# Strategies Used by Older Adults with Asthma for Adherence to Inhaled Corticosteroids

*Taylor L. Brooks[1], Howard Leventhal, PhD[2], Michael S. Wolf, PhD[3], Rachel O'Conor, MPH[3], Jose Morillo, BA[4], Melissa Martynenko, MPA, MPH[4], Juan P. Wisnivesky, MD, DrPH[4,5], and Alex D. Federman, MD, MPH[4]*

[1]New York University, New York, NY, USA; [2]Institute of Health, Health Care Policy and Aging Research, Rutgers University, New Brunswick, NJ, USA; [3]Division of General Internal Medicine, Feinberg School of Medicine, Northwestern University, Chicago, IL, USA; [4]Division of General Internal Medicine, Mount Sinai School of Medicine, New York, NY, USA; [5]Division of Pulmonary, Critical Care and Sleep Medicine, Mount Sinai School of Medicine, New York, NY, USA.

***BACKGROUND:*** Older adults with asthma have low levels of adherence to their prescribed inhaled corticosteroids (ICS). While prior research has identified demographic and cognitive factors associated with ICS adherence among elderly asthmatics, little is known about the strategies that older adults use to achieve daily use of their medications. Identifying such strategies could provide clinicians with useful advice for patients when counseling their patients about ICS adherence.

***OBJECTIVE:*** To identify medication use strategies associated with good ICS adherence in older adults.

***PARTICIPANTS:*** English-speaking and Spanish-speaking adults ages 60 years and older with moderate or severe asthma were recruited from primary care and pulmonary practices in New York City, NY, and Chicago, IL. Patients with chronic obstructive pulmonary disease, other chronic lung diseases or a smoking history of greater than 10 pack-years were excluded.

***MAIN MEASURES:*** Medication adherence was assessed with the Medication Adherence Rating Scale (MARS). Medication use strategies were assessed via open-ended questioning. "Good adherence" was defined as a mean MARS score of 4.5 or greater.

***KEY RESULTS:*** The rate of good adherence to ICS was 37 %. We identified six general categories of medication adherence strategies: keeping the medication in a usual location (44.2 %), integrating medication use with a daily routine (32.6 %), taking the medication at a specific time (21.7 %), taking the medication with other medications (13.4 %), using the medication only when needed (13.4 %), and using other reminders (11.9 %). The good adherence rate was greater among individuals who kept their ICS medication in the bathroom (adjusted odds ration [AOR] 3.05, 95 % CI 1.03–9.02, $p$=0.04) or integrated its use into a daily routine (AOR 3.77, 95 % CI: 1.62–8.77, $p$=0.002).

***CONCLUSIONS:*** Keeping ICS medications in the bathroom and integrating them into daily routines are strategies associated with good ICS adherence. Clinicians concerned with adherence should consider recommending these strategies to their older asthmatic patients, although additional research is needed to determine whether such advice would improve adherence behaviors.

*KEY WORDS:* medication adherence; asthma; inhaled corticosteroids.
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## INTRODUCTION

Regular use of inhaled corticosteroids (ICS) is integral for controlling the chronic lung inflammation characteristic of asthma, and daily use can make acute asthma attacks less frequent and less severe.[1,2] However, adherence to ICS medication tends to be quite low, especially among older adults, among whom only 40 % use ICS medications as prescribed by their physicians.[2–5]

Sub-optimal adherence to ICS among older adults is a major public health concern because of the large number of individuals affected and the particular vulnerability of this population to poor outcomes. Asthma affects up to 9 % of the US population over the age of 65 years.[6,7] Older adults with asthma are more susceptible to asthma morbidity and mortality than younger adults and children, with higher rates of hospitalization, longer hospital stays once admitted, and over twice the rate of death from asthma.[8] Approximately two-thirds of asthma-related deaths in the U.S. occur among adults over age 55.[8]

