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Medication identification in pediatric asthma (MED ID): The reliability and validity of a novel screening tool

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Abstract

Objectives: To evaluate the reliability and validity of MED ID, a novel survey assessing caregiver-perceived ability to identify inhaled asthma medications.

Methods: We analyzed baseline data from the School-Based Asthma Care for Teens (SB-ACT) trial in Rochester, NY. Caregivers of adolescents with persistent asthma named the inhaled medications used by their child, and identified medications on a pictorial chart. Accurate identification was defined as completed matches between listed names and selected images. Caregivers answered the MED ID survey of four scaled questions on perceived ability to identify inhaled medications. We determined internal consistency reliability using Cronbach's alpha; examined concurrent validity by comparing MED ID sum scores with accurate identification using bivariate and multivariate analyses; and assessed the diagnostic utility of MED ID through ROC analysis.

Results: 126 caregivers (76% of enrolled) reported >1 inhaled medication; 52% of caregivers accurately identified medications. Two MED ID questions were removed during analysis. The two remaining questions had a score range of 2–10 points; higher scores indicate greater caregiver-perceived ability to identify medications. The Cronbach's alpha was 0.603. Accurate identification of medications was associated with a higher mean MED ID score (8.6 vs 7.6, $P=0.01$). Accuracy was most strongly associated with MED ID scores ≥ 8 points (88% vs 60%, $P<0.001$, Phi 0.32); findings were consistent in regression analysis. The greatest AUC was seen with MED ID scores ≥ 8 points (0.638).

Conclusions: The two item MED ID survey is a reliable and valid way to assess caregiver ability to identify inhaled asthma medications.

Keywords

Control/Management; Pediatrics; Pharmacotherapy; Prevention

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Declaration of Interest:

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

INTRODUCTION

Almost seven million children under the age of 18 are diagnosed with asthma in the United States, making it one of the most prevalent chronic diseases of childhood.⁽¹⁾ A disproportionate burden of disease morbidity and mortality is borne by poor, minority, and inner-city children.^(2–6) The United States Department of Health and Human Services has established goals for asthma morbidity and mortality in Healthy People 2020,⁽⁷⁾ including a reduction in asthma-related deaths, hospitalizations, and emergency department visits. Fortunately, there is a roadmap for how to accomplish these goals.

Asthma management guidelines published by the National Heart, Lung, and Blood Institute (NHLBI)⁽⁸⁾ emphasize the importance of preventive care, specifically recommending daily treatment with medications such as inhaled corticosteroids (ICS) for every patient with persistent asthma. Routine use of ICS has been associated with improved clinical outcomes for children with persistent asthma, including a reduction in asthma-related deaths, hospitalizations, and emergency department visits.^(9–13) Despite more than two decades of guidelines and effective preventive therapy, however, little progress has been made in decreasing the high rates of pediatric asthma morbidity in the United States.⁽¹⁾

Poor adherence with ICS medication is a significant contributor to stagnant morbidity rates. Only about half of all prescribed ICS doses are administered to younger children with persistent asthma.⁽¹⁴⁾ By late adolescence, only one of four prescribed doses is used.⁽¹⁴⁾ Bailey's Model of Medication Self-Management was developed to better understand the dynamic process of medication adherence, incorporating health literacy principles to generate a more patient-centric framework of medication use.⁽¹⁵⁾ This model describes how, after filling prescriptions, the next step required for medication use is "the ability to name, identify, and understand how to take medications," "a fundamental yet often overlooked part of medication self-management."⁽¹⁵⁾ Although NHLBI guidelines emphasize the importance of educating patients on how to take medications,⁽⁸⁾ clinic-based education about preventive medications does not routinely occur, particularly for urban children with persistent asthma.⁽¹⁶⁾ The importance of naming and identifying medications to self-management is not well understood in pediatric asthma, and thus may represent an unrecognized barrier to adherence.

A recent cross-sectional survey in Rochester, NY examined medication identification among caregivers for school age children with persistent asthma. The study found that perceived difficulty in remembering medication names was associated with a decreased ability to correctly name available medications, as well as an increase in reported asthma symptoms, rescue medication use, and missed doses of preventive medication.⁽¹⁷⁾ A pair of studies on adults with hypertension further supports confusion around medication names as a potential barrier to adherence: subjects who were unable to identify medications by name were more likely to have poor hypertension control and adverse sequelae.^(18, 19) These studies provide empirical support to the theoretical importance of medication names in chronic disease management.

