

population may differ from our study. Limitations of our study also include true use of and adherence to SIE treatment, which can only be implied by the number of refill rates over time. These numbers do not account for frequency of symptoms or actual SIE use. Demographics may have also influenced adherence because older patients may have increased awareness of medical conditions with the convenience of filling their SIE with other medications. Our patient population, with a mean age of 66 years, may not be representative of the general population. In addition, the VA exclusively carries EpiPen with a copayment of \$8 to \$12, whereas the copayment in the community could be up to \$100; thus, we assume cost was not a factor in poor refill adherence. However, veterans do not have access to alternative available SIEs (ie, Adrenaclick, Auvi-Q), which may have size and usability advantages.

In conclusion, our study reports that refill rate adherence to SIE remains low and needs further investigation into reasons for non-adherence and actual use of SIE. Many issues remain unanswered. Further investigations should focus on causes and types of non-adherence. Factors that may influence adherence could include severity of patients' reactions, frequency of and comfort level in SIE use, and frequency of referral or discussion of immunotherapy for patients with venom allergy. We plan to address these questions in a follow-up patient survey study.

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Sex differences in hospital length of stay in children and adults hospitalized for asthma exacerbation

Asthma prevalence remains at historically high levels, affecting 26 million Americans in 2010.¹ The disease burden is uneven between women and men, with considerable differences in prevalence, chronic morbidity, and health care use (eg, higher risks of hospitalization).^{1–4} With regard to asthma hospitalizations, there are 372,000 annually in the United States.⁵ The limited literature on sex differences in acute morbidity among patients hospitalized for asthma exacerbation is conflicting, with hospital length of stay (LOS) among women found to be no different³ or longer than^{6,7} that among men. Despite the public health importance, there have been no recent efforts to examine sex differences in acute morbidity in this population at highest risk. To address this knowledge gap, we investigated sex differences in patient characteristics and hospital LOS in 1,000 children and adults hospitalized for asthma exacerbation.

This was a planned secondary analysis of a multicenter observational study of patients hospitalized for asthma exacerbation, the 37th Multicenter Airway Research Collaboration (MARC-37) study. The design, setting, and methods of data collection used in MARC-37 have been reported previously.^{8,9} Briefly, we conducted this chart review study at 25 hospitals across 18 states in the United States

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(eTable 1); we recruited the hospitals by primarily inviting sites that had participated in the University HealthSystem Consortium Asthma Clinical Benchmarking Project.³ Using a principal discharge diagnosis of asthma, we identified all hospitalizations for asthma exacerbation during 2012 through 2013 in children (2–17 years old) and adults (18–54 years old) with a history of physician-diagnosed asthma. Chart abstractors reviewed randomly selected medical records of 40 patients after training (lecture, practice charts, and certification). Using a standardized form, investigators abstracted data, including patients' demographics, markers of chronic asthma (eg, asthma history, medications), acute asthma presentation (eg, vital signs), in-hospital asthma management, and hospital course. The institutional review board of each participating hospital approved the study.

To investigate the adjusted association of a patient's sex with hospital LOS, we constructed negative binomial models adjusting for age, race or ethnicity, health insurance, estimated household income, hospitalization for asthma in the preceding year, current use of oral and inhaled corticosteroids, respiratory rate, oxygen saturation and peak expiratory flow (for adults) at presentation, and comorbidities. We also used a generalized estimating equation to account for patient clustering within hospitals. The negative binomial model has advantages in that there is no need to define arbitrary cutoff points of the LOS and the model appropriately accounts for statistical over-dispersion. All analyses were performed with SAS 9.4 (SAS Institute, Cary, North Carolina).

In MARC-37, we enrolled 1,000 patients hospitalized for asthma exacerbation from 25 hospitals. Of 385 children, 145 (38%) were girls and 240 (62%) were boys. Of 615 adults, 392 (64%) were

Table 1
Patient characteristics and in-hospital management of patients hospitalized for asthma exacerbation, according to age group and sex^a