While studies of older asthmatics have identified characteristics that distinguish adherent and non-adherent patients,[5,9–13] little has been published on specific mechanisms employed by patients to achieve and maintain adherence, and none have addressed strategies used by older adults who may differ in their ICS use from younger adults because of the greater prevalence

of polypharmacy in this population.[14] One study of HIV-seropositive individuals found that adherence improved when pill-taking was linked to daily activities such as eating breakfast, watching a favorite television program, attending weekly meetings and sleeping at home.[15] Patients displayed episodes of non-adherence when they deviated from that routine (e.g., waking up late, sleeping at a friend's house).[16] Additional evidence suggests that simple and rigid medication routines like these best improve adherence, especially for diseases with complex or long-term treatments.[17] Simple medication use activities may fit well with patients' existing daily routines, which tend to change little from day to day. Assimilating medication use into patients' rigid routines should foster the initiation and establishment of strong medication use habits.[18]

In this study, we sought to identify specific ICS use strategies among older adults with asthma. We hypothesized that those who reported integrating medication behaviors into daily routines would report higher levels of medication adherence than patients who employed other strategies, and that the predictive power of these strategies would not be independent of patient demographic characteristics and cognitive factors associated with adherence.

## METHODS

### Settings and Participants

This study used data collected at baseline and 3 months from the Asthma Beliefs and Literacy in the Elderly (ABLE) study, a prospective cohort study of self-management behaviors, health literacy, and illness beliefs among older adults with asthma. Patients were recruited from outpatient hospital and community-based primary care and pulmonary clinics in New York, NY, and Chicago, IL, from December 2009 through May 2012, and were interviewed in English or Spanish by bilingual research assistants. The ABLE study was approved by the Institutional Review Boards of the Icahn School of Medicine at Mount Sinai and the Feinberg School of Medicine at Northwestern University.

Patients were eligible to participate if they 1) spoke English or Spanish, 2) were aged 60 or older and 3) had persistent moderate or severe asthma. Patients with chronic obstructive pulmonary disease, other chronic lung diseases or a smoking history of greater than 10 pack-years were excluded. For these analyses, we included only those participants who were prescribed an ICS controller medication and who completed their 3-month interview, resulting in a sample of 328 participants. Use of ICS was determined by self-report and inspection of medications at the baseline interview.

### Self-Reported Medication Adherence

Adherence to ICS was measured with the ten-item Medication Adherence Rating Scale (MARS) tailored to assess adherence with asthma medications.[19] The MARS is comprised of statements about medication use behaviors, including regular versus as-needed use and intentional versus unintentional non-adherence. Respondents are asked how often they exhibit the behavior, with five options ranging from always to never. The MARS has high inter-item reliability (Cronbach's $\alpha$=0.85), good test-retest reliability ($r$=0.65, $p$<0.001), and correlates strongly with objective measurements of ICS adherence through electronic monitoring for both English-speaking and Spanish-speaking patients.[19] A mean MARS score between 1 and 5 was calculated from the answers to individual items; higher scores indicate better adherence. We dichotomized scores to facilitate data interpretation. A mean score of 4.5 or greater was considered "good adherence" as per prior research and was used as our primary outcome measure.[19]

### Treatment Strategies

Strategies for adherence to these medications were identified by asking, "What do you do to remember to take your [name of medication]?" followed by repeated probes to obtain a comprehensive account of patients' adherence behaviors. The interviewers did not provide examples of strategies used by other patients. All responses were documented verbatim. Two investigators (AF, JM) independently coded the text of the responses to identify specific themes, then met to compare their coding and reconcile differences. When a patient reported using multiple strategies, each action was coded as a separate strategy. For example, a patient who said "I keep my medication in the kitchen and then I take it when I eat dinner" would be coded as both storing it in a usual location (kitchen) and integrating it with a daily routine (evening).

### Other Variables

Our analyses incorporated demographic and cognitive factors previously shown to have an association with ICS adherence among older asthmatics.[5,9–13] Demographic characteristics included age, race, education, income and English proficiency.[5,6] Other variables that might affect adherence strategies included patient birthplace and past experiences with asthma (e.g., intubation, years with asthma).

Cognitive factors included illness and medication beliefs, anxiety and depression, and health literacy. Studies framed according to the Common Sense Model of Self-Regulation[20] have found that medication adherence is associated with

accurate conceptualizations (beliefs) of asthma and favorable opinions of ICS.[5,21] Three questions from the validated Brief Illness Perceptions Questionnaire and used extensively in prior research were used to measure asthma beliefs.[5,22,23] Subjects were asked whether they expected their doctors to cure their asthma and whether they thought they would always have asthma. Response options were dichotomized as definitely/probably vs. possibly/no. We also asked if they believed they only have asthma when they are symptomatic. For this question, responses were dichotomized as "I have asthma all the time"/"most of the time" and "I have asthma some of the time"/"only when symptomatic."