The ability to identify medications through physical properties may also play an important role in routine use and disease control. Among adults with epilepsy requiring treatment with anti-epileptic drugs, Kesselheim found that “patients who experience changes in pill color... have an increased risk of interruptions in medication use.”⁽²⁰⁾ A similar dynamic is seen in adults prescribed cardiovascular medications following a myocardial infarction: a patient-initiated discontinuation of treatment was significantly associated with changes in medication color or shape just prior to stopping therapy.⁽²¹⁾ These studies indicate that visual properties of medications play a role in the sustained use of prescribed therapies.

Whether by name or physical appearance, a patient’s ability to identify medications has increasingly been associated with medication use and disease control. Further studies are needed to refine our understanding of this potential barrier to adherence. One obstacle to such work is the lack of a reliable and valid survey tool that can be easily implemented by clinicians and researchers alike to assess a patient’s ability to identify medications. The objectives of this study are to evaluate the reliability of a new survey assessing a caregiver’s perceived ability to identify inhaled asthma medications, and determine the validity of these questions through comparison with observed ability to name and visually identify inhaled medications. A brief, reliable, and valid survey will enable a greater understanding of medication identification, and help clinicians to better identify patients who might be at increased risk of non-adherence due to this novel barrier.

METHODS

Parent study

School-Based Asthma Care for Teens (SB-ACT) is a randomized control trial currently underway in Rochester, New York. The study is designed to assess an intervention promoting adherence with preventive medications among young urban adolescents with persistent asthma. Adolescents are eligible for inclusion into the study if they are between 12 and 15 years old, have been diagnosed with asthma by a physician, attend a Rochester City School District (RCSD) school, and have persistent asthma symptoms or poorly controlled asthma per NHLBI guidelines.⁽⁸⁾ Teens are excluded if the family has no access to a working phone, the caregiver is unable to speak or understand English, or if the adolescent has another significant medical condition impacting respiratory symptoms. The current analysis was additionally limited to caregivers reporting more than one inhaled asthma medication, anticipating that medication identification is a less likely barrier to adherence when only one inhaled medication is being used.

Potential subjects were identified for initial eligibility screening through a combination of school screening forms, school medical alert forms, and a list of students requiring nursing care for asthma-related concerns. A member of the study team contacted each caregiver by phone to confirm eligibility and schedule a baseline home visit for enrollment. Written informed consent was obtained from each caregiver, and verbal assent was obtained from all adolescents. This secondary analysis uses data from baseline surveys of caregivers completed between November 2014 and January 2016. The study protocol was approved by the institutional review board of the University of Rochester.

Survey development

No pre-existing survey addressing medication identification was discovered in the literature. Accordingly, a short panel of new survey questions was developed through an iterative process. The questions were initially crafted by drawing on clinical experience within an urban academic pediatric practice, with the intent to explore caregiver confidence, attitudes, knowledge, and behaviors around medication identification. Drafted questions underwent several rounds of pre-testing in the primary care clinic with parents of children with persistent asthma. Additional iterative changes were made as recommended by the asthma research team. The finalized panel of four medication identification (MED ID) questions was incorporated into the SB-ACT baseline survey.

Survey

Caregivers responded to the MED ID questions by selecting their level of agreement with four statements about identifying medications, including: (1) perceived ease of remembering medication names; (2) confidence in ability to identify medications; (3) confusion while trying to identify medications when other breathing medications are present in the home; and (4) whether an improved ability to recognize medications would change preventive medication use behaviors. Responses to these questions were selected from a five item Likert scale ranging from strongly agree (score = 5) to strongly disagree (score = 1).

To determine caregiver ability to identify medications, respondents were asked to name all of the inhaled asthma medications used by their child. Caregivers were additionally asked to point out medications used by their child on a chart of inhaled medication pictures printed in color. Accurate medication identification was defined as complete matches between all named and all visually identified inhaled asthma medications. Both generic and trade names were accepted responses. Generic medication names like ‘albuterol’ were considered correct if any albuterol sulfate medication was identified on the chart, while trade medication names were only considered correct if that specific brand was visually identified.

