity				
Non-Hispanic white	1 [reference]	—	1 [reference]	—
Non-Hispanic black	1.19 (0.75–1.89)	0.47	0.44 (0.14–1.32)	0.14
Hispanic	0.48 (0.25–0.92)	0.03	0.57 (0.13–2.51)	0.46
Others	0.48 (0.25–0.92)	0.03	0.57 (0.13–2.51)	0.46
Health insurance				
Private	1 [reference]	—	1 [reference]	—
Public	1.71 (1.06–2.77)	0.03	0.25 (0.07–0.82)	0.02
No insurance	1.75 (1.02–2.99)	0.04	0.26 (0.07–0.94)	0.04
Quartiles for median household income				
1 (lowest)	1.23 (0.64–2.36)	0.54	0.45 (0.09–2.25)	0.33
2	1.14 (0.55–2.34)	0.73	1.55 (0.28–8.55)	0.62
3	1.11 (0.55–2.23)	0.78	1.64 (0.28–9.60)	0.58
4 (highest)	1 [reference]	—	1 [reference]	—
Having a primary care physician	1.40 (0.90–2.18)	0.14	1.66 (0.60–4.62)	0.33
Seen by an asthma specialist in the past 12 mo	0.49 (0.28–0.86)	0.01	0.95 (0.26–3.46)	0.94
Ever intubated for asthma	0.91 (0.58–1.43)	0.69	0.88 (0.32–2.44)	0.80
Hospitalization for asthma in the past 12 mo	1.19 (0.79–1.79)	0.40	1.71 (0.67–4.36)	0.27
Current use of inhaled corticosteroids	0.63 (0.43–0.93)	0.02	1.31 (0.55–3.11)	0.54
Concomitant medical disorders	1.35 (0.92–1.99)	0.13	1.60 (0.68–3.74)	0.28

OR = odds ratio; CI = confidence interval.

*Mixed-effects models with binomial response by using random intercepts for hospitals to account for the clustering of patients within hospitals.

#Analyzed for 215 adults who were current smokers at the time of the index hospitalization.

asthma specialist care was small (11%). Interestingly, analysis of our data demonstrated that, although asthma specialist care was associated with a decreased risk of smoking, there was no significant association between having a primary care physician and a lower risk in either unadjusted or adjusted analyses. These findings reiterate the call for health care providers and policy makers to improve access to asthma specialists while also striving to optimize the quality of primary care for patients with uncontrolled asthma.¹⁹

Hospitalization is an opportune occasion to implement preventive efforts, especially when resource limitations affect care in the outpatient setting. However, we were struck with the suboptimal smoking cessation interventions in the inpatient setting. Furthermore, analysis of our data demonstrated that the population most likely to smoke (*i.e.*, patients with public health insurance or no health insurance) was also the population least likely to receive the inpatient smok-

ing cessation interventions. This disparity in preventive asthma care by insurance status is paralleled by previous studies that reported limited access to health care among adults without health insurance.^{19,20} The pathway through which insurance status affects smoking status and inpatient smoking cessation intervention is undoubtedly complex rather than directly causative. Analysis of our data revealed the provocative association and should facilitate further investigation to disentangle the observed relationship between insurance status and inpatient smoking cessation intervention.

The study had several potential limitations. First, we collected data through chart review. This could have led to errors in data measurement and collection; however, to minimize its impact, we rigorously trained chart reviewers at each site and used a previously applied standardized data collection system with uniform definitions. Second, we did not evaluate the re-

lapse rate in former smokers who recently quit and were more likely to relapse. Third, the quality and effectiveness of the smoking cessation intervention, which might be different across the sites, was not evaluated in this study. Fourth, as an observational study, the associations we observed might be confounded by unmeasured factors, for instance, interhospital practice variations. We addressed this concern, at least in part, by accounting for patient clustering within hospitals. Fifth, we did not collect information on certain smoking descriptors, such as pack/years; however, our classification of smoking status has been used in previous studies.^{16,17} Sixth, we conducted this study in urban teaching hospitals; as such, our findings may not be generalizable to other settings, *e.g.*, rural or community hospitals. Nevertheless, urban areas have disproportionately high asthma morbidity, and it is this population for which targeted preventive interventions need to be implemented.

CONCLUSION

In this multicenter study of 597 U.S. adults hospitalized for asthma exacerbation, we found a high prevalence of cigarette smoking (36%) and thereby suggest inadequacy of prevention-oriented chronic asthma care in this population. We also found that, despite the association of a previous evaluation by an asthma specialist with a decreased risk of smoking, many of the current smokers did not receive this guideline-recommended care. In addition, analysis of our data also demonstrated that only 55% of the smokers received inpatient smoking cessation interventions. For clinicians and policy makers, our observations not only underscored the importance of continued efforts to improve smoking cessation efforts at all clinical encounters (*i.e.*, ambulatory and inpatient settings) but indicated an urgent need to improve access to specialist care. Furthermore, the observed disparity in preventive care among those with public health insurance or no health insurance should encourage researchers to investigate the barriers to the delivery of the best preventive interventions in this high-risk asthma population.

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