The Beliefs about Medicines Questionnaire (BMQ) was used to ascertain subjects' treatment beliefs. The BMQ is comprised of two five-item subscales measuring concerns and beliefs about the necessity of the treatment.[24] Higher scores on the concern subscale indicate greater concern about long-term medication use, while higher scores on the necessity subscale indicate greater belief in the medication's necessity for good health.[24]

Anxiety was measured using the Generalized Anxiety Disorder 7 questionnaire (GAD-7), a seven-item scale that assesses the frequency of anxiety symptoms using a four-point Likert scale (not at all, several days, more than half the days, nearly every day).[25] Answers were summed, with higher scores indicating more frequent anxiety. Patients with a total score of ≥ 10, indicating moderate or worse anxiety, were coded as anxious for our analyses. Depression was measured using the Patient Health Questionnaire-9 (PHQ-9), a nine-item scale about frequency of depressive symptoms with response options and scoring identical to that of the GAD-7.[26] Depression was defined as a score of ≥ 10, indicating moderate or more severe depression.[26]

Health literacy was assessed with the Short Test of Functional Health Literacy in Adults (S-TOFHLA). The S-TOFHLA is a 36-item reading comprehension and four-item numeracy exercise. The reading comprehension section has two timed (7 min) reading passages that omit key words and phrases. Four multiple-choice answers are provided under each missing section of the text and the participant must choose the response that contextually and grammatically completes the sentence. The numeracy section assesses the patient's ability to read and interpret information on appointment slips and instructions for medication use. The items are summed for a total score of 0–100, with higher scores indicating better literacy. We dichotomized scores as adequate (≥ 67) and marginal or low (< 67).[27] The S-TOFHLA has been validated for use in both English and Spanish.[28]

## Statistical Analysis

We conducted bivariate tests of association between patient characteristics and good adherence using chi-square tests and t-tests. We then examined the bivariate associations of adherence with each of the identified adherence strategies. Strategies that had a significant association in the bivariate analysis were further examined in multivariable logistic regression models that sequentially adjusted for demographic characteristics, physical and mental health, and asthma beliefs. Lastly, we conducted bivariate analyses to identify characteristics of patients who used the strategies associated with good adherence. All analyses were conducted with SAS version 9.3 (SAS Institute, Cary, NC).

# RESULTS

## Sample Characteristics

The mean age was 67.5 years, and 31 % of participants were over age 70 years. Most were female (84 %) (Table 1). The majority of the sample was non-white (38 % Latino, 31 % black), 53 % had a monthly income of $1,350 or less, and 25 % had limited English proficiency. Twenty percent of subjects had depression, 21 % had anxiety, and 34 % had low health literacy.

The majority of subjects had correct beliefs about the duration and curability of asthma: 71 % said they would always have asthma and 81 % said their doctor could not cure asthma. However, 51 % reported that they have asthma only when symptomatic, indicating a false perception of asthma as episodic rather than chronic. Beliefs about ICS medication were mostly positive. The mean BMQ score was 3.5, indicating that most respondents believed the benefits of ICS use outweighed the risks.

The rate of good medication adherence was poor overall (37 %). The good adherence rate was significantly worse among black and Hispanic patients, those with low incomes, lower levels of education, low English proficiency, low health literacy, those born in Puerto Rico and the Dominican Republic, those with poor physical health, and those with anxiety or depression (Table 1). It was also lower among subjects who endorsed the no symptoms, no asthma belief and the belief that they will not always have asthma, as well as among subjects who had greater concerns about asthma controller medications and had weaker beliefs about the necessity of medications for asthma control.