Analysis

Analyses were completed using SPSS version 22 software (SPSS Inc., Chicago, Ill.). A two-sided alpha of <0.05 was considered statistically significant.

Sample

We used univariate descriptive analyses, including means and standard deviations, to describe the baseline characteristics of the sample including demographics, distribution responses to MED ID questions, and accurate identification of medications. We used bivariate analyses (chi-square, t-test) to compare demographic variables with the ability of caregivers to accurately identify medications.

Reliability of MED ID survey

As the panel of four MED ID questions was posed to caregivers during a single survey setting, internal consistency reliability was determined using Cronbach’s alpha. An alpha of 0.6–0.7 indicates acceptable internal consistency reliability. If this threshold was not

reached, individual scale items were evaluated for elimination, and the Cronbach's alpha was recalculated for remaining items.

Criterion Validity

An assessment of MED ID scale concurrent validity followed the reliability analysis, to determine whether MED ID sum scores were associated with accurate identification. The overall MED ID sum score was determined for each subject. For the first two questions, responses of "strongly agree" generated 5 points, while "strongly disagree" earned 1 point. Responses to questions three and four were inverted for analysis, so that higher scores represent less confusion when identifying medications; responses of "strongly disagree" generated 5 points on these questions. A maximum sum score of 20 points indicates that the respondent does not perceive any difficulty in accurately identifying inhaled asthma medications (range 4–20).

Mean MED ID sum scores were compared between caregivers who accurately identify medications and those who do not using a t-test. We compared proportions for different sum score cutoffs on the scale using chi-square analysis, with phi coefficients calculated to assess the magnitude of observed relationships. Finally, chi-square analyses compared individual MED ID items with accurate medication identification. Item responses were dichotomized for these analyses: scores of 4 and 5 were combined into one category, with scores of 1, 2, and 3 combined to create the referent category.

For MED ID sum score cutoffs that were associated with accurate medication identification, a logistic regression model was constructed to account for the potential influence of confounding variables. Covariates were selected for inclusion based on the results of earlier descriptive analysis: we incorporated any demographic variables with a P value <0.1 into the model.

Finally, MED ID sum scores were evaluated for precision in screening for accurate medication identification. We determined sensitivity, specificity, positive predictive value, negative predictive value, and the area under the curve (AUC) in receiver operating characteristic (ROC) analyses for multiple score thresholds.

RESULTS

Sample

One-hundred and seventy-six pairs of adolescents and caregivers were enrolled during the first two years of the SB-ACT trial (participation rate 75%). All caregivers completed the in-home baseline assessment; 126 caregivers (76%) reported that their child used more than one inhaled asthma medication. The characteristics of this sample, including a demographic comparison between accurate and inaccurate medication identification, can be found in Table 1.

The baseline sample of adolescents was 54% male, 59% Black, and 33% Hispanic. The average child was 13.5 years old, and most were covered by Medicaid or another managed care public insurance (79%). Few caregivers in either group were married (18%). Overall,

52% of caregivers accurately identified medications with a complete match between all named and all visually identified inhaled asthma medications. Caregivers who accurately identified medications, compared with inaccurate caregivers, were younger (38.9 years vs 42.1 years, $P=0.03$) and more likely to speak only in English at home (56% vs 44%, $p=0.03$). There was a trend for accurate caregivers to have greater than a high school education, though this did not reach statistical significance.

Reliability of MED ID survey

An internal consistency reliability analysis of the full MED ID survey yielded a Cronbach's alpha of 0.57. The fourth item, exploring whether caregivers felt medication adherence would improve if medications were easier to identify, was removed due to potential ambiguity of the question and concerns that it was overly complex. Internal consistency reliability was subsequently recalculated to be 0.65.

