

Factors associated with concordance with the non-level-A guideline recommendations for emergency department patients with acute asthma

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Clinical Implications

- This multicenter observational study of acute asthma management demonstrated significant associations between having an emergency department clinical pathway on acute asthma and higher concordance with non-level-A guideline recommendations. These findings underscore the importance of knowledge translation initiatives.

TO THE EDITOR:

Acute asthma remains a significant public health problem, which accounts for 1.8 million emergency department (ED) visits annually.¹ To improve asthma care, the National Institutes of Health (NIH) have published asthma management guidelines with goals of translating research findings into clinical practice.² In *Health People 2020*, the federal government also outlined a key objective: to improve the quality of asthma care by providing guideline-concordant care.³ However, we recently found that concordance with the non-level-A guideline recommendations about ED asthma care (eg, peak expiratory flow [PEF] measurement, timeliness measures) decreased between 1997 and 2012, whereas that with the level-A recommendations increased.⁴ To further improve the quality of ED asthma care, barriers to the delivery of guideline-concordant care remain to be elucidated. In this context, using data from a 48-center observational study of emergency asthma care, we investigated the ED-level factors associated with concordance with the non-level-A recommendations in the NIH guidelines.²

We performed a multicenter chart review study to characterize adult ED patients with acute asthma, as part of the Multicenter Airway Research Collaboration (MARC). The study setting, participants, methods of measurement, and measured variables have been reported previously.⁴ Briefly, we recruited 48 academic and community EDs across 23 US states (see Table E1 in this article's Online Repository at www.jaci-inpractice.org). Using a primary discharge diagnosis of asthma, we identified all ED visits made by adults aged 18 to 54 years and the history of physician-diagnosed asthma in 2011-2012. Onsite chart abstractors reviewed randomly selected 40 ED charts after completing training (lecture, practice charts, and certification). In the case of repeated visits, we included only the first randomly sampled ED visit and defined it as the index ED visit. Using a standardized form, investigators abstracted data, including patients' demographics, past asthma history, presentation, and asthma management in the ED. Additionally, a site survey was conducted at

each ED to collect ED-level characteristics—eg, US region, annual number of ED visits, affiliation with a residency program, and presence of an ED clinical pathway on management of acute asthma. The institutional review board of each participating center approved the study.

Outcome measures were patient- and ED-level guideline concordance with 4 non-level-A recommendations in the 2007 NIH asthma guidelines, based on the previous study (Table I).⁴ First, we summarized these evidence-based process measures by using a single patient composite concordance score. The patient composite concordance score was computed by summing the guideline-concordant care measures for each patient, dividing this sum by the patient's total number of eligible opportunities, and then multiplying by 100.⁴ Scores ranged from 0 to 100, with a score of 100 indicating perfect guideline concordance. Next, these scores were averaged across patients at the ED level to obtain ED composite scores. Analyses were performed using SAS 9.4 (SAS Institute, Cary, NC). To examine ED-level predictors of composite concordance with the non-level-A recommendations, we fit a hierarchical linear model adjusting for 8 patient-level factors (ie, age, sex, race and/or ethnicity, ED visits for acute asthma in the previous year, current use of inhaled corticosteroids, respiratory rate, oxygen saturation, and initial PEF at ED presentation) and potential patient clustering within EDs (ie, patient-level concordance scores within a site may not be independent).

The analytic cohort comprised 1920 adult patients with acute asthma who presented to one of the 48 EDs. The median age of the patients was 34 years, and 59% of them were women. EDs had a median of 77,217 annual visits and a median of 689 annual visits for acute asthma (see Table E2 in this article's Online Repository at www.jaci-inpractice.org). Approximately half of the EDs had a clinical pathway on acute asthma management.

At the patient level, composite concordance with non-level-A recommendations was suboptimal with a median score of 50 (interquartile range, 33-75; see Table E3 in this article's Online Repository at www.jaci-inpractice.org). This finding was driven by low concordance with assessment of PEF, initial PEF within 30 minutes of ED arrival, and administration of systemic corticosteroids within 75 minutes of arrival (all <70%). Likewise, at the ED level, composite concordance was suboptimal with a mean score of 50 (SD, 16; see Figure E1 in this article's Online Repository at www.jaci-inpractice.org). The concordance varied considerably across the EDs; the worst-performing ED scored 16, whereas the best-performing ED scored 82. In the hierarchical model (Table II), EDs with a clinical pathway on acute asthma management were more likely to deliver guideline-concordant care (β -coefficient, 5.4; 95% CI, 1.1 to 9.7; $P < .001$). By contrast, southern and western EDs and those with higher patient volume were less likely to deliver guideline-concordant care (all $P < .05$).

