
Impact of positive and negative beliefs about inhaled corticosteroids on adherence in inner-city asthmatic patients

Diego Ponieman, MD*; Juan P. Wisnivesky, MD, MPH*; Howard Leventhal, PhD†‡; Tamara J. Musumeci-Szabó, PhD†; and Ethan A. Halm, MD, MPH§

Background: Daily inhaled corticosteroid (ICS) use is the cornerstone of asthma management, although it is often suboptimal, especially in inner-city populations.

Objective: To assess the impact of potentially modifiable medication beliefs on adherence with ICS therapy across time.

Methods: Asthma history, medication beliefs, and ICS therapy adherence were determined in a prospective, observational cohort. Medication beliefs were based on self-regulation and self-efficacy theory. Self-reported adherence with ICS therapy was assessed using the Medication Adherence Reporting Scale, a validated 10-item instrument, at baseline and at 1 and 3 months. Repeated-measures multivariable regression identified beliefs independently associated with adherence across time after adjusting for age, sex, race, and asthma severity.

Results: The 261 patients were low-income minorities with high rates of asthma hospitalization, emergency department visits, intubation, and oral corticosteroid use. Adherence with ICS therapy was stable across time, with 70% of patients saying that they used ICS all or most of the time when asymptomatic. Most patients (82%) thought it was important to use ICS when asymptomatic, although 49% worried about side effects and 37% worried about becoming addicted. Although 82% felt confident in using ICS, 7% felt that their regimen was hard to follow. In multivariable analyses, the odds of adherence increased for those who felt that using ICS when asymptomatic was important (odds ratio [OR], 4.15) and for those who were confident in using ICS (OR, 2.23) and decreased by worries about side effects (OR, 0.52) or feeling the regimen was hard to follow (OR, 0.48).

Conclusions: Several positive and negative beliefs about ICS were associated with adherence. Eliciting and addressing these potentially modifiable beliefs may help improve adherence and outcomes.

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INTRODUCTION

Daily use of inhaled corticosteroids (ICS) is the cornerstone of the evidence-based management of persistent asthma.¹ However, despite strong evidence supporting their efficacy and consensus guidelines advocating their use, asthma remains poorly controlled in many patients, particularly in minorities in inner-city communities.^{2–4}

Medications work only if they are taken, and suboptimal adherence is widespread. There is a large literature showing rates of adherence with ICS therapy in adults with chronic asthma ranging from 30% to 80% across a broad spectrum of studies and settings.^{5–10} Minority patients tend to have lower

rates of adherence with ICS therapy, even those with regular providers and insurance coverage for drugs,^{7–9,11–13} and these lower rates of medication use are believed to partly explain disparities in asthma outcomes in socially disadvantaged groups.^{2–4,9}

There is growing theoretical and empirical support for the notion that an individual's understanding of his or her disease and its treatment may be an important mediator of key health behaviors, such as medication use. Understanding the impact of beliefs about ICS is important for several reasons. First, it promises to yield insights into the cognitive and behavioral mechanisms through which prescribed, dispensed ICS are not used regularly. Second, attitudes about ICS should be potentially modifiable. Third, highlighting key misconceptions or concerns about medications could help physicians identify specific health messages to concentrate on when counseling patients or designing future asthma education programs.

Self-regulation theory posits that patients consider both the pros and the cons of taking medications and that 2 main domains of attitudes about drugs influence adherence: (1) beliefs about the “necessity” or importance of the therapy and (2) “concerns” about therapy (worries about side effects and addiction).^{14,15} This necessity-concern framework has been shown to explain medication adherence in several chronic diseases, including asthma.^{15–17} Several other constructs that

Affiliations: * Division of General Internal Medicine, Mount Sinai School of Medicine, New York, New York; † Institute for Health, Health Care Policy and Aging Research, Rutgers University, New Brunswick, NJ; ‡ Department of Psychology, Rutgers University, New Brunswick, New Jersey; § Departments of Internal Medicine and Clinical Sciences, University of Texas Southwestern Medical Center, Dallas, Texas.

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have been associated with medication adherence in other diseases include self-efficacy and regimen complexity.^{18–20}

The aims of this study were to (1) characterize a broad spectrum of beliefs about ICS that might affect adherence, including necessity, concerns, self-efficacy, and regimen complexity, and (2) identify key medication beliefs independently associated with adherence to ICS therapy controlling for other predictors of adherence.

METHODS

Study Sites, Participants, and Data Collection

We used data from a multisite, prospective, observational cohort study of minority adults with persistent asthma that has been previously described.²¹ Adults with a physician diagnosis of persistent asthma were recruited from the general internal medicine clinics of Mount Sinai Hospital in East Harlem, New York, New York, and Robert Wood Johnson Medical Center, New Brunswick, New Jersey. Patients were excluded if they had a smoking history of at least 10 pack-years or chronic obstructive lung disease. For the present study, patients needed to have been prescribed ICS. Bilingual, bicultural research staff interviewed patients in English or Spanish at baseline and at 1 and 3 months. Data collection included sociodemographics, asthma history, comorbidities, medication beliefs, and adherence with ICS therapy. The institutional review boards of both sites approved the study.