## Medication Adherence Strategies

We identified six general categories of medication adherence strategies (Table 2): keeping the medication in a usual location (44.2 %), integrating the medication as part of a daily routine (32.6 %), taking the medication at a specific time of day (21.7 %), taking the medication with other medications (13.4 %), using the medication only when needed (13.4 %), and using other reminders (11.9 %). Few patients reported keeping written notes to remind themselves (1.5 %), having

**Table 1. Patient Characteristics by Adherence to Inhaled Corticosteroids (n=358)**

| | Total, % | Good Adherence to ICS | | *P* |
|---|---|---|---|---|
| | | Yes | No | |
| Age, years | | | | 0.65 |
| 60–64 | 44.1 | 46.1 | 42.9 | |
| 65–69 | 24.9 | 26.1 | 24.2 | |
| 70+ | 31.0 | 27.8 | 32.8 | |
| Male | 15.9 | 17.2 | 15.1 | 0.61 |
| Race | | | | < 0.001 |
| Non-Hispanic black | 30.9 | 25.9 | 33.8 | |
| Non-Hispanic white | 21.7 | 35.3 | 13.6 | |
| Hispanic | 37.9 | 26.7 | 44.4 | |
| Other | 9.6 | 12.1 | 8.1 | |
| Household income <$1,350/month | 53.4 | 41.2 | 60.6 | 0.001 |
| Education | | | | < 0.001 |
| College graduate | 29.0 | 45.7 | 19.2 | |
| Some college | 20.4 | 20.7 | 20.2 | |
| High school | 18.2 | 12.9 | 21.2 | |
| <12 years | 32.5 | 20.7 | 39.4 | |
| Poor English language skills | 24.8 | 15.5 | 30.3 | 0.003 |
| Low health literacy | 34.3 | 19.5 | 43.2 | < 0.001 |
| Married or partnered | 32.1 | 36.5 | 29.4 | 0.19 |
| Place of birth | | | | 0.001 |
| Mainland US | 60.2 | 73.3 | 52.5 | |
| Puerto Rico | 21.3 | 12.9 | 26.3 | |
| Dominican Republic | 18.5 | 13.8 | 21.2 | |
| General health, poor–fair | 75.8 | 66.4 | 81.3 | 0.003 |
| Years with asthma, *mean* (*sd*) | 30.7 (20.2) | 30.0 (19.6) | 30.1 (20.0) | 0.96 |
| Ever intubated | 10.3 | 8.9 | 11.1 | 0.53 |
| Depression | 20.1 | 9.73 | 26.2 | < 0.001 |
| Generalized anxiety | 20.6 | 7.8 | 28.1 | < 0.001 |
| Asthma illness beliefs | | | | |
| No symptoms no asthma | 49.2 | 32.8 | 58.9 | < 0.001 |
| Will not always have asthma | 29.4 | 14.7 | 38.1 | < 0.001 |
| Physician can cure asthma | 19.2 | 15.5 | 21.3 | 0.21 |
| Asthma medication beliefs | | | | |
| Medication concerns, *mean* (*sd*) | 13.7 (4.2) | 12.3 (4.2) | 14.6 (4.1) | < 0.001 |
| Medication necessity, *mean* (*sd*) | 12.8 (4.4) | 11.6 (4.1) | 13.4 (4.5) | < 0.001 |

*ICS denotes inhaled corticosteroid*

another person remind them (1.2 %), or using an alarm (0.6 %); 4.3 % had no specific strategy and 9.8 % of patients did not answer.

Patients who reported keeping their medications in specific locations did so most commonly at the bedside (20.1 % of the total sample), followed by in the bathroom (9.2 %); 12.5 % of the sample reported integrating medication use with morning activities, such as brushing teeth or eating breakfast, and 8.2 % did so in the evening, typically at bedtime.

Of all reported strategies, only three were significantly associated with good adherence (Table 2): keeping the medication in the bathroom (adherent, 16.4 % vs. non-adherent, 4.6 %, $p=0.0004$), integrating the medication as part of a daily routine (morning: 25.0 % vs. 5.1 %, $p<0.0001$; evening: 12.9 % vs. 6.1 %, $p=0.04$), and taking the medication at a specific time of day (29.3 % vs. 16.7 %, $p=0.008$). A