In this multicenter study of 1920 patients with acute asthma, we found substantial variability in concordance with the non-level-A guideline recommendations across the 48 EDs. Although our previous studies identified suboptimal concordance with these recommendations,⁴⁻⁶ this is the first to identify its predictors. For example, higher ED volume was associated with lower guideline concordance, whereas the presence of an ED

TABLE I. Description of guideline-recommended care (non-level-A evidence)

Measure	Numerator	Denominator	Level of evidence according to the 2007 NIH guidelines
Process measure			
Assessment of airflow limitation	At least 1 PEF measured in ED	Patients presenting to the ED with an asthma exacerbation. Exclusion: respiratory extremis (oxygen saturation <90% or RR ≥ 30)	B
Assessment of airflow limitation	Initial PEF checked within 30 min of arrival	Patients who presented to the ED with an asthma exacerbation and have at least 1 PEF measured. Exclusion: respiratory extremis (oxygen saturation <90% or RR ≥ 30)	B
Treatment with inhaled β-agonists in ED	Inhaled β-agonists given within 60 min of arrival	Patients who present to the ED with an asthma exacerbation and are given β-agonists	n/a
Treatment with systemic corticosteroids in ED	Systemic corticosteroids given within 75 min of ED arrival	ED asthmatic patients who meet the criteria to receive systemic corticosteroids (see above)	n/a

ED, Emergency department; ICU, intensive care unit; NIH, National Institutes of Health; PEF, peak expiratory flow; RR, respiratory rate.
n/a: level of evidence not assigned.

TABLE II. Multivariable model of composite guideline concordance with non-level-A recommendations at the patient level

ED characteristics	β-coefficient in concordance score (95% CI)	P-value
Census region		
Northeast	Reference	
Midwest	−4.6 (−12.3 to 3.1)	.24
South	−14.8 (−6.7 to −22.9)	<.001
West	−17.9 (−10.1 to −25.6)	<.001
No. of ED visits per year		
≤24,999 visits	Reference	
25,000-49,999 visits	5.3 (−11.2 to 0.6)	.78
50,000-74,999 visits	−7.5 (−1.8 to −13.2)	.01
≥75,000 visits	−5.7 (−0.4 to −11.1)	.03
Quartiles for ED visits for asthma per year*		
≤429 visits (lowest quartile)	Reference	
430-688 visits	7.6 (1.8 to 13.5)	.01
689-1547 visits	5.2 (0.004 to 10.4)	.049
≥1548 visits (highest quartile)	4.1 (−1.9 to 10.2)	.18
Affiliated with asthma center	0.6 (−4.4 to 5.5)	.83
Has ED clinical pathway on how to manage acute asthma	5.4 (1.1 to 9.7)	.01
Has asthma rooms	2.2 (−10.0 to 5.7)	.59
Has standardized form for recording patients with asthma	−7.0 (−14.1 to 0.04)	.05
Has standardized form for ordering asthma treatment	−1.3 (−5.5 to 3.0)	.57
Has protocol-based asthma education program	0.6 (−7.9 to 9.0)	.89

CI, Confidence interval; ED, emergency department.

Hierarchical linear model adjusted for 8 patient-level factors (ie, age, sex, race and/or ethnicity, ED visits for asthma exacerbation in the previous year, current use of inhaled corticosteroids, respiratory rate, oxygen saturation, and initial peak expiratory flow at ED presentation).

Bold results are statistically significant.

*Categorized the annual number of ED visits with asthma into quartiles.

clinical pathway on acute asthma, a modifiable factor, was associated with higher concordance.

Our data corroborate and build on previous reports about the association between ED patient volume and quality of asthma care, a finding of clinical and research importance. It is plausible that ED crowding in the high-volume EDs might have contributed to suboptimal performance in the quality measures, particularly in timeliness measures.^{7,8} Interestingly, we found that several measures (eg, an asthma room or standardized form for ordering asthma treatment) were not associated with guideline concordance in the ED. By contrast, the observed association between having an ED clinical pathway and guideline-concordant care is encouraging and suggests the importance of integrated knowledge translation initiatives.⁹

Our study has several potential limitations. First, the study relied on chart review for quality measure assessment; therefore, some of the apparent care gaps might be owing to underdocumentation. However, a previous study showed high agreement in ED asthma care between chart review and direct observation.¹⁰ Second, the observed associations between EDs with clinical pathways and better guideline-concordance might be confounded by unmeasured factors (eg, individual provider experience). Third, our sample consisted predominantly of adult patients in urban EDs. Our inferences, therefore, may not be generalizable to children or rural EDs, in which guideline concordance might be substantially different from our participating EDs. Finally, because 47 of the 48 EDs in our study were academic EDs (see Table E2 in this article's Online Repository at www.jaci-inpractice.org), our findings might not generalize to community EDs that are not affiliated with an emergency medicine residency program.