Patient characteristics	Children (2–17 y old)		P value	Adults (18–54 y old)		P value
	Female (n = 145, 38%)	Male (n = 240, 62%)		Female (n = 392, 64%)	Male (n = 223, 36%)	
Demographics						
Age (y)			.74			.63
2–4	53 (37)	93 (39)		—	—	—
5–11	70 (48)	117 (49)		—	—	—
12–17	22 (15)	30 (13)		—	—	—
18–29	—	—	—	87 (22)	57 (26)	—
30–39	—	—	—	121 (31)	65 (29)	—
40–54	—	—	—	184 (47)	101 (45)	—
Race or ethnicity ^b			.55			.78
Non-Hispanic white	50 (35)	76 (32)		90 (23)	48 (22)	
Non-Hispanic black	61 (42)	99 (41)		203 (52)	124 (56)	
Hispanic ethnicity	25 (17)	43 (18)		60 (15)	34 (15)	
Others	4 (3)	14 (6)		12 (3)	10 (5)	
Health insurance ^b			.47			<.001
Private	51 (35)	93 (39)		106 (27)	46 (21)	
Public	80 (55)	125 (52)		180 (46)	76 (34)	
No insurance	4 (3)	12 (5)		82 (21)	84 (38)	
Estimated median household income (US\$), median (IQR)	41,100 (33,277–53,827)	41,252 (33,277–55,900)	.47	39,614 (30,572–51,698)	40,119 (30,572–52,987)	.62
Having primary care physician	137 (95)	227 (95)	.32	285 (73)	116 (52)	<.001
Seen by asthma specialist in past 12 mo	36 (25)	64 (27)	.58	76 (19)	20 (9)	.001
Chronic asthma factors						
Current smoker	2 (1)	0 (0)	.14	134 (34)	81 (36)	.59
Exposure to passive smoke in home	45 (31)	57 (24)	.13	47 (12)	24 (11)	.53
Ever intubated for asthma	2 (1)	12 (5)	.09	105 (27)	51 (23)	.28
ED visit for asthma in past 12 mo	67 (46)	123 (51)	.61	222 (57)	118 (53)	.44
Hospitalization for asthma in past 12 mo	52 (36)	82 (34)	.50	154 (39)	78 (35)	.39
Current asthma medications						
Current use of oral corticosteroids	32 (22)	55 (23)	.85	123 (31)	57 (26)	.12
Current use of ICS	77 (53)	146 (61)	.14	226 (58)	104 (47)	.008
Current use of ICS and/or LABA	24 (17)	39 (16)	.94	169 (43)	66 (30)	.002
Current use of leukotriene modifiers	32 (22)	63 (26)	.38	87 (22)	31 (14)	.02
Presentation and ED or clinic course						
Duration of symptoms ≤24 h	41 (28)	59 (25)	.42	93 (24)	72 (32)	.01
Vital signs						
Initial respiratory rate (breaths/min), median (IQR)	32 (27–44)	32 (26–44)	.68	24 (20–28)	22 (20–27)	.27
Initial oxygen saturation (%), median (IQR)	93 (90–96)	94 (91–96)	.21	97 (90–93)	94 (90–97)	<.001
Initial PEF (L/min)^c, median (IQR)						
Mild	—	—	—	14 (11)	4 (6)	.63
Moderate	—	—	—	40 (31)	19 (29)	
Severe	—	—	—	53 (41)	28 (42)	
Very severe	—	—	—	22 (17)	15 (23)	
Concomitant medical disorders ^d	28 (19)	52 (22)	.57	120 (31)	64 (29)	.64
Acute asthma treatment						
Systemic corticosteroids	127 (88)	219 (91)	.39	344 (88)	204 (92)	.27
Inhaled anticholinergics	92 (63)	163 (68)	.37	248 (63)	156 (70)	.09
Noninvasive positive pressure ventilation	0 (0)	8 (3)	.03	32 (8)	17 (8)	.88
Intubation	2 (1)	1 (<1)	.27	14 (4)	5 (2)	.47
Inpatient course						
Initial admission location						
ED observation unit	1 (1)	7 (3)	.32	72 (18)	41 (18)	.98
Hospital ward	92 (63)	158 (66)		241 (62)	133 (60)	
Stepdown unit	5 (3)	11 (5)		24 (6)	15 (7)	
ICU	47 (32)	64 (27)		55 (14)	34 (15)	
Acute asthma treatment						
Systemic corticosteroids	141 (97)	232 (97)	.99	371 (95)	210 (94)	.81
Noninvasive positive pressure ventilation	6 (4)	6 (3)	.38	18 (5)	11 (5)	.85
Intubation	2 (1)	1 (<1)	.56	18 (5)	10 (5)	.95
Hospital LOS (d), median (IQR)	2 (2–3)	2 (1–3)	.001	2 (1–4)	2 (0–3)	.12 ^e
Disposition						
Sent home	145 (100)	240 (100)	—	380 (97)	209 (94)	.09
Died in hospital	0 (0)	0 (0)		2 (1)	2 (1)	
Other (transfer to another facility, left against medical advice)	0 (0)	0 (0)		8 (2)	12 (5)	

Abbreviations: ED, emergency department; ICS, inhaled corticosteroid; ICU, intensive care unit; IQR, interquartile range; LABA, long-acting β -agonist; LOS, length of stay; PEF, peak expiratory flow.

^aData are presented as number (percentage) unless otherwise indicated.

^bPercentages are not equal to 100 because of missing data.

^cAnalyzed for 195 adults with initial PEF values available. Severity of asthma exacerbation was classified according to the initial PEF at presentation as follows: mild, at least 400 L/min for men and at least 300 L/min for women; moderate, 250 to 399 L/min for men and 200 to 299 L/min for women; severe, 150 to 249 L/min for men and 120 to 199 L/min for women; and very severe, lower than 150 L/min for men and lower than 120 L/min for women.

^dDefined by pneumonia, congestive heart failure, pneumothorax, arrhythmia, and others.

^eBy Mann-Whitney *U* test.

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