**Table 2. Strategies for Inhaled Corticosteroid Adherence and Association with Self-Reported Good Adherence (*n*=358)**

| | Total, % | Good ICS Adherence | | *p* |
|---|---|---|---|---|
| | | Yes | No | |
| Keep medication in a usual location | 44.2 | 50.0 | 40.4 | 0.10 |
| Bedside or elsewhere in bedroom | 20.1 | 23.3 | 18.2 | 0.28 |
| Bathroom | 9.2 | 16.4 | 4.6 | < 0.001 |
| Purse or bag | 4.9 | 1.7 | 5.7 | 0.10 |
| Kitchen | 3.9 | 4.3 | 4.0 | 0.91 |
| Other locations | 8.5 | 7.8 | 9.1 | 0.68 |
| Integrate as part of a routine | 32.6 | 50.0 | 22.2 | < 0.001 |
| Morning routine | 12.5 | 25.0 | 5.1 | < 0.001 |
| Evening routine | 8.2 | 12.9 | 6.1 | 0.04 |
| Take at a specific time of day | 21.7 | 29.3 | 16.7 | 0.008 |
| Taken with other chronic medications | 13.4 | 16.4 | 11.6 | 0.23 |
| Use only when needed | 13.4 | 0.0 | 21.2 | < 0.001 |
| Other reminders | 11.9 | 9.48 | 14.1 | 0.23 |
| Person to person reminder | 1.2 | 0.0 | 2.0 | 0.12 |
| Written note reminder | 1.5 | 2.6 | 1.0 | 0.28 |
| Alarm reminder | 0.6 | 0.0 | 1.0 | 0.28 |
| No specific strategy employed | 4.3 | 5.2 | 4.0 | 0.64 |
| Did not provide an answer | 9.8 | 9.5 | 9.1 | 0.91 |

*ICS denotes inhaled corticosteroid*
*Subjects may have described one or more strategy, and thus values in column 2 do not add to 100 %*

fourth strategy, taking the medication only when needed, was significantly associated with poorer adherence. As this study is interested in strategies to improve adherence, we did not conduct further analyses of taking medications only when needed.

Two of the three strategies remained significant after controlling for other variables. The first, storing the medication in the bathroom, was a significant predictor of good adherence across all regression models. In the fully adjusted model, patients who stored their medication in the bathroom had greater odds of good adherence than patients who did not (AOR: 3.05, 95 % CI: 1.03–9.02, $p=0.04$) (Table 3). After adjusting for significant covariates, patients who integrated medication use into their daily routine also had greater odds of good adherence (AOR: 3.77, 95 % CI: 1.62–8.77, $p=0.002$) (Table 3). However, patients who took their medication at a specific time of day did not have significantly higher odds of good adherence in the fully adjusted model (AOR: 1.63, 95 % CI: 0.81–3.29, $p=0.18$).

Among the 39 people who used the morning routine, 74.4 % had good adherence at baseline ($p<0.0001$), and 68.8 % had good adherence at 12 months follow up ($p=0.008$).

## Characteristics of Patients Using Daily Routine and Bathroom Strategies

Patients who used their ICS as part of a daily routine or kept their ICS in the bathroom were more likely to be white, to