In sum, this large study of patients with acute asthma demonstrated substantial variability in concordance with the non-level-A guidelines across 48 EDs, and thereby suggests areas for future quality improvement efforts. For researchers, considering the recent finding—ie, the successful implantation of the level-A recommendations in the EDs,⁴ our data should facilitate further investigation to build more robust evidence on the non-level-A recommendations, coupled with dissemination of these findings.

We also found associations of higher ED volume with lower guideline concordance, and evidence that having an ED clinical pathway may improve concordance. For clinicians and policy makers, our observations underscore the importance of knowledge translation initiatives (eg, implementations of clinical pathways) to bridge the identified gaps in emergency asthma care.

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TABLE E1. Site investigators at the 48 participating sites in the 36th Multicenter Airway Research Collaboration

Akron City Hospital	Kirk A. Stiffler, MD, MPH
Albert Einstein Medical Center	Stewart O. Sanford, MD
Allegheny General Hospital	Arvind Venkat, MD
Baystate Medical Center	Howard A. Smithline, MD, MS
Ben Taub General Hospital	Michael G. Gonzalez, MD
Beth Israel Deaconess Medical Center	Nathan Shapiro, MD
Brigham and Women's Hospital	Daniel J. Pallin, MD, MPH
Brooklyn Hospital Center	Mark J. Leber, MD, MPH
Buffalo General Hospital	Jeanne M. Basior, MD
Carolinas Medical Center	D. Matthew Sullivan, MD
Christiana Hospital	John T. Powell, MD
Cooper Medical School of Rowan University	Brigitte M. Baumann, MD, MSCE
Detroit Receiving Hospital	Claire Pearson, MD, MPH
East Carolina University, Vidant Medical Center	John E. Gough, MD
Hartford Hospital	Michael J. Drescher, MD
Hennepin County Medical Center	Richard O. Gray, MD
Henry Ford Hospital	Richard M. Nowak, MD, MBA
John H. Stroger Jr Hospital of Cook County	Rashid F. Kysia, MD, MPH
Lincoln Medical And Mental Health Center	Muhammad Waseem, MD, MS
Long Island Jewish Medical Center	Robert A. Silverman, MD
Maricopa Medical Center	Frank LoVecchio, MD
Massachusetts General Hospital	Eva Tovar Hirashima, MD, MPH
Mercy Hospital of Philadelphia	Patrick Shen, MD
MetroHealth Medical Center	Rita K. Cydulka, MD, MS
Mount Sinai St. Luke's and Mount Sinai Roosevelt Hospitals	Daniel J. Egan, MD
New York Methodist Hospital	Theodore J. Gaeta, DO, MPH
New York Presbyterian Hospital/Weill Cornell Medical Center	Sunday Clark, ScD, MPH
Newark Beth Israel Medical Center	Eric J. Wasserman, MD
Oregon Health & Science University Hospital	Stephanie Nonas, MD
Palmetto Health Richland	Joseph S. Myslinski, MD
Sentara Norfolk General Hospital	Francis L. Counselman, MD
Shands Hospital at the University of Florida	J. Adrian Tyndall, MD, MPH
St. Barnabas Hospital	Blanca Grand, DO
Stanford University Medical Center	Nancy E. Wang, MD
Temple University Hospital	Megan Healy, MD
Thomas Jefferson University Hospital	Bernard L. Lopez, MD, MS
Truman Medical Center Hospital	P. Charles Inboriboon, MD, MPH
University of Arkansas for Medical Sciences	Talmage M. Holmes, PhD, MPH
University of California Davis Medical Center	Suzanne S. Teuber, MD
University of California Irvine Medical Center	Mark I. Langdorf, MD, MHPE
University of California San Diego Medical Center	Brian Snyder, MD
University of California San Francisco Medical Center	Christopher Fee, MD

(continued)

TABLE E1. (Continued)

University of Maryland Medical Center	Rose M. Chasm, MD
University of Oklahoma School of Community Medicine—Hillcrest Medical Center	Annette O. Arthur, PharmD
University of New Mexico Health Sciences Center	Cameron Crandall, MD, PhD
University of Texas Health Science Center at San Antonio	Dan Mosely, MD
University of Texas Southwestern Medical Center—Parkland Memorial Hospital	Ava E. Pierce, MD
York Hospital	Ronald S. Benenson, MD

