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Identifying Which Children with Persistent Asthma have Preventive Medications Available at Home

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Abstract

Objective: To compare caregiver-reported preventive medication use and pharmacy data with medications available at home for children with persistent asthma, and identify factors associated with having preventive medication at home.

Methods: We analyzed baseline data from the School-Based Telemedicine Enhanced Asthma Management (SB-TEAM) study, including medication use, symptoms, and demographics. Research assistants documented all asthma medications available during home visits. We reviewed pharmacy records for a subset of children. Bivariate and multivariate analyses identified factors associated with having any preventive medication in the home.

Results: We included 335 children (mean 7.7yrs, 56% Black, 34% Hispanic, 77% Medicaid; participation 79%). Most caregivers (69%) reported preventive medication use, yet only 45% had preventive medication at home. Compared to families with preventive medication at home, more families without preventive medication reported discontinuous insurance in the prior year (7% v 15%, $p=0.02$) and medication sharing (22% v 32%, $p=0.04$). For the subset with pharmacy records ($n=192$), 40% filled a preventive medication in the past year and 15% had a preventive medication at home. In multivariate analyses, children were less likely to have preventive medication at home when caregivers reported no preventive medication use in the past 2 weeks (OR 0.25; 95%CI 0.14,0.43), discontinuous insurance (OR 0.42; 95%CI 0.19,0.97), medication sharing (OR 0.54; 95%CI 0.32,0.91), or caregiver education HS (OR 0.59; 95%CI 0.35,0.99).

Conclusion: Among urban children with persistent asthma, neither caregiver-report nor pharmacy data reflect home preventive medication availability. Inquiring about insurance coverage and medication sharing may improve preventive medication availability for these children.

Keywords

Prevention; management/control; pediatrics

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Disclosure of Interest

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

Introduction

Asthma is one of the most common chronic pediatric conditions, with approximately 6 million children affected in the US each year.[1] Morbidity from uncontrolled asthma is also common. In addition to frequent respiratory symptoms (e.g., cough, wheezing, chest tightness, shortness of breath), uncontrolled asthma is a risk factor for school absenteeism, limitations on physical activity, a decreased quality of life, and missed work for caregivers. [2, 3] Further, it is understood that children living in poverty and from minority ethnic and racial backgrounds suffer disproportionately from asthma.[3–5]

Routine healthcare assessments and an appropriate medication regimen, including preventive medications for all children with persistent asthma, are vital components of guideline-based asthma management.[6] These care goals are best achieved through ongoing engagement with a primary care provider (PCP) that includes regular symptom monitoring, medication adjustments as needed, a review of triggers, and home management education.[6] Importantly, poor, urban, and minority children who are at the greatest risk of disease-related morbidity often do not receive key elements of guideline-based care such as education or appropriate preventive treatment.[7–9]

When children are connected with a PCP and prescribed preventive medications, adherence to those medications is often poor: only ~50% of prescribed doses are taken, and this rate decreases further as children get older.[10] Improving adherence with controller medications can reduce preventable morbidity; accordingly, it is essential for PCPs to routinely assess adherence. Common assessment strategies in ambulatory care settings include asking caregivers/patients to describe home medication use, or reviewing pharmacy fill data when available through an electronic medical record.[11–13] While these assessments are available to providers at the point of care, there are clear limitations to each approach. Caregiver/patient reporting may be influenced by poor recall, and patients often overestimate adherence. Studies of pharmacy fill data often indicate that adherence to controller medications is low [11, 14, 15], but these data provide limited insight into adherence behaviors when families share medications or when the filled medication is not actually available to the child at home (i.e., the medication is lost or at another location).

As part of the adherence discussion, it may also be useful for PCPs to consider whether preventive medications are available at the child's home. Medication readiness, including the availability of necessary preventive medications, has been recently identified as a potential barrier to adherence that disproportionately impacts poor, minority children.[16] The ready availability of preventive medications is clearly necessary for adherence, if not sufficient to promote routine use. It is currently unknown whether caregiver report of preventive medication use or pharmacy fill data accurately reflects whether children with persistent asthma have home access to necessary medications.

