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Medication identification among caregivers of urban children with asthma

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Abstract

Objectives—To determine caregiver ability to name their child’s inhaled asthma medications, and examine whether perceived ease of remembering names is associated with accurate naming and asthma outcomes.

Methods—As part of the School-Based Telemedicine-Enhanced Asthma Management trial in Rochester, NY, we asked caregivers of children with persistent asthma to: 1) name their child’s inhaled medications; and 2) indicate agreement with the statement, “it is easy to remember the names of my child’s asthma medications.” We limited analyses to subjects with 31 inhaled medication. Reported names were compared with canisters available during a home visit; complete matches were considered concordant. We compared ease of remembering names with concordance, asthma symptoms, and adherence using bivariate and multivariate analyses.

Results—Overall, 141 caregivers (87%) had children with 31 inhaled medication (62% Black, 68% Medicaid). Most (74%) perceived it easy to remember medication names, yet only 46% reported names concordant with medications at home. Caregivers who did not easily remember medication names were less likely to concordantly name available medications (23% vs 54%, $p=0.002$), and more likely to report that their child experienced >2 symptom days/week (33% vs 16%, $p=0.03$), >2 symptom nights/month (31% vs 12%, $p=0.02$), and missed 1 dose(s) of preventive medication in the prior 2 weeks (52% vs 28%, $p=0.03$). Findings were consistent in multivariate regression analyses.

Conclusions—Caregivers of urban children with persistent asthma who considered medication names difficult to remember were less able to accurately name available medications, and reported worse control and medication adherence. Greater attention to medication identification may improve outcomes in this population.

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Conflicts of Interest:

None of the authors have any conflicts of interest to report.

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Keywords

asthma; childhood; primary care; prevention; adherence

INTRODUCTION

Asthma continues to be the most prevalent chronic disease of childhood, affecting an estimated seven million children in the United States.⁽¹⁾ Guidelines published by the National Asthma Education and Prevention Program (NAEPP)⁽²⁾ recommend that all individuals with persistent asthma use a daily preventive medication, such as an inhaled corticosteroid (ICS). Routine use of an ICS improves clinical asthma outcomes.^(3–7) Despite this available, effective therapy, the high national rates of asthma-related hospitalization and emergency healthcare use remain largely stagnant,⁽¹⁾ with only small improvements in morbidity and racial disparities over time.⁽⁸⁾ One driver of sustained asthma morbidity is poor adherence with prescribed preventive ICS therapy.

Children with asthma take on average just over half of all prescribed ICS doses, and by late adolescence the adherence rate decreases to 25%.⁽⁹⁾ Poor, urban, and minority children are disproportionately burdened by asthma prevalence and morbidity,^(1, 10–14) and are less likely to adhere to daily preventive therapy when prescribed.^(15, 16) While many patient and system factors influence medication adherence,^(17–19) one important barrier is the complexity of the medication regimen. Regimens involving inhaled medications and multiple dosing frequencies are difficult for patients to follow.⁽²⁰⁾ Control of persistent asthma often requires multiple inhaled medications, which may have different drug delivery mechanisms, physical appearances, and indications for use (i.e. acute symptom relief versus long-term preventive therapy). This creates an opportunity for confusion and unwitting non-adherence, even among patients with intention to adhere.⁽²¹⁾ One aspect of complex medication regimens that has not received adequate attention in the literature is the burden imposed by multiple medication names.

After prescriptions are filled, the model of medication self-management requires patients to be able to “name, identify, and understand how to take medications.”⁽¹⁷⁾ Patients who cannot differentiate available inhaled asthma medications by name may be unable to follow a written asthma action plan. Using a physical attribute to identify medications, such as color rather than name, could potentially introduce additional confusion among patients, caregivers, and providers. This is because inhaled asthma medications in different classes can share the same color: for example, ProAir® HFA and Symbicort® HFA are both manufactured with red plastic actuators. Moreover, the same medication may be marketed with different colors: three albuterol sulfate HFA inhalers are currently being manufactured with different actuator colors.