TABLE E2. Patient and emergency department characteristics

Characteristics	
Patient characteristics	n = 1920
Demographics	
Age (y), median (IQR)	34 (25-45)
Female sex	1140 (59)
Race/ethnicity*	
Non-Hispanic white	360 (19)
Non-Hispanic black	985 (51)
Hispanic ethnicity	364 (19)
Asian	27 (1)
Others	37 (2)
Having primary care physician	1114 (58)
Health insurance*	
Private	592 (31)
Public	743 (39)
No insurance	514 (27)
Median household income estimated from ZIP code (IQR)	35,445 (26,949-49,878)
Current smoker	627 (33)
Chronic asthma factors	
Admitted for asthma in past year	283 (15)
ED visit for asthma in past year	830 (43)
Ever intubated for asthma	230 (12)
Current use of oral corticosteroids	239 (12)
Current use of inhaled corticosteroids	672 (35)
Current use of long-acting β -agonist	470 (24)
Current use of leukotriene modifiers	208 (11)
Duration of symptoms*	
≤ 3 h before ED arrival	188 (10)
> 3 h	1607 (84)
ED presentations	
Initial respiratory rate (breaths/min), median (IQR)	20 (18-22)
Initial oxygen saturation (%), median (IQR)	98 (96-99)
Severity based on initial PEF†	
Mild	159 (20)
Moderate	312 (40)
Severe	240 (31)
Very severe	73 (9)

(continued)

TABLE E2. (Continued)

Characteristics	
Concomitant medical disorder [‡]	266 (14)
ED length of stay (min), mean (SD)	244 (200)
ED disposition	
Sent home	1570 (82)
Admission (hospital ward/observation unit)	284 (15)
ICU admission	31 (2)
Other (eg, left against medical advice)	31 (2)
ED characteristics n = 48	
Census region	
Northeast	18 (38)
Midwest	7 (15)
South	11 (23)
West	12 (25)
No. of ED visits per year, median (IQR)	77,217 (52,957-99,428)
No. of ED visits for asthma per year, median (IQR)	689 (430-1548)
Affiliated with emergency medicine residency program	47 (98)
Location	
Metropolitan	48 (100)
Nonmetropolitan	0 (0)
Affiliated with asthma center	22 (46)
Has ED clinical pathway on how to manage acute asthma	22 (46)
Has asthma rooms	9 (19)
Has standardized form for recording patients with asthma	19 (40)
Has standardized form for ordering asthma treatment	24 (50)
Has protocol-based asthma education program	6 (13)

ED, Emergency department; ICU, intensive care unit; IQR, interquartile range; PEF, peak expiratory flow; SD, standard deviation.

Data were expressed as n (%) unless otherwise indicated.

*Percentages are not equal 100 because of missing data.

[‡]Analyzed for 784 patients with initial PEF available.

[‡]Including pneumonia, pneumothorax, congestive heart failure, arrhythmia, otitis, sinusitis, and others.

TABLE E3. Performance on quality measures at the patient and emergency department level

Quality measure	Percentage of recommended care patient received (95% CI)	Mean ED performance (SD)
Process of care		
Assessment of PEF	47 (45-49)	47 (32)
Initial PEF $\leq$ 30 min of arrival	35 (32-38)	32 (23)
Inhaled β -agonists $\leq$ 60 min of arrival	73 (71-74)	73 (18)
Systemic corticosteroid $\leq$ 75 min of arrival	44 (41-47)	42 (20)
Composite score (non-level-A evidence)	Patient level, median (IQR) 50 (33-75)	ED level, mean (SD) 50 (16)

CI, Confidence interval; ED, emergency department; IQR, interquartile range; PEF, peak expiratory flow; SD, standard deviation.

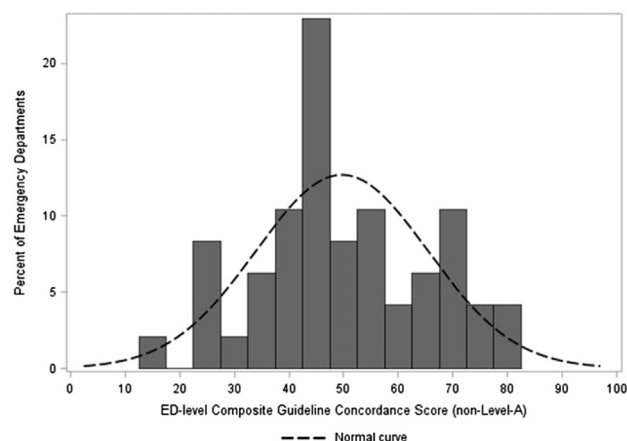


FIGURE E1. Distribution of the composite guideline concordance score at the emergency department level. The superimposed curve represents the normal curve based on the sample mean and standard deviation.

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