**Table 3. Multivariate Associations of Adherence Strategies with Good Inhaled Corticosteroid Adherence ($n$=301)**

| | Adherence | | | |
|---|---|---|---|---|
| | Bathroom Strategy | | Daily Routine Strategy | |
| | OR (95 % CI) | p | OR (95 % CI) | *p* |
| Strategy | 3.05 (1.03–9.02) | 0.04 | 3.77 (1.62–8.77) | 0.002 |
| Age, years | | | | |
| 60–64 | Ref. | | Ref. | |
| 65–74 | 0.93 (0.48–1.78) | 0.82 | 0.95 (0.48–1.85) | 0.87 |
| 75+ | 0.47 (0.17–1.27) | 0.14 | 0.50 (0.19–1.31) | 0.16 |
| Male | 1.21 (0.52–2.82) | 0.66 | 1.23 (0.51–2.93) | 0.65 |
| Race | | | | |
| Non-Hispanic white | Ref. | | Ref. | |
| Non-Hispanic black | 0.59 (0.23–1.52) | 0.27 | 0.46 (0.18–1.22) | 0.12 |
| Hispanic | 1.07 (0.31–3.67) | 0.92 | 0.81 (0.24–2.73) | 0.73 |
| Other | 0.73 (0.23–2.39) | 0.61 | 0.69 (0.21–2.21) | 0.53 |
| Household income<$1,350/month | 1.03 (0.46–2.32) | 0.94 | 1.14 (0.51–2.54) | 0.75 |
| Education | | | | |
| Some college or more | Ref. | | Ref. | |
| High school | 0.45 (0.18–1.13) | 0.09 | 0.47 (0.19–1.19) | 0.11 |
| <12 years | 0.99 (0.35–2.82) | 0.99 | 0.90 (0.32–2.54) | 0.84 |
| Poor English language skills | 0.77 (0.29–2.08) | 0.61 | 0.71 (0.26–1.89) | 0.49 |
| Low health literacy | 0.58 (0.24–1.39) | 0.22 | 0.62 (0.25–1.49) | 0.28 |
| Married or partnered | 0.88 (0.43–1.77) | 0.71 | 0.99 (0.48–2.02) | 0.97 |
| Place of birth | | | | |
| Mainland US | Ref. | | Ref. | |
| Puerto Rico | 0.47 (0.14–1.66) | 0.24 | 0.53 (0.15–1.81) | 0.31 |
| Dominican Republic | 0.54 (0.19–1.57) | 0.26 | 0.43 (0.15–1.23) | 0.11 |
| General health, poor–fair | 1.17 (0.52–2.63) | 0.70 | 1.33 (0.59–3.00) | 0.50 |
| Years with asthma, by 5-year increments | 0.99 (0.91–1.07) | 0.73 | 1.00 (0.92–1.09) | 0.98 |
| Ever intubated | 1.22 (0.43–3.45) | 0.71 | 1.02 (0.42–3.44) | 0.73 |
| Depression | 0.60 (0.22–1.66) | 0.33 | 0.47 (0.17–1.32) | 0.15 |
| Generalized anxiety | 0.18 (0.06–0.56) | 0.003 | 0.23 (0.07–0.69) | 0.009 |
| Asthma illness beliefs | | | | |
| No symptoms no asthma | 0.57 (0.30–1.08) | 0.08 | 0.58 (0.30–1.09) | 0.09 |
| Will not always have asthma | 0.55 (0.25–1.21) | 0.14 | 0.50 (0.22–1.13) | 0.10 |
| Physician can cure asthma | 2.47 (1.01–6.06) | 0.05 | 3.17 (1.26–7.95) | 0.01 |
| Asthma medication beliefs | | | | |
| Medication concerns | 0.89 (0.82–0.97) | 0.008 | 0.91 (0.84–0.99) | 0.03 |
| Medication necessity | 0.88 (0.81–0.94) | < 0.001 | 0.88 (0.82–0.95) | < 0.001 |

have at least a partial college education, and to have been born in the United States (Table 4). Patients with low incomes, limited English proficiency, low health literacy, poor physical health, depression, anxiety, and those erroneous asthma beliefs (asthma only when symptomatic, doctor could cure asthma) were less likely to use these strategies. Finally, patients who used either strategy had lower mean scores on both the medication concerns and necessity scales.

## DISCUSSION

Previous research has indicated that both psychological and socio-demographic factors influence elderly patients' adherence to ICS medications,[5,9–13] but there has been little research into how specific medication use strategies influence adherence. Our study contributes to the field by identifying strategies older asthmatics use to maintain adherence to their ICS medications. Older asthmatics who kept their ICS medication in the bathroom or used it as part of their daily routine were more likely to be adherent than those who used other strategies. A small minority of individuals reported using these strategies, but such individuals were more likely to be adherent to ICS, whereas those who used the more common strategy of keeping medications in the bedroom, including at the bedside, were not. Furthermore, the bathroom and daily routine strategies were stronger correlates of good adherence than the demographic and cognitive factors that we considered. Because adherence strategies are modifiable, the findings in this study may provide clinicians and care coaches with straightforward and useful messages to help older patients improve their medication adherence.

Based on previous research[1–5,9–13] we expected that inaccurate asthma beliefs and positive medication perceptions would correlate with lower levels of adherence, as would other cognitive factors like depression, anxiety, and low health literacy. We therefore expected the odds of adherence based on strategy to attenuate when these factors were introduced. However, results indicated that these strategies were associated with better adherence regardless of these cognitive factors.