The current pediatric asthma literature does not examine this dynamic. However, the importance of knowing medication names for successful self-management of chronic illness has emerging empirical support, as illustrated by the findings from a pair of recent studies. Among adults with hypertension, the inability to name prescribed antihypertensive medications^(22, 23) and an over-reliance on visual identification of medications⁽²³⁾ were

associated with impaired disease control and adverse outcomes. It is unclear whether caregivers of urban children with persistent asthma can readily name available inhaled medications, or whether an inability to name medications impacts clinical asthma outcomes. If medication names are a barrier to adherence, such confusion could potentially be elicited by clinicians at the point of care as a risk factor for poor control.

We conducted a study to explore the dynamic of medication name recognition and pediatric asthma outcomes with two primary objectives. First, we determined the ability of caregivers to correctly name their child's inhaled asthma medications that were available in the home. Second, we examined whether a caregiver's perceived ability to remember medication names was associated with either correct medication naming or clinical asthma outcomes. The Health Belief Model considers self-efficacy to be important for engaging in health-related behaviors like medication adherence;⁽²⁴⁾ regardless of objective ability, caregivers who do not perceive themselves as able to name necessary medications may doubt their ability to manage asthma at home. We hypothesized that the caregivers who perceived greater difficulty in naming asthma medications would be less likely to have accurate medication identification, and that their children would experience more disease-related morbidity.

METHODS

Settings and Participants

The School-Based, Telemedicine Enhanced Asthma Management (SB-TEAM) study is an ongoing, four-year randomized controlled trial being conducted in urban Rochester, NY. Through a collaboration with the Rochester City School District (RCS D), children randomized into the intervention arm receive: 1) directly observed therapy with preventive medication administered daily under nurse supervision while school is in session; and 2) three telemedicine-based asthma follow-up visits with their primary care provider (PCP). Children randomized into the Enhanced Usual Care control group have a report of recent symptoms sent to their PCP. All caregivers from both arms of the trial are contacted by telephone for three bi-monthly follow-up surveys over a six month period, and each subject receives two home visits. The baseline home visit is scheduled following a positive eligibility screen, and randomization of enrolled subjects is performed at that time. A second home visit is conducted at the final follow-up seven to nine months after baseline measures are collected. The data for this analysis include all subjects in the second year of the trial and are drawn from the baseline and final home visits, conducted between August 2013 and June 2014.

Screening for eligibility was conducted in partnership with RCS D school nurses and health aides. Children with asthma were identified through pre-school and kindergarten health screening forms, school "medical-alert" forms, and lists of students presenting to nursing offices with asthma concerns. An asthma team member contacted each child's caregiver by telephone to confirm eligibility, describe the study, and schedule a baseline home visit for enrollment.

For inclusion into the study, children had to be between three and ten years old, carry a physician diagnosis of asthma, attend a RCSD preschool or elementary school, and have persistent or poorly controlled asthma. Asthma severity and control were determined based on caregiver report of recent symptoms, in accordance with NAEPP guidelines.⁽²⁾ Children were excluded from participating if their caregiver was unable to speak or understand English, the family had no access to a working phone, the child had participated in a previous asthma study or had another significant medical condition (e.g. congenital heart disease, cystic fibrosis, other chronic lung diseases), or if the family planned to leave the school district within six months.

Only one child per family was eligible for enrollment. Written informed consent was obtained from each caregiver. Verbal assent was obtained from all children aged seven years and older. Compensation for caregiver time was provided in the form of grocery store gift cards after each telephone follow-up and home visit, with a maximum payment of \$130 per subject completing the study. The study protocol was approved by the institutional review board of the University of Rochester.

Assessment

Caregiver ability to identify inhaled asthma medications—As part of the final SB-TEAM home visit, we asked caregivers of children with persistent asthma to name all of their child’s inhaled asthma medications. Reported names were documented, and then compared with medication canisters available at the home during the visit. Generic and trade names were both accepted responses, though subject to different interpretation. Caregivers providing a generic name like “albuterol” were considered correct if any albuterol sulfate HFA medication was available in the home for their child. Identifying medications by trade name required caregivers to produce the matching brand of medication, as inaccurate naming was considered an indicator of potential confusion over medication names. Concordant identification was defined as complete matches between all named and all available inhaled asthma medications.