Primary Outcome: Self-reported Medication Adherence

Adherence with ICS therapy was measured at baseline and at 1 and 3 months using the Medication Adherence Reporting Scale (MARS). The MARS is a previously validated 10-item questionnaire shown to have good internal, construct, and criterion validity in English and Spanish, including correlations with objective measures of adherence (electronic monitoring and pharmacy dispensing data).^{10,15,17} The MARS contains items that measure intentional (“I avoid using it if I can”) and unintentional (“I forget to use it”) nonadherence,^{22,23} and these questions are phrased such that nonadherence is considered common to minimize social desirability bias. Medication use is rated on a 5-point Likert scale (1 = always to 5 = never). Cronbach α for the MARS in this sample was .86.

Predictors of Adherence: Medication Beliefs

At baseline, we ascertained a variety of beliefs about ICS based on Leventhal’s self-regulation theory²⁴ and Horne’s necessity/concern framework using items from previously published studies.^{15,17} Beliefs about the necessity of ICS therapy included questions about how important patients felt it was to use their ICS when symptomatic and asymptomatic. Concerns about ICS therapy included how much patients worried about side effects, about becoming addicted to ICS, and about whether ICS would stop working if used all the time. We also asked a standard general self-efficacy question about control over their future health and a drug-specific self-efficacy item about confidence in using ICS as pre-

scribed. The regimen complexity item asked about how hard it was for patients to follow their asthma regimen. All belief items had Likert scale responses.

Statistical Analysis

Means, standard deviations, and frequencies are presented to describe patient characteristics, ICS adherence, and medication beliefs. We used odds ratios (ORs) to examine univariate associations between medication beliefs and good adherence with ICS therapy at all 3 periods. “Good” self-reported adherence was defined as a mean MARS score of 4.5 or greater, the 50th percentile score, which was equivalent to being adherent with ICS therapy at least 80% of the time in the electronic adherence substudy.¹⁰ We obtained similar results when good adherence was defined as a 75th percentile MARS score. We performed multivariable logistic regression to identify independent predictors of good adherence across time using generalized estimating equations to analyze good adherence as a repeated measure. The final multivariable model adjusted for age, sex, race, and asthma severity (previous intubation and frequency of oral corticosteroid use). All statistical tests were performed using a software program (SAS 9.0; SAS Institute Inc, Cary, North Carolina) using 2-tailed tests for significance at the $P = .05$ level.

RESULTS

Patient Participation and Response Rates

Two hundred sixty-one of the overall cohort of 318 patients (82.1%) were prescribed daily ICS. We completed the 1-month follow-up survey on medication use with 259 patients (99.2%) and the 3-month interview with 201 (77.0%). Characteristics of the 261 participants are given in Table 1. The mean patient age was 48 years (range, 20–87 years), 82% were women, 57% were Hispanic, 30% were black, and 20% completed the survey in Spanish. Asthma morbidity was significant, with 12% reporting a history of intubation, 57% having been hospitalized for asthma, and 77% having taken oral corticosteroids.

Adherence With ICS Therapy

Self-reported adherence with ICS use was stable across time, with a mean MARS score of 4.3 at baseline and at 1 and 3 months (range, 1–5, with higher values indicating better adherence). Adherence patterns were also steady across time when judged by the proportion of patients saying that they used their ICS all or most of the time when asymptomatic (70% at baseline, 69% at 1 month, and 70% at 3 months).

Medication Beliefs

Most patients believed that it was important to use their ICS, although somewhat more felt that ICS were important to use when they were having symptoms (88%) compared with when they were asymptomatic (82%, $P = .06$) (Table 2). Concerns about ICS were high. Half of all participants (49%) worried about the side effects of ICS therapy, and one-third (37%) worried about becoming addicted to ICS or thought that ICS would stop working if they used them all the time

Table 1. Demographic and Clinical Characteristics of 261 Asthmatic Patients

Characteristic	Value
Age, mean (SD), y	48 (13)
Female sex, %	82
Ethnicity, %	
Hispanic	57
Black	30
White	13
Insurance status, %	
Medicaid (with or without Medicare)	66
Medicare alone	18
Commercial insurance	14
Uninsured	2
Income <\$30,000/y, %	64
Education level < high school, %	39
Asthma history, %	
Age of onset ≤20 y	50
Ever intubated	12
Ever taken oral corticosteroids	77
Ever hospitalized for asthma	57
Asthma ED visit in past year	56
Comorbid conditions, %	
Allergic rhinitis	65
Hypertension	49
GERD	38
Diabetes mellitus	26
Congestive heart failure	5

Abbreviations: ED, emergency department; GERD, gastroesophageal reflux disease.