Better understanding how often preventive medications are available at home for a child with asthma may help direct opportunities to improve guideline-based care. In this study, our objective was to compare caregiver report of preventive medication use and pharmacy dispensing data with medications actually available within the home for children with

persistent asthma, and identify factors associated with having a preventive medication available at home. We hypothesized that regardless of caregiver report of preventive medication use or pharmacy fill data, many of these children would not have medications available at home. We also hypothesize that those without medications available at home will report worse asthma symptoms and more acute visits for asthma.

Methods

We enrolled 400 children into the School-Based Telemedicine Enhanced Asthma Management (SB-TEAM) study, a 4 year randomized controlled trial (2012–2016) designed to assess an intervention combining in-school administration of preventive asthma medication with telemedicine follow-up visits.[17] Enrollment criteria included child age between 3–10 years, enrollment in the Rochester City School District, a physician diagnosis of asthma, and recent symptoms consistent with persistent asthma as outlined by national asthma management guidelines [6]. Subjects were ineligible if they were unable to speak English, did not have a telephone, or had any other medical conditions (e.g., congenital heart disease, cystic fibrosis) that may conflict with the assessments.[17]

During in-home baseline assessments, trained members of our research team used structured surveys to ask caregivers about their child's asthma symptoms, family demographic variables (age, income, gender, race/ethnicity, marital status, insurance, and), smoke exposure, and caregiver depressive symptoms (Center for Epidemiologic Studies - Depression [CES-D] scale).[17, 18] We also asked caregivers about their child's asthma medications (i.e., name, strength, prescribed dose, and time of administration) and adherence. Caregivers stated whether their child received any doses of their daily asthma medication in the prior 2 weeks (yes/no). We also asked caregivers if their family shares asthma medications, and if they reported their child 'ever' sharing a rescue or controller medication we classified the child as sharing medications. Finally, we asked caregivers to collect all of the child's asthma medications available in the home, and allowed caregivers to reference these medications when answering survey questions. Caregivers were not systematically prompted to prepare asthma medications or dosage information prior to the home visit. Members of our research team documented all asthma medications that caregivers presented. This documentation was used to determine if a preventive medication was available in the home.

Caregivers additionally were asked to report all pharmacies used to fill prescriptions for their child during the prior year. Our team faxed signed consent forms to the named pharmacies requesting itemized records for each subject; pharmacies that did not respond to an initial fax request received follow-up telephone calls and/or email correspondence, as necessary. We considered subjects to have a complete pharmacy dataset after our team obtained pharmacy records from all reported pharmacies for 12 months prior to baseline. Trained research assistants reviewed pharmacy records to identify prescriptions for asthma medications, and coded individual subjects as having a prescription filled for a preventive medication prior to baseline or not.

For this study, we analyzed records for 335 subjects enrolled during years 2–4 of the study, when both home medication and pharmacy data were collected systematically. We reviewed baseline survey data to identify subjects for whom a caregiver presented any preventive medication (i.e., MDI, diskus, or montelukast tablets) at the time of the home visit. Subjects were defined as having a preventive medication at home if *any* preventive medication was presented, even if labeled boxes were not available to ensure that the medication was prescribed for the child. Importantly, the preventive medication presented by caregivers did not have to match the prescribed medication(s) identified in the pharmacy record or any medication name(s) that caregivers reported to be considered for analysis. This approach represents a ‘best case scenario’ of preventive medication availability that did not rely upon caregivers’ knowledge or recollection of exact medication names.

We performed Chi-square and T-test analyses to explore variables associated with having a preventive medication at home. These bivariate analyses examined demographic variables including income (below or above the 2017 Federal Poverty Line [FPL])[19], age (child and caregiver), caregiver education (less than high school vs high school completion), race (Black, White or Other), Ethnicity (Hispanic/non-Hispanic), any gap in insurance in the 12 months prior to baseline (discontinuous insurance, Y/N), medication sharing in the home (caregiver report of child ever sharing any asthma medications, Y/N), and caregiver depressive symptoms (score of ≥ 16 on CES-D [18]). In addition, we examined several measures of asthma morbidity, including the Asthma Control Test [20] (ACT; disease control over the prior four weeks), symptom-free days (number of 24-hour periods within the prior two weeks during which the child has no asthma symptoms), acute ED visits for asthma in the prior year (dichotomized Y/N), whether the child had missed any school days in the prior year due to asthma (Y/N), and caregiver asthma-related quality of life (QOL) using Juniper’s Pediatric Caregiver Quality of Life Scale.[2] We also compared caregiver report of medication prescription (yes/no), and preventive medication use in the prior 2 weeks (yes/no), with home medication availability (yes/no). Finally, for the subset of children with complete pharmacy records available, we compared home availability of any preventive medication with pharmacy data indicating that a preventive medication had been filled in the prior 12 months (yes/no).