The third item, assessing confusion in identifying medication when other family members have inhaled medications at home, was also removed. One-hundred twelve caregivers responded with opinions to this third item; twelve selected "not applicable," indicating that no other family members had inhaled medications at home. This lies in contrast to responses generated from a separate question in the baseline instrument, asking caregivers whether "there are any other breathing medicines in your home used by other household members": only 55 caregivers responded in the affirmative. This indicates that over half of all caregivers responding to the third MED ID item may have been mischaracterized by selecting an answer other than "not applicable." When removed from the scale, internal consistency reliability for the first two items was 0.603.

Criterion validity

Concurrent validity of the two-item MED ID scale was assessed by comparing scale sum scores with accurate medication identification (Table 2). After removing two items from the scale, the maximum possible score decreased to ten points; a value of 6 points signifies that caregivers neither agree nor disagree with included statements. Caregivers who accurately identified medications had a higher mean MED ID sum score than caregivers who did not accurately identify medications (8.6 vs 7.6, $P=0.01$).

For all dichotomized sum score thresholds of 7 points or greater (indicating some level of agreement with the statements), caregivers reaching the score threshold were significantly more likely to identify medications accurately. The strongest association between sum score and accurate medication identification was observed among respondents scoring eight or more points (88% vs 60%, $P<0.001$, Phi 0.32). A logistic regression analysis incorporating the covariates of caregiver age, caregiver education, and primary language spoken at home confirmed these findings (Table 3): caregivers with a MED ID score ≥ 8 , compared with caregivers scoring <8 , were 5.9 times more likely to accurately identify inhaled medications. Caregiver age and language at home maintained significant associations with accurate identification of medications in regression analysis.

The two remaining MED ID items were individually compared with accurate medication identification. Caregivers who agreed that it is easy to remember medication names (score of

4 or 5) were more likely to accurately identify medications (61% vs 39%, $P=0.001$, $\Phi=0.3$). Confidence in ability to identify medications was not associated with accurate identification.

MED ID Screening Characteristics

The diagnostic properties of the MED ID scale in identifying accuracy in medication identification were evaluated for each cutoff score of 6 points or higher (Table 4). Overall, sensitivity increases as MED ID sum scores decrease. Specificity estimates increased with increasing sum scores. The greatest AUC is seen with a sum score ≥ 8 (0.638). This score threshold is 88% sensitive in screening for accurate medication identification, with a specificity of 40% indicating that many who cannot accurately identify medications would still meet this threshold. The high negative predictive value (75%) indicates that most respondents who score less than 8 on the two item MED ID scale are truly unable to accurately identify medications.

DISCUSSION

The ability to name and identify medications is considered fundamental to the routine use of medications in chronic illness.⁽¹⁵⁾ These abilities have not been well studied among patients with chronic disease in general, and only a single study examining this potential barrier to self-management in pediatric asthma could be identified.⁽¹⁷⁾ To our knowledge, this study is the first to evaluate survey questions measuring accurate identification of asthma medications.

We found that only about half (52%) of the caregivers for young urban adolescents with persistent asthma in our sample were able to accurately identify inhaled medications used by their children, a notable finding in itself that underscores the need for a quick screening tool to detect and address issues with medication identification. Accurate identification was defined as complete matches between the medication names provided by caregivers and the images they selected on a pictorial chart of inhaled asthma medications. Higher sum scores on the two-item MED ID scale were significantly associated with accurate identification at several scoring thresholds. A score threshold of 8 points best categorized accurate medication identification, with a phi coefficient greater than 0.3 and results that held following logistic regression analysis.

Using 8 as a threshold score for analysis helps diagnose accurate identification of inhaled medications. The high sensitivity (88%) indicates that most caregivers who can accurately identify asthma medications will be detected with a survey score of 8. A positive predictive value of 61% indicates that a score of 8 or more will identify 61% of participants who can truly identify medication. The high negative predictive value (75%) also supports the utility of this threshold score: approximately three-quarters of respondents scoring less than 8 points will be unable to accurately identify medications. Accordingly, a score less than 8 can help identify medication identification as a potential barrier to adherence. Finally, a score cutoff of 8 points is associated with the largest AUC in ROC analysis.

Together, these findings indicate that the two-item MED ID survey is a reasonably reliable and valid method to assess the ability to accurately identify inhaled asthma medications. It

allows for a speedy determination of which caregivers are likely impacted by this potential barrier to self-management, so that specific clinical education about inhaled asthma medications can be better triaged and delivered.