Caregivers were then asked to indicate agreement with the statement, “it is easy to remember the names of my child’s asthma medications.” Answers were selected from a 5 point Likert scale ranging from “strongly agree” to “strongly disagree.” As a secondary outcome measure, we asked caregivers whether it was easiest to identify their child’s inhaled asthma medications by name, color, or some other identifier.

Assessment of asthma severity, symptoms, and adherence—Asthma severity (or level of control if using daily preventive medication) was assessed for each subject at baseline using a series of structured questions adapted from NAEPP guidelines.⁽²⁾ Each child was categorized as having mild, moderate, or severe persistent asthma based on caregiver report of recent impairment and expected future risk. During the final home visit, caregivers reported on asthma-related impairment over the previous two weeks (symptom free days, number of days requiring rescue medication) and the previous month (number of days with daytime symptoms, nighttime symptoms, or rescue medication use). Caregivers also provided an estimate of risk by identifying the number of times systemic corticosteroids

were required over the previous year. To measure adherence, we asked caregivers to report the number of preventive medication doses that were missed over the previous two weeks.

Assessment of covariates—Caregivers were asked demographic questions during the baseline home visit, including child age and gender; caregiver age, marital status, and education; primary language spoken at home; and insurance type. As this analysis used data from the final follow-up visit, randomized study group allocation was also considered a potential covariate.

Analysis

Analysis was completed using SPSS version 22 software (SPSS Inc., Chicago, Ill.). Responses for the caregiver perception variable measuring ease of remembering medication names were dichotomized: we defined responses of “strongly agree” and “agree” as “easy to remember”; and we defined “uncertain”, “disagree”, and “strongly disagree” responses as “not easy to remember.” These dichotomized caregiver perception groups framed all subsequent analyses. In order to examine the impact of multiple medication names on pediatric asthma outcomes, analyses were limited to subjects reporting more than one inhaled asthma medication. Descriptive statistics, concordant naming ability, and clinical asthma outcomes were compared between caregiver perception groups using chi-square and t-test analyses.

We conducted a series of regression analyses to clarify observed relationships between variables, with caregiver perception group as the principal independent variable of interest. We used multiple linear regressions to examine the continuous dependent variables of symptom free days and rescue medication use within the previous two weeks. Multivariable logistic regression models incorporated categorical dependent variables such as concordant naming ability and dichotomized clinical asthma outcomes over the past month. For all regression models, covariates were included if bivariate analyses between the covariate and any dependent variable (e.g. caregiver perception group, concordance, clinical asthma outcomes) yielded p values ≤ 0.1 . On this basis, caregiver age and child age were included in all regression models; randomized group allocation was also included to account for any potential intervention effect. A 2-sided alpha of <0.05 was considered statistically significant.

RESULTS

We enrolled a total of 165 subjects in year two of the SB-TEAM trial, with a participation rate of 80% among eligible subjects. Of those enrolled, 162 children (98%) completed the final home follow-up visit. Caregivers of 141 subjects (87%) reported more than one inhaled medication used by their child.

The demographic characteristics of this sample are displayed in Table 1. Overall, the sample completing the final follow-up was 62% male, 62% Black, and 30% Hispanic. The average child age was 7.4 years. A majority of caregivers had a high school education or greater (74%), were unmarried (80%), and spoke only English at home (87%). With respect to caregiver perception of their ability to name medications, 105 caregivers (75%) considered it

easy to remember inhaled asthma medication names, while 36 caregivers (25%) did not consider it easy. No significant differences were identified between the two caregiver perception groups across key demographic domains, including caregiver education and English language spoke at home.

We compared self-perceived ability to recall medication names with concordant naming ability through bivariate analysis. Caregivers who considered medication names easy to remember were significantly more likely to accurately name available medications, compared to those who did not find names easy to remember (53.5% vs 22.9%, $p = 0.002$). Overall, less than half of all caregivers (46%) were able to accurately name available medications with complete concordance.