Next, we performed a multi-variate logistic regression analysis that modeled preventive medication availability as the dependent variable, controlling for discontinuous insurance, symptom free days, child age, public insurance, child sharing of medication, caregiver education, and controller medication use in the prior 2 weeks. Independent variables were selected for inclusion when bivariate comparisons yielded a p-value <0.1 , with the exception of public insurance. We included public insurance in the multi-variate analysis due to an a priori assumption that caregiver ability to obtain/purchase medications to have at home may be influenced by insurance status.

The study was approved by the University of Rochester Institutional Review Board. All caregivers provided written informed consent, and children older than 7 provided verbal assent to participate in the study. All analyses were conducted using SPSS v25,[21] and a two-sided p-value of <0.05 was considered statistically significant.

Results

We enrolled 400 children into the SB-TEAM study (overall participation rate: 79.1%), and used data for 335 children from years 2–4 for this analyses.[17] The mean age of subjects was 7.7 years (SD 1.7); 38% of our subjects were female, 77% of children had public insurance, and 11% had an insurance lapse in the prior year. Most children were African American (56%) or Hispanic (34%), and had a combined family income below the 2017 Federal Poverty Line (62%). Caregivers had a mean age of 34.8 years (SD 8.4); 33% reported depressive symptoms, 45% described at least one smoker in the home, 54% were currently employed, and most (71%) had completed high school/GED or additional education (Table 1).

Bivariate Analysis

While all 335 subjects included in this analysis had symptoms consistent with uncontrolled/persistent asthma, only 231 caregivers (69%) reported the child had a preventive medication prescription, and 150 caregivers (45%) were able to present a preventive medication during the baseline in-home assessment. There were a few differences in demographics between subjects based on the presence or absence of a preventive medication at home. Children without a preventive medication at home were older than children with a preventive medication (7.9 years vs 7.5 years, $p=0.048$). Families without a preventive medication at home were more likely than families with preventive medications to report a lapse in insurance during the prior 12 months (15% vs 7%, $p=0.023$), and to report sharing of asthma medications (32% vs 22%, $p=0.037$) (Table 1).

The availability of preventive medications at home was not associated with several measures of caregiver-reported morbidity; including ACT scores, symptom-free days, ED utilization, asthma-related school absenteeism, adherence, or caregiver asthma-related quality of life score (Table 2). However, families without a preventive medication at home were less likely to report their child had a preventive medication prescription (45% vs 98%, $p<0.001$), and less likely to report they used a preventive medication in the prior 2 weeks (56% vs 82%, $p<0.001$).

Multivariate Analysis

In multivariate regression analysis, several independent variables were associated with the absence of a preventive medication in the home (Table 3). Preventive medications were less likely to be available in the home when caregivers reported medication sharing (OR 0.54; 95% CI 0.32, 0.91; $p=0.021$), discontinuous insurance in the prior 12 months (OR 0.42; 95% CI 0.19, 0.97; $p=0.041$), high school completion or higher education (OR 0.59; 95% CI 0.35, 0.99; $p=0.046$), or no child use of any preventive medication in the prior two weeks (OR 0.25; 95% CI 0.14, 0.43; $p<0.001$). Of note, caregiver report of a preventive medication prescription was not used as a comparison in multivariate analysis due to a small number of caregivers ($n=3$) who did not report having a preventive medication prescription, but did present a preventive medication at home.

We were able to collect full pharmacy data for 192 (57%) children in the whole sample. From these children, 77 (40%) had pharmacy data indicating a fill for a preventive medication in the prior 12 months. Among the families who filled a preventive medication, only 30 (15%) were able to present any preventive medication in the home. There was no difference in pharmacy fill data among families without and with a preventive medication at home (46% vs 33%, $p=0.077$) (Table 2).

Discussion

In this study we compared caregiver report of preventive medication use and pharmacy dispensing data with medications actually available within the home for urban children with asthma. We found that, out of 335 children with persistent asthma symptoms for whom national guidelines recommend a daily preventive medication, about two-thirds reported taking a preventive medication and less than half of families had any preventive medication actually available in the child's home. Among the 192 subjects with available pharmacy records, a little more than a third had a preventive medication fill in the prior year, and many were not able to present medications at home. Based on caregiver report and pharmacy records, many children are not receiving recommended preventive medications, and our data suggest these methods overestimate medications available for use at the child's home.