The MED ID scale is not a perfect instrument. Despite an iterative design process and clinical pre-testing with the target population, issues with two items were not identified until the analysis was conducted. The fourth item in the original scale could be perceived as overly complex, impairing the ability to cleanly interpret caregiver answers. An additional problem was discovered with the third scale item, in which many caregivers may have inaccurately responded, possibly due to social desirability bias in the presence of an interviewer. The internal consistency reliability of the remaining two items passed the alpha threshold of 0.6; this reliability is acceptable but low, indicating that the survey could likely benefit from further refinement.

The second item addressing confidence in the caregiver's ability to identify medications was not independently associated with accurate identification. Accordingly, it is possible that the first item on the scale may perform as well as the two-item scale. As survey properties were only examined within a single population, however, it is also possible that other populations (i.e. adolescents, younger children) would respond differently to the second item. This point reflects the reality of clinical practice in pediatrics: children and adolescents are often tasked with responsibility of managing asthma medications,^(22–24) yet many children may not be able to recall names and instead identify medications through generalized physical descriptors.⁽²⁵⁾ Accordingly, a question about confidence in overall ability to identify medications may well complement a question about name recall in certain populations.

Additionally, respondents' confidence in their ability to identify medications relates to self-efficacy, which is considered important by the Health Belief Model for patient behaviors including medication adherence.⁽²⁶⁾ Further, the two item scale performed well in the ROC analysis, and higher sum scores on the two item scale were significantly associated with accurate identification at several scoring thresholds. Therefore, the decision was made to retain the two-item MED ID scale in anticipation of the strong foundation it will provide for future work in patient-centered research on the ability to identify medications.

This study does not assess whether accurate identification of medications is associated with reported symptoms or adherence with preventive therapy. While these outcomes are of obvious interest when assessing a potential barrier to adherence, they were beyond the scope of this study, which was designed to measure the performance of a novel survey tool. In addition, the primary responsibility for asthma self-management gradually transitions from caregiver to child during adolescence. Caregivers who are not as directly involved in daily medication management may be less able to accurately report on medication adherence or recent symptoms.

Limitations and Strengths

The performed analysis has several limitations that merit consideration. As this is a secondary analysis of cross-sectional data, findings are limited by the methods originally used to construct and refine questions about medication identification. Specifically, the

questions were developed for a baseline survey administered at the start of a clinical trial involving urban children with persistent asthma. It is uncertain how generalizable the results will be to other populations or clinical settings. A relatively small sample size was included in this study, limiting both subgroup analysis and statistical power.

Additionally, the scale questions are potentially subject to social desirability bias: caregivers may not want to acknowledge difficulty in identifying necessary asthma medications during an in-person interview. In fact, this may help explain why 60% of caregivers who could not accurately identify medications responded to the MED ID survey with a score of 8 or higher. Revising the wording to craft more neutral statements in future survey iterations may diminish the influence of social desirability bias. Nevertheless, the high negative predictive value indicates that a “negative” sum score less than 8 is a reasonable marker for inaccuracy in medication identification.

The method for determining accuracy in medication identification is one of the chief strengths of this analysis. However, the medications named and visually identified by caregivers may not reconcile well with pharmacy data or electronic medical record documentation. In addition, the ability to match medication names and images does not mean that the child has necessary inhaled medications at home, or that the medications would be used as prescribed if available. Rather, this method for gauging accuracy allows for the determination of whether or not medication identification itself is a potential barrier to adherence and self-management.

The sample population is an additional strength. While generalizability of results may be limited, this sample of high-risk children with persistent asthma is a good representation of the pediatric populations most affected by asthma. Accordingly, this subject population is ideal to work with, in order to explore patient-centered barriers to adherence where disparities are greatest.

Future Directions

The two-item MED ID survey would benefit from additional study. Analyzing teen respondent data from the SB-ACT trial will provide valuable information about the transition process: as young adolescents gradually take on greater responsibility for medication management, does the MED ID survey accurately identify an increasing ability to identify medications? Given the developmental implications of pediatric asthma management, it will also be important to assess the reliability and validity of this survey among caregivers of younger children with persistent asthma. A younger sample in which caregivers have the majority of responsibility for disease management would potentially allow for a determination of whether accuracy in medication identification, as determined by the MED ID scale, is associated with either clinical symptoms or reported adherence.