Table 2. Beliefs About Inhaled Corticosteroids (ICS)

Medication belief domains and items	Percentage
Necessity	
Important to use ICS when symptomatic	88
Important to use ICS when asymptomatic	82
Concerns	
Worried about side effects of ICS	49
Worried about getting addicted to ICS	37
If use ICS all the time they will stop working	32
Self-efficacy	
Confident in ability to use ICS as prescribed	82
Confident in ability to control asthma	57
Confident can control future health	75
Regimen complexity	
ICS regimen was hard to follow	7

(32%). Most patients (82%) felt confident in their ability to use their ICS as prescribed. Conversely, few patients (7%) felt that their ICS regimen was hard to follow.

Associations Between Medication Beliefs and Adherence

Several different medication beliefs were univariate predictors of adherence with ICS therapy at all 3 intervals (Table 3). Believing it was important to use ICS when asymptomatic was the strongest individual predictor of regular medication use (OR, 2.6–7.6). Beliefs about the importance of using ICS

when symptomatic were not associated with adherence ($P < .05$ for all times). Feeling confident in the ability to use ICS as prescribed tripled the odds of adherence at all 3 intervals (OR, 2.4–3.5). Conversely, 2 concerns about ICS, worries about side effects and addiction, markedly lowered the chances of adherence, as did believing that the medication regimen was hard to follow.

The final multivariable, repeated-measures regression model found that 4 medication beliefs were independently associated with adherence with ICS use after adjusting for age, sex, race, and asthma severity. Believing it was important to use ICS when asymptomatic quadrupled the risk-adjusted odds of adherence (OR, 4.15; 95% confidence interval [CI], 2.54–6.77; $P < .001$), and being confident in the ability to use ICS as prescribed doubled these odds (OR, 2.23; 95% CI, 1.42–3.52; $P < .001$). Worries about side effects (OR, 0.52; 95% CI, 0.36–0.74; $P < .001$) and feeling that it was hard to follow the regimen (OR, 0.48; 95% CI, 0.23–0.99; $P = .04$) halved the risk-adjusted odds of adherence.

DISCUSSION

This prospective, multisite, inner-city asthma cohort study sought to understand the impact of a broad spectrum of medication beliefs on the use of ICS—the cornerstone of evidence-based asthma care. In a group of predominantly minority, low-income patients with high asthma morbidity who all had a usual ambulatory provider, the rate of prescription of ICS was 88%. This rate is higher than that in many studies,^{5–9} but it still reflects underuse of anti-inflammatory therapy in high-risk asthmatic patients. Of those prescribed ICS, 70% reported using their ICS all or most of the time when asymptomatic. These rates of adherence are on the higher end of what is reported in similar populations, although still lower than desirable to achieve optimal control.^{5–9,13}

We found that several different theory-based domains of medication beliefs were independently associated with adherence with ICS therapy across time even after adjusting for other factors known to affect ICS use. The self-regulation constructs of medication necessity and concerns had an impact on medication-taking behavior. The positive belief of saying it was important to use ICS when asymptomatic was the single strongest predictor, quadrupling the odds of adherence. Such conviction suggests that a patient truly understands and accepts the rationale for daily anti-inflammatory therapy. Being worried about the side effects of ICS therapy halved the odds of adherence, indicating that negative attitudes toward these medications also have a strong effect on behavior. This confirms the findings of 2 studies of asthmatic patients in England¹⁵ and the Netherlands¹⁷ that also found that necessity and concern beliefs about ICS were correlated with self-reported and pharmacy-dispensing–based measures of adherence and extends them in 2 areas. First, we show that positive and negative attitudes about ICS are very prevalent and predictive of ICS adherence in high-morbidity minority patients in 2 inner-city communities in the United States.

Table 3. Univariate Associations Between Medication Beliefs and Adherence With ICS Therapy