This highlights a significant problem related to medication adherence. While children may be non-adherent to daily asthma medications for reasons such as lack of understanding about the differences between medications and the importance of daily adherence, inconvenience, and social factors, [10] it is also important to consider whether or not the child has the medications available for routine use. We found that many children did not have preventive medications at their home. Some possible reasons for missing medications include the medication being at another caregivers' home (e.g., a second parent or grandparent), the medication being at school, if the medication had been lost, or if the child was in need of a refill. Without having medications available in the home, appropriate adherence to a recommended daily regimen is unlikely to occur.

Importantly, we found that discontinuous insurance in the prior year was associated with a decreased likelihood of families having a medication at home. This result is consistent with previous research demonstrating that children with discontinuous insurance are significantly more likely than children with continuous insurance to delay or not receive necessary healthcare, and may be informed by the high cost of many preventive asthma medications. [22, 23] Inquiring about insurance difficulties at the point of care and utilizing community resources to facilitate consistent coverage may be helpful. We also found that caregiver report of the child sharing medications was associated with not having medications available at home. Sharing of medications may lead to confusion about appropriate use as well as lost or empty canisters. We also know that many children in this population spend time in multiple different households, which may have led to medications being inadvertently left behind.

Another factor associated with a decreased likelihood of having preventive medications in the home was caregiver education. Caregivers who had attained at least a high school level

of education were less likely to have a preventive medication at home. Higher education levels are associated with higher annual incomes. [24] Similar to patients with discontinuous insurance, we suspect that caregivers whose income is too high to qualify for public health insurance plans may experience greater difficulty in covering out-of-pocket costs for asthma medications. Prior work has identified a strong correlation between maternal education and type of child health insurance, and that privately insured children are more likely than publicly insured children to be underinsured and/or not have healthcare costs adequately covered by insurance. [22] Although insurance type was not associated with medication availability in this study, future work should examine whether underinsurance among privately insured children is specifically associated with medication availability and/or medication sharing at home.

There are some limitations of this analysis. While we inquired about which pharmacies were used, it is possible that medication refills were obtained outside of the records collected for this study. Second, when caregivers were not able to present medications at the baseline home visit, we did not systematically ask follow up questions to detail why the medication was unavailable and whether it might have been left elsewhere (i.e.; at a different caregiver's home). Importantly though, since the visits were conducted with the primary caregiver in their home, we assume that if no medication was presented at the time of the survey then the child did not have access to the medication at that time. Third, sharing of medications was defined as the sharing of any asthma medication, so we are unable to determine whether families in this study were more likely to share rescue medication, preventive medication, or both. However, prior literature indicates that when families report any sharing of asthma medications, they are likely to report sharing both types of medication.[25] Finally, caregivers may have been subjected to social desirability bias when they reported preventive medication use at baseline.

Conclusion

Adherence to daily controller medications is poor for underserved children with asthma. We found that both caregiver reported adherence and pharmacy data may overestimate the actual home availability of preventive medications for this patient population. Children were less likely to have medications available at home if caregivers reported medication sharing or discontinuous insurance coverage in the prior year. Utilizing clinical encounters to screen for availability of preventive medications at home as well as asking about issues regarding insurance coverage, medication sharing, or medications being taken in multiple locations represents an opportunity for providers to reach some of the highest risk children who may be missing out on the benefits of consistent preventive asthma treatment.

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Table 1:

Demographic Factors Associated with Preventive Medication in the Home [N(%)]