Reported symptoms and medication use were then compared between caregiver perception groups (Table 2). Caregivers who did not easily remember names reported significantly fewer symptom free days over the previous two weeks compared to caregivers who did easily remember (10.5 vs 12.1, $p = 0.04$). There was a trend of increasing days requiring rescue medication use among children of caregivers who did not easily remember, but the difference did not reach significance (3.0 vs 1.6, $p = 0.08$). Caregivers who did not easily remember medication names were significantly more likely to report daytime symptoms on more than two days per week (33.3% vs 16.2%, $p = 0.03$) and nighttime symptoms more than twice a month (30.6% vs 12.4%, $p = 0.02$). No differences between groups were identified in reported oral corticosteroid courses over the previous year. Finally, more caregivers who did not easily remember names reported that their child missed one or more doses of preventive medication in the previous two weeks (51.7% vs 28.4%, $p = 0.03$).

Regression analyses support and expand upon these findings (Tables 3,4). Multiple linear regression confirmed the relationship between caregivers not easily remembering medication names and reporting fewer symptom free days (B -1.87 (95% CI $-3.21, -0.52$)), as well as more days requiring rescue medication use (B 1.54 (95% CI $0.20, 2.89$)). Similarly, the relationship between caregiver naming ability and categorical dependent variables remained intact in multivariate logistic regression analyses. Caregivers who did not easily remember medication names were more likely to not accurately name available medications, compared with those who did easily remember (OR 3.98 , 95% CI $1.61, 9.83$); they also reported more symptoms, including daytime symptoms on more than two days per week (OR 3.25 , 95% CI $1.30, 8.15$), nighttime symptoms more than twice a month (OR 4.22 , 95% CI $1.55, 11.49$), and rescue medication use more than twice a week (OR 2.56 , 95% CI $1.07, 6.24$). Lastly, caregivers who did not easily remember medication names were more likely to report missing one or more doses of prescribed controller medications (OR 2.82 , 95% CI $1.17, 6.81$).

Finally, as a secondary outcome measure, we asked all caregivers whether it was easiest to identify their child's inhaled asthma medications by name, color, or some other method. In order to identify the percentage of caregivers whose preferred method of identifying their child's asthma medications is something other than name alone, "color" and "other" responses were combined for analysis. Slightly more than one quarter of caregivers (27%) selected medication names as the easiest method of recognizing or identifying their child's

asthma medications, compared with 73% of caregivers who selected “color” or “other” as options.

DISCUSSION

Controlling persistent asthma often requires the use of multiple inhaled medications, including daily adherence with a preventive therapy like ICS. High-risk children with asthma face many barriers to adherence, but the literature says little about the inability of caregivers to identify medications by name as a potential barrier to asthma management. In this study, 75% of caregivers for urban children with persistent asthma considered it easy to remember the names of inhaled asthma medications, yet only 46% of caregivers were able to provide names that matched the inhaled medications they had available at home. Perceived difficulty in remembering medication names was significantly associated with an inability to accurately name available medications, an increased frequency of asthma symptoms in children, an increased use of rescue medications by children, and an increased likelihood of children missing preventive medication doses. In other words, when parents say they don't easily remember medication names, they actually don't, and their children are more symptomatic. Finally, a significant majority of caregivers (75%) did not consider names to be the easiest way to identify their child's inhaled asthma medications.

Other studies of medication adherence lend conceptual support to our findings. For example, caregivers of children with asthma who misunderstand the role of preventive medications are less likely to report adherence with routine therapy.⁽²⁵⁾ Knowledge of medication names and knowledge of indications for use are distinct concepts, but they are linked together through the model of medication self-management:⁽¹⁷⁾ unless a caregiver understands basic information about asthma medications, their child is unlikely to have them administered as prescribed. Similarly, limited health literacy has been associated with a decreased ability to identify both medication names and indications for use among adult patients,⁽²⁶⁾ and impairs medication reconciliation.⁽²⁷⁾ Although health literacy was not assessed in this study, the findings are salient to our work. If patients are unable to reconcile prescribed medications by name, then adherence to a written care plan, provider medication counseling, and coordination of care are potentially at risk.⁽²⁷⁾

It is worth noting that 73% of caregivers in our sample preferred to identify inhaled asthma medications by some characteristic other than name alone. Although the present study focuses on the role of medication names in asthma management, the implications of this finding are clear: whether manufacturing inhaled asthma medications or educating about them in clinic, ensuring that patients can easily differentiate between necessary medications by both name and color may enhance the ability of families to succeed in home asthma management. Future studies should specifically examine visual identification of inhaled asthma medications, and assess whether visual cues like device color impact self-efficacy, adherence, and disease control.