It would be interesting to determine how the MED ID scale performs at different levels of respondent health literacy. As measures of health literacy were not included in the SB-ACT baseline assessment, this could not be assessed in the current study. Finally, educational efforts in the primary care office should be assessed, to determine if medication identification can be overcome as a potential barrier to adherence.

There are significant potential public health implications of this work. Accurate identification of medications is increasingly recognized as important to adherence and the self-management of chronic illness. To our understanding, no other tool currently exists to assess the ability of patients to perform this task. This brief, reliable, and valid two-item MED ID survey tool can stimulate conversations between clinicians and patients, inform future clinical studies, and empower families to attain control of persistent asthma.

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REFERENCES

1. Akinbami LJ, Moorman JE, Bailey C, Zahran HS, King M, Johnson CA, et al. Trends in asthma prevalence, health care use, and mortality in the United States, 2001–2010. NCHS Data Brief. 2012(94):1–8. PubMed PMID: . [PubMed: 22617340]
2. Akinbami LJ, LaFleur BJ, Schoendorf KC. Racial and income disparities in childhood asthma in the United States. *Ambul Pediatr*. 2002;2(5):382–7. PubMed PMID: . [PubMed: 12241134]
3. Gupta RS, Carrion-Carire V, Weiss KB. The widening black/white gap in asthma hospitalizations and mortality. *J Allergy Clin Immunol*. 2006;117(2):351–8. Epub 2006/02/08. doi: S0091–6749(05)02724–7 [pii]10.1016/j.jaci.2005.11.047. PubMed PMID: . [PubMed: 16461136]
4. Flores G, Snowden-Bridon C, Torres S, Perez R, Walter T, Brotanek J, et al. Urban minority children with asthma: substantial morbidity, compromised quality and access to specialists, and the importance of poverty and specialty care. *J Asthma*. 2009;46(4):392–8. Epub 2009/06/02. doi: 10.1080/02770900802712971. PubMed PMID: . [PubMed: 19484676]
5. Crocker D, Brown C, Moolenaar R, Moorman J, Bailey C, Mannino D, et al. Racial and ethnic disparities in asthma medication usage and health-care utilization: data from the National Asthma Survey. *Chest*. 2009;136(4):1063–71. doi: 10.1378/chest.09-0013. PubMed PMID: . [PubMed: 19567492]
6. Oraka E, Iqbal S, Flanders WD, Brinker K, Garbe P. Racial and ethnic disparities in current asthma and emergency department visits: findings from the national health interview survey, 2001–2010. *J Asthma*. 2013;50(5):488–96. doi: 10.3109/02770903.2013.790417. PubMed PMID: . [PubMed: 23544662]
7. U.S. Department of Health and Human Services, Office of Disease Prevention and Health Promotion,. *Healthy People 2020*. Washington D.C.: Government Printing Office; 2011.
8. Expert panel report III: guidelines for the diagnosis and management of asthma. NIH publication No. 07–4051. Bethesda, MD: U.S. Department of Health and Human Services; National Institute of Health; National Heart, Lung, and Blood Institute; National Asthma Education and Prevention Program, 2007.
9. Donahue JG, Weiss ST, Livingston JM, Goetsch MA, Greineder DK, Platt R. Inhaled steroids and the risk of hospitalization for asthma. *Jama*. 1997;277(11):887–91. PubMed PMID: . [PubMed: 9062326]
10. Suissa S, Ernst P, Benayoun S, Baltzan M, Cai B. Low-dose inhaled corticosteroids and the prevention of death from asthma. *N Engl J Med*. 2000;343(5):332–6. PubMed PMID: . [PubMed: 10922423]
11. Adams RJ, Fuhlbrigge A, Finkelstein JA, Lozano P, Livingston JM, Weiss KB, et al. Impact of inhaled antiinflammatory therapy on hospitalization and emergency department visits for children with asthma. *Pediatrics*. 2001;107(4):706–11. PubMed PMID: . [PubMed: 11335748]