Medication belief domains and items	OR (95% CI)		
	Baseline	1 mo	3 mo
Necessity			
Important to use ICS when symptomatic	0.6 (0.2–1.3)	0.8 (0.3–2.1)	0.3 (0.1–1.1)
Important to use ICS when asymptomatic	7.6 (3.5–16.9) ^a	2.6 (1.2–5.6) ^a	5.8 (2.3–14.6) ^a
Concerns			
Worried about side effects of ICS	0.4 (0.2–0.7) ^a	0.5 (0.2–0.9) ^a	0.3 (0.2–0.7) ^a
Worried about getting addicted to ICS	0.4 (0.2–0.8) ^a	0.6 (0.3–1.1)	0.4 (0.2–0.8) ^a
If use ICS all the time they will stop working	0.6 (0.3–1.1)	0.8 (0.4–1.6)	0.4 (0.2–0.9) ^a
Self-efficacy			
Confident in ability to use ICS as prescribed	3.5 (1.8–6.9) ^a	2.4 (1.2–4.8) ^a	3.5 (1.6–7.6) ^a
Confident in ability to control asthma	1.1 (0.6–1.8)	1.3 (0.7–2.3)	0.8 (0.4–1.9)
Confident can control future health	1.2 (0.6–2.1)	1.5 (0.8–2.8)	0.9 (0.4–1.6)
Regimen complexity			
ICS regimen was hard to follow	0.3 (0.1–0.9) ^a	0.8 (0.2–2.7)	0.2 (0.05–0.8) ^a

Abbreviations: CI, confidence interval; ICS, inhaled corticosteroid; OR, odds ratio.

^a Association significant at $P < .05$

Second, the works of Horne et al¹⁵ and Menckeborg et al¹⁷ predominantly focused on necessity and concern beliefs analyzed as psychometric scales. This study hones this down further to 2 key, easily ascertainable medication beliefs that would be easy to evaluate in real-world clinical practice.

Two other domains of medication beliefs were also related to behavior. Having confidence in their ability to properly use ICS, a drug-specific measure of self-efficacy, doubled the odds of adherence. Drug- or condition-specific self-efficacy has been associated with adherence in other chronic diseases, such as hypertension, human immunodeficiency virus, and osteoarthritis, among others.^{18–20} The general self-efficacy items did not correlate with medication use behavior. We interpret this to mean that behavior-specific self-efficacy is more important than is generic self-efficacy. This has clinical relevance because physicians and nurses should be able to bolster confidence in using ICS by actively coaching patients on effective inhaler technique. Feeling that the ICS regimen was hard to follow (our measure of self-perceived regimen complexity) reduced the chance of adherence.

In addition to having significance for behavioral theories of medication adherence, these findings have several practical clinical applications. First, we identified 4 questions that physicians can ask that may help identify patients who have fundamental beliefs about ICS that may be major barriers to long-term medication adherence and effective self-management. Second, these 4 medication beliefs ought to be potentially modifiable with some fairly direct educational messages. For example, physicians and nurses can focus scarce counseling time to emphasize the importance of and rationale for using ICS even when asymptomatic and coach patients on proper use of inhalers to bolster confidence using them. Asthma care providers should also recognize that concerns about the side effects of ICS are very common, so in addition to bolstering positive beliefs, it is probably also important to acknowledge and address worries about side

effects. We hypothesize that the combination of bolstering positive beliefs and mitigating the negative ones will increase adherence rates. A recent systematic review²⁵ suggests that the few initial interventions that sought to change patients' health beliefs were effective in enhancing medication adherence in those with chronic disease. The strengths of this study should be viewed in the context of its limitations. Medication adherence was self-reported, so the absolute levels of adherence are likely to be overestimates.^{5,6}

We performed an electronic adherence substudy that confirmed the validity of the MARS in this inner-city US population (using metered-dose inhaler log monitors on the ICS canisters).¹⁰ However, it was deemed too expensive and logistically infeasible to perform electronic drug monitoring in 261 patients across 3 periods. Menckeborg et al¹⁷ found associations between medication beliefs and pharmacy-based measures of adherence with ICS in asthmatic patients in the Netherlands, which also strengthens our confidence that the relationships between medication beliefs and adherence behaviors reported herein are real.

We deliberately sought to focus on high-risk, inner-city patients because these are the populations with the highest morbidity and mortality from asthma. The generalizability of these findings to other settings is less well known, although similar relationships between medication beliefs and adherence with ICS therapy have been noted in 2 different European studies.^{15,17} The present study participants were all clinic-attending patients, and nearly all had access to low-cost medications, which made ICS very affordable. This may explain the relatively high rates of self-reported ICS use. Adherence patterns and beliefs about ICS in those with more limited access to medical care and higher out-of-pocket drug costs would be expected to be worse. Finally, although most physicians' clinical experience would suggest that the beliefs we identified ought to be modifiable, whether they really are,

or if such attitudinal changes will alter adherence, should be the focus of future asthma education interventions.

In conclusion, several positive and negative beliefs about medications were associated with adherence to ICS therapy. Eliciting and addressing these underlying beliefs may help improve adherence and outcomes. These potentially modifiable beliefs are promising targets for counseling patients in real-world clinical practice and for the design of future asthma self-management interventions.

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Requests for reprints should be addressed to:

Ethan A. Halm, MD, MPH

Division of General Internal Medicine

University of Texas Southwestern Medical Center

5323 Harry Hines Blvd

Dallas, TX 75390-8889

E-mail: Ethan.Halm@UTsouthwestern.edu