Our study has several strengths. Almost all families exclusively spoke English at home, so there was unlikely to be an oral language barrier between interviewers and respondents impacting medication naming. By limiting analyses to those caregivers reporting more than

one inhaled medication, we were able to more closely examine the potential confusion introduced by multiple medications in complex regimens.

The use of home visitation for the interview was also an asset, allowing for the direct assessment of the medications available at home. Although asthma medications inspected in the home were not compared with medical record or pharmacy data, these other methods are not obviously superior to in-home medication inspection as a standard against which to compare caregiver naming ability. In fact, our approach to assessing concordance may have been ideal to assess medication identification. One in four new medication prescriptions are not picked up by patients,⁽¹⁷⁾ so the use of medical record prescription data would likely include a substantial number of medications unknown to caregivers. Pharmacy records can determine prescription filling habits and thus estimate adherence.^(28, 29) Visualizing medications in the home is a better marker of medication availability at the time of the survey, however.

Several limitations also warrant discussion. The cross-sectional design of this study means that no causal link can be drawn between a caregiver's perceived ability to name medications and a child's symptoms. We had a relatively small sample size, precluding any ability to conduct subgroup analysis. It would have been interesting to examine whether concordant naming ability differed for rescue and preventive therapies, or whether caregivers were mischaracterizing medications by class. Likewise, it would be valuable to determine whether any caregiver characteristics predict overconfidence in the ability to name medications. This study is embedded within a larger, ongoing trial, thus we were limited to the sample size available from the trial. The concordant naming variable may underestimate the number of caregivers who can correctly identify all inhaled asthma therapies by name, if medications were accurately named but not available during the home visit. Nevertheless, the study allowed us to identify those caregivers for whom medication names were not a likely barrier to home asthma management. Further, since the assessment was conducted at the end of the randomized trial, our findings might represent a conservative estimate of caregiver's ability to accurately name medications.

Relying on caregiver report of asthma morbidity potentially subjects our findings to recall bias, though the two week and one month recall periods are widely accepted reporting windows (i.e. NAEPP guidelines⁽²⁾, Asthma Control Test⁽³⁰⁾). The one-year recall period for corticosteroid use increases the potential for recall bias. Although not specific to corticosteroid use, however, there is evidence that caregivers can accurately report acute asthma events and health care utilization after one year.⁽³¹⁾ Similarly, social desirability bias might inflate caregiver perceptions of naming ability to exceed observed ability. Responses where caregivers do not consider medication names easy to remember may be less susceptible to such bias; accordingly, providers may find it useful to screen for caregivers who perceive such difficulty. Finally it should be recognized that this study, conducted among predominantly English-speaking caregivers of urban youth with persistent asthma, may not be generalizable to all populations and settings.

Conclusions

A majority of caregivers of urban children with persistent asthma were unable to concordantly name inhaled medications available in the home. It is important that the health care system take notice of this problem, and further studies to better describe and understand the potential relationship between medication identification and improved adherence to care are needed. Incorporating more health literate approaches to asthma care, with attention to caregiver ability to identify medications by both name and color, may reduce barriers to understanding complex treatment regimens and equip families with the self-efficacy necessary to succeed in managing asthma at home.

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WHAT'S NEW

Suboptimal adherence with inhaled preventive medications is a significant contributor to pediatric asthma morbidity the United States. A caregiver-perceived inability to identify medications by name may act as a barrier to adherence and disease control.