12. Senthilselvan A, Lawson JA, Rennie DC, Dosman JA. Regular use of corticosteroids and low use of short-acting beta2-agonists can reduce asthma hospitalization. *Chest*. 2005;127(4):1242–51. Epub 2005/04/12. doi: 10.1378/chest.127.4.1242. PubMed PMID: . [PubMed: 15821201]
13. Wennergren G, Kristjansson S, Strannegard IL. Decrease in hospitalization for treatment of childhood asthma with increased use of antiinflammatory treatment, despite an increase in prevalence of asthma. *J Allergy Clin Immunol*. 1996;97(3):742–8. PubMed PMID: . [PubMed: 8613629]
14. McQuaid EL, Kopel SJ, Klein RB, Fritz GK. Medication adherence in pediatric asthma: reasoning, responsibility, and behavior. *J Pediatr Psychol*. 2003;28(5):323–33. PubMed PMID: . [PubMed: 12808009]
15. Bailey SC, Oramasionwu CU, Wolf MS. Rethinking adherence: a health literacy-informed model of medication self-management. *J Health Commun*. 2013;18 Suppl 1:20–30. doi: 10.1080/10810730.2013.825672. PubMed PMID: ; PubMed Central PMCID: PMC3814610. [PubMed: 24093342]
16. Frey S, Fagnano M, Halterman J. caregiver education to promote appropriate use of preventive asthma medications: What is happening in primary car? *J Asthma*. 2015 Epub 18 Aug 2015.
17. Frey S, Fagnano M, Halterman J. Medication identification among caregivers of urban children with asthma [abstract]. In: PAS 2015 Annual Meeting Program Guide 2015.
18. Persell SD, Bailey SC, Tang J, Davis TC, Wolf MS. Medication reconciliation and hypertension control. *Am J Med*. 2010;123(2):182 e9–e15. doi: 10.1016/j.amjmed.2009.06.027. PubMed PMID: . [PubMed: 20103029]
19. Lenahan JL, McCarthy DM, Davis TC, Curtis LM, Serper M, Wolf MS. A Drug by Any Other Name: Patients' Ability to Identify Medication Regimens and Its Association With Adherence and Health Outcomes. *Journal of Health Communication*. 2013;18:31–9. doi: 10.1080/10810730.2013.825671. PubMed PMID: . [PubMed: 24093343]
20. Kesselheim AS, Misono AS, Shrank WH, Greene JA, Doherty M, Avorn J, et al. Variations in pill appearance of antiepileptic drugs and the risk of nonadherence. *JAMA Intern Med*. 2013;173(3): 202–8. doi: 10.1001/2013.jamainternmed.997. PubMed PMID: . [PubMed: 23277164]
21. Kesselheim AS, Bykov K, Avorn J, Tong A, Doherty M, Choudhry NK. Burden of changes in pill appearance for patients receiving generic cardiovascular medications after myocardial infarction: cohort and nested case-control studies. *Ann Intern Med*. 2014;161(2):96–103. doi: 10.7326/M13-2381. PubMed PMID: . [PubMed: 25023248]
22. Winkelstein ML, Huss K, Butz A, Eggleston P, Vargas P, Rand C. Factors associated with medication self-administration in children with asthma. *Clin Pediatr (Phila)*. 2000;39(6):337–45. Epub 2000/07/06. PubMed PMID: . [PubMed: 10879935]
23. Orrell-Valente JK, Jarlsberg LG, Hill LG, Cabana MD. At what age do children start taking daily asthma medicines on their own? *Pediatrics*. 2008;122(6):e1186–92. doi: 10.1542/peds.2008-0292. PubMed PMID: . [PubMed: 19047221]
24. Yinusa-Nyahkoon LS, Cohn ES, Cortes DE, Bokhour BG. Ecological barriers and social forces in childhood asthma management: examining routines of African American families living in the inner city. *J Asthma*. 2010;47(7):701–10. doi: 10.3109/02770903.2010.485662. PubMed PMID: . [PubMed: 20726827]
25. Pradel FG, Hartzema AG, Bush PJ. Asthma self-management: the perspective of children. *Patient Educ Couns*. 2001;45(3):199–209. PubMed PMID: . [PubMed: 11722856]
26. Rosenstock IM, Strecher VJ, Becker MH. Social learning theory and the Health Belief Model. *Health Educ Q*. 1988;15(2):175–83. PubMed PMID: . [PubMed: 3378902]

Table 1.