	Overall (n=335)	No Prev. Med. at Home (n=185)	Yes Prev. Med. at Home (n=150)	P-Value
CAREGIVER/Family				
Income (<FPL)	196 (62%)	110 (63%)	86 (61%)	0.815
Age (Years)^a	34.8 (8.4)	34.3 (7.8)	35.3 (9.1)	0.301
Employed (Yes)	181 (54%)	104 (56%)	77 (51%)	0.380
Family member with asthma (Yes)	302 (90%)	163 (88%)	139 (93%)	0.198
Marital Status (Single)	253 (76%)	136 (74%)	117 (78%)	0.373
Depressive Symptoms (Yes)	109 (33%)	63 (34%)	46 (31%)	0.557
Education (High School/GED)	239 (71%)	139 (75%)	100 (66%)	0.091
CHILD				
Gender (Female)	128 (38%)	70 (38%)	58 (39%)	0.910
Age (Years)^a	7.7 (1.7)	7.9 (1.5)	7.5 (1.8)	0.048 *
Race (African American)	188 (56%)	101 (55%)	87 (58%)	0.580
Ethnicity (Hispanic)	114 (34%)	64 (35%)	50 (33%)	0.818
Public Insurance (Yes)	257 (77%)	146 (79%)	111 (74%)	0.301
Discontinued Insurance (Yes)	37 (11%)	27 (15%)	10 (7%)	0.023 *
ENVIRONMENT/Home				
Child Shares Medications (Yes)^b	93 (28%)	60 (32%)	33 (22%)	0.037 *
Smokers in the Home (Yes)	152 (45%)	83 (45%)	69 (46%)	0.912
Cotinine Level (Ng/mL)^a	1.5 (2.0)	1.6 (2.2)	1.3 (1.7)	0.310

FPL = Federal Poverty Level

^aMean (SD)^bCaregiver report of child sharing asthma medications with another family member

*p<0.05

Table 2:

Asthma-specific Factors Associated with Preventive Medication in the Home

	Overall (n=335)	No Prev. Med. at Home (n=185)	Yes Prev. Med. at Home (n=150)	P-Value
Severity Level (Moderate to Severe) ^a	159 (48%)	89 (48%)	70 (47%)	0.826
ACT score (Poor Control) [*]	216 (66%)	111 (62%)	105 (71%)	0.101
Acute ED Visits for Asthma in prior year (Yes)	113 (34%)	66 (36%)	47 (31%)	0.418
Symptom-free Days (0–14 days) ^b	7.5 (5.1)	7.3 (5.2)	7.7 (5.0)	0.473
Days with Daytime Symptoms (0–14 days) ^b	4.8 (4.7)	4.9 (4.8)	4.6 (4.5)	0.583
Nights with Nighttime Symptoms (0–14 nights) ^b	3.0 (3.9)	3.2 (4.1)	2.8 (3.5)	0.345
Days Needing Rescue Medication (0–14 days) ^b	4.2 (4.6)	4.2 (4.5)	4.3 (4.7)	0.939
Days Needing Slow Down (0–14 days) ^b	3.5 (4.4)	3.9 (4.7)	3.0 (3.9)	0.061
Missed school days due to asthma in prior year (Yes)	9.8 (18.1)	9.5 (16.7)	10.2 (19.7)	0.719
Quality of Life (Range 1–7) ^b	5.8(1.2)	5.7(1.3)	5.8(1.0)	0.267
Caregiver report of Preventive Medication Prescription	231 (69%)	84 (45%)	147 (98%)	<0.001
Caregiver report of Preventive Medication use in prior 2 weeks (Yes)	227 (68%)	104 (56%)	123 (82%)	<0.001
Pharmacy Fill for Preventive Medication Indicated ^{***}	77 (40%)	47 (46%)	30 (33%)	0.077

^aN (%)^bMean (SD)^{*} Overall n=327. No Prev. Med at Home n=179. Yes Prev. Med at Home n=148^{**} Overall n=221. No Prev. Med at Home n=79. Yes Prev. Med at Home n=142^{***} Overall n=192 with Pharmacy Fill Data. No Prev. Med at Home n=101. Yes Prev. Med at Home n=91.

Table 3:

Logistic Regression of Factors Associated with Home Availability of Preventive Medication

Full Sample (n=335)	OR	95%CI	P-Value
Child Shares Medications	0.54	0.32, 0.91	0.021 *
Medicaid/Options	0.62	0.35, 1.10	0.105
Discontinued Insurance	0.42	0.19, 0.97	0.041 *
Child Age	0.89	0.77, 1.02	0.098
Symptom-Free Days (0–14 days) ^a	1.03	0.98, 1.08	0.212
Child Race (African American)	1.29	0.80, 2.07	0.291
Education (High School Graduate)	0.59	0.35, 0.99	0.046 *
Did Not Use Preventive Medication in Prior 2 Weeks	0.25	0.14, 0.43	<0.001 *

^aMean (SD)*
p<0.05