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Table 1

Demographics and Other Baseline Characteristics - Caregiver Perception Groups

Characteristic	All Subjects (n = 141)	Easy to Remember (n = 105)	Not Easy to Remember (n = 36)	P value *
Child Age, y	7.4 (1.7)	7.4 (1.7)	7.7 (1.7)	0.27
Gender (Male)	88 (62%)	64 (61%)	24 (67%)	0.69
Black	88 (62%)	66 (63%)	22 (61%)	0.85
Hispanic	42 (30%)	31 (30%)	11 (31%)	1.00
Medicaid Insurance	96 (68%)	71 (68%)	25 (69%)	1.00
Caregiver age, y	35.3 (8.9)	35.3 (9.1)	35.4 (8.3)	0.93
Caregiver marital status: Married	28 (20%)	18 (17%)	10 (28%)	0.23
Caregiver education: High School	105 (74%)	78 (74%)	27 (75%)	1.00
Language spoken at home: English Only	122 (87%)	90 (86%)	32 (89%)	0.78
Randomized study arm:				
Control	64 (45%)	50 (48%)	14 (39%)	0.44
SB-TEAM Intervention	77 (55%)	55 (52%)	22 (61%)	

* Statistically significant at $P < 0.05$

Table 2

Caregiver Perception, Concordant Identification, and Reported Symptoms *

“It is easy to remember the names of my child’s asthma medications”:	<u>Easy to Remember</u> (n = 105)	<u>Not Easy to Remember</u> (n = 36)	<u>P value</u> **
<u>Concordant identification of available medications</u> †			
Yes	54 (53.5%)	8 (22.9%)	0.002 **
No	47 (46.5%)	27 (77.1%)	
<u>In the past two weeks:</u>			
Symptom free days	12.1 (3.3)	10.5 (4.2)	0.04 **
Number of days rescue medication was used	1.6 (3.1)	3.0 (4.5)	0.08
<u>In the past month:</u>			
Number of days with symptoms			
2/week	88 (83.8%)	24 (66.7%)	0.03 **
> 2/week	17 (16.2%)	12 (33.3%)	
Number of nights with symptoms			
2/month	92 (87.6%)	25 (69.4%)	0.02 **
> 2/month	13 (12.4%)	11 (30.6%)	
Number of days rescue medication was used			
2/week	86 (81.9%)	24 (66.7%)	0.07
> 2/week	19 (18.1%)	12 (33.3%)	
<u>In the past year:</u>			
Number of times oral steroids were required			
1	90 (86.5%)	29 (80.6%)	0.42
> 1	14 (13.5%)	7 (19.4%)	
<u>Adherence:</u> ‡			
Number of doses of controller medication missed in past two weeks			
0	63 (71.6%)	14 (48.3%)	0.03 **
1	25 (28.4%)	15 (51.7%)	
<u>Preferred way to identify child’s asthma medication:</u>			
Name	31 (29.5%)	7 (19.4%)	0.28
Color/Other	74 (70.5%)	29 (80.6%)	

* Data are presented as n (%) or mean (standard deviation).

** Statistically significant at P < 0.05

† Missing data on 5 subjects

‡ Missing data on 24 subjects

Table 3Multiple Linear Regressions - Caregivers Do Not Agree That Medication Names Are Easy to Remember [†]

Dependent Variable	B (95% CI)	Standard Error	P value *
Symptom free days over past two weeks	-1.87 (-3.21, -0.52)	0.68	0.01 *
Number of days rescue medication used over past two weeks	1.54 (0.20, 2.89)	0.68	0.03 *

CI = Confidence Interval

* Statistically significant at P < 0.05

[†]Regression models controlled for child age, caregiver age, treatment group

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Table 4

Multivariable Logistic Regressions - Caregivers Do Not Agree That Medication Names Are Easy to Remember [†]

Dependent Variable	B	Standard Error	OR (95% CI)	P value *
No concordant identification of available medications	1.38	0.46	3.98 (1.61, 9.83)	0.003 *
Daytime symptoms in part month: > twice/week	1.18	0.47	3.25 (1.30, 8.15)	0.01 *
Nighttime symptoms in past month: > twice/month	1.44	0.51	4.22 (1.55, 11.49)	0.005 *
Rescue medication use in past month: > 2/week	0.95	0.45	2.56 (1.07, 6.24)	0.04 *
Number of controller medication doses missed in past 2 weeks: 1	1.04	0.45	2.82 (1.17, 6.81)	0.02 *

OR = Odds Ratio; CI = Confidence Interval

* Statistically significant at P < 0.05

[†]Regression models controlled for child age, caregiver age, treatment group