Baseline Characteristics - Accurate Medication Identification

Characteristic	<u>All Subjects</u> (n = 125)	<u>Accurate</u> (n = 65)	<u>Not Accurate</u> (n = 60)	<u>P value</u>
Child Age, y	13.5 (1.0)	13.5 (1.2)	13.4 (0.9)	0.51
Gender (Male)	67 (54%)	37 (55%)	30 (45%)	0.48
Black	74 (59%)	40 (54%)	34 (46%)	0.59
Hispanic	41 (33%)	20 (49%)	21 (51%)	0.70
Medicaid Insurance	96 (79%)	50 (52%)	46 (48%)	0.82
Caregiver age, y	40.4 (8.2)	38.9 (6.8)	42.1 (9.3)	0.03 [*] [†]
Caregiver marital status: Married	22 (18%)	11 (50%)	11 (50%)	1.00
Caregiver education: > High School	53 (42%)	33 (62%)	20 (38%)	0.07 [†]
Language spoken at home: English Only	109 (87%)	61 (56%)	48 (44%)	0.03 [*] [†]
Asthma severity:				
Intermittent/Mild Persistent	90 (73%)	52 (80%)	38 (66%)	0.102
Moderate/Severe Persistent	33 (27%)	13 (20%)	20 (34%)	

* Statistically significant at $P < 0.05$

[†] Included in logistic regression model

Table 2

Comparing accurate medication identification with MED ID scale.

	Accurate (n = 65)	Not accurate (n = 60)	p-value	Phi coefficient
MED ID Scale (Full)				
Mean score (SD)	8.6 (1.4)	7.6 (1.8)	0.01 *	
MED ID Scale (Dichotomized)				
Sum Score 7	59 (91%)	42 (70%)	0.006 *	0.26
Sum Score 8	57 (88%)	36 (60%)	<0.001 *	0.32
Sum Score 9	33 (51%)	19 (32%)	0.045 *	0.19
Sum Score 10	24 (37%)	12 (20%)	0.048 *	0.19
MED ID Individual Items [†]				
Easy to remember medication names	56 (61%)	36 (39%)	0.001 *	0.30
Confidence in ability to identify medications	63 (54%)	54 (46%)	0.15	0.14

* Statistically significant at $p < 0.05$.

[†] Data shown for item scores of 4 or 5

Table 3.Multivariable Logistic Regression: Accurate identification of medication[†]

Independent Variable	B	Standard Error	OR (95% CI)	P value [*]
MED ID Sum Score 8	1.77	0.51	5.87 (2.17, 15.87)	<0.001 [*]
Caregiver language: English only	1.72	0.67	5.56 (1.50, 20.63)	0.01 [*]
Caregiver education: > high school	-0.44	0.50	0.65 (0.24, 1.73)	0.39
Caregiver age	-0.08	0.03	0.93 (0.88, 0.98)	0.006 [*]

OR = Odds Ratio; CI = Confidence Interval

^{*} Statistically significant at P < 0.05[†] Model controlling for caregiver age, language at home (English only vs other), caregiver education (> high school vs other)

Table 4.

Comparing matched medication identification with MED ID sum score (Max 10).

MEDID sum score	Accurate	Not accurate	Total	Sensitivity (%)	Specificity (%)	PPV	NPV	Area Under ROC Curve	ROC Asymptotic significance
2	65	60	0	*	*	*	*	*	*
3	65	60	0	*	*	*	*	*	*
4	65	60	7	*	*	*	*	*	*
5	63	55	3	*	*	*	*	*	*
6	63	52	14	97	13	55%	80%	0.551	0,323
7	59	42	8	91	30	58%	75%	0.604	0.045
8	57	36	93	88	40	61%	75%	0.638	0.008
9	33	19	52	51	68	64%	56%	0.596	0.66
10	24	12	36	37	80	67%	54%	0.585	0.103
Total	65	60	213						

* Not calculated.