These findings are supported by research that suggests that there are two distinct types of non-adherence: intentional and

**Table 4.. Association of Patient Characteristics with Use of the Bathroom or Daily Routine Adherence Strategies**

| | Use of Strategy | | |
|---|---|---|---|
| | Yes (%) | No (%) | *p* |
| Age, years | | | |
| 60–64 | 47.2 | 42.8 | 0.56 |
| 65–69 | 19.4 | 25.5 | |
| 70+ | 33.3 | 31.8 | |
| Male | 18.1 | 16.0 | 0.68 |
| Race | | | |
| Non-Hispanic white | 38.9 | 17.7 | < 0.001 |
| Non-Hispanic black | 26.4 | 31.8 | |
| Hispanic | 23.6 | 41.2 | |
| Other | 11.1 | 9.4 | |
| Household income< $1,350/month | 35.2 | 57.7 | < 0.001 |
| Education | | | |
| College graduate | 51.4 | 23.5 | < 0.001 |
| Some college | 22.2 | 19.6 | |
| High school | 8.3 | 20.4 | |
| <12 years | 18.1 | 36.5 | |
| Poor English language skills | 15.3 | 27.5 | 0.03 |
| Low health literacy | 14.3 | 39.8 | < 0.001 |
| Married or partnered | 36.1 | 30.8 | 0.40 |
| Place of birth | | | |
| Mainland US | 69.4 | 57.7 | 0.01 |
| Puerto Rico | 8.3 | 24.3 | |
| Dominican Republic | 22.2 | 18.0 | |
| General health, poor–fair | 56.9 | 79.6 | < 0.001 |
| Years with asthma, by 5-year increments, *mean* (*sd*) | 6.3 (4.2) | 6.1 (4.0) | 0.68 |
| Ever intubated | 7.0 | 11.8 | 0.25 |
| Depression | 9.72 | 22.1 | 0.02 |
| Generalized anxiety | 9.7 | 23.5 | 0.01 |
| Asthma illness beliefs | | | |
| No symptoms no asthma | 37.5 | 53.2 | 0.02 |
| Will not always have asthma | 22.2 | 31.5 | 0.13 |
| Physician can cure asthma | 8.3 | 22.1 | 0.009 |
| Asthma medication beliefs | | | |
| Medication concerns, *mean* (*sd*) | 12.76 (4.49) | 13.94 (4.15) | 0.04 |
| Medication necessity, *mean* (*sd*) | 11.57 (4.34) | 13.15 (4.41) | 0.008 |

unintentional, the latter caused by forgetfulness or poor understanding of how or when to use the medication.[10] The bathroom and daily routine strategies may address forgetful non-adherence by integrating the medication into an already-existing routine. Taking the medication only as needed, on the other hand, may indicate faulty disease or medication beliefs. These inaccurate beliefs may underlie intentional non-adherence, thus explaining why they have little impact on the associations between these successful strategies and reported adherence. Taken together, these findings provide further evidence of the value of patient-centered care: Clinicians need to understand why patients do not use their medications appropriately before counseling patients on ways to improve adherence. If patients are simply forgetful, recommending a more effective medication use strategy might improve adherence. If they are intentionally non-adherent, addressing their medication beliefs and other factors, such as out-of-pocket costs and side effects, is likely a better course of action.

Our study fills a gap in the literature by identifying simple, easily modified medication use strategies associated with good ICS adherence among older adults. It does, however, have some important limitations. Findings from this study may not extend to adherence with other medications, especially those that are not administered with a handheld inhaler device. Additional research is needed to identify strategies effectively used by patients to maintain adherence to medications administered in other ways, such as orally. Additionally, ICS adherence was measured at baseline, but the adherence strategies were assessed at 3 months. While it would have been preferable to gather all data at one time, analyses indicated that adherence rates were relatively stable at 12 months among patients who used these strategies.

In conclusion, older asthmatics who keep their ICS medications in the bathroom or incorporate their use into daily routines are more likely to have good adherence than those using other strategies or no strategy at all. Clinicians should consider encouraging their older asthmatic patients to adopt such strategies when they suspect ICS adherence problems, although research is needed to determine the benefit of such counseling.

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***Corresponding Author:***
*Alex D. Federman, MD, MPH; Icahn School of Medicine at Mount Sinai, Division of General Internal Medicine, One Gustave L. Levy Place, Box 1087, New York, NY 10025, USA (e-mail: alex.federman@mountsinai.org).*

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