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Practice variation in management of childhood asthma is associated with outcome differences

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Abstract

Background—Although specialist asthma care improves children's asthma outcomes, the impact of primary care management is unknown.

Objective—To determine if variation in preventive and acute care for asthma in pediatric practices affects patients' outcomes.

Methods—For 22 practices, we aggregated 12-month patient data obtained by chart review and parent telephone interviews for 948 children, 3 to 12 years old diagnosed with asthma to obtain practice-level measures of preventive (1 asthma maintenance visit/year) and acute (1 acute asthma visit/year) asthma care. Relationships between practice-level measures and individual asthma outcomes (symptom-free days, SFD; parental quality of life, pQOL; emergency department visits, ED; and hospitalizations) were explored using generalized estimating equations, adjusting for seasonality, specialist care, Medicaid insurance, single family status, and race.

Results—For every 10% increase in the proportion of children in the practice receiving preventive care, SFDs/child increased by 7.6 days ($p=0.02$) and ED visits/child decreased by 16.5% ($p=0.002$), with no difference in pQOL or hospitalizations. Only the association between more preventive care and fewer ED visits persisted in adjusted analysis (12.2% reduction, $p=0.03$). For every 10% increase in acute care provision, ED visits/child and hospitalizations/child decreased by 18.1% ($p=0.02$) and 16.5% ($p<0.001$), respectively, persisting in adjusted analyses (ED visits 8.6% reduction, $p=0.02$; hospitalizations 13.9%, $p=0.03$).

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Conclusions—Children cared for in practices providing more preventive and acute asthma care had improved outcomes, both impairment and risk. Persistence of improved risk outcomes in the adjusted analyses suggests practice-level interventions to increase asthma care may reduce childhood asthma disparities.

Keywords

Asthma; pediatrics; primary care

INTRODUCTION

Asthma is a common childhood disease that is most often managed by the child's primary care pediatrician.¹ National asthma guidelines recommend a collaborative partnership between the family and their physician, with regular asthma maintenance care visits to monitor and adjust the treatment plan as needed, and to provide education and support for asthma management by parents at home.² A minimum of two visits/year is recommended, with more frequent visits if needed to ensure asthma control. Morbidity is reduced and use of effective preventive medications is higher in patients who report regularly scheduled visits with asthma specialists.^{3–5} However, few visits to optimize preventive management occur in primary care, and the impact of these visits on the child's asthma outcomes is uncertain.^{6–10}

Initiatives such as the patient-centered medical home encourage primary care practices to adopt office systems to coordinate and manage care of patients with chronic diseases including asthma, as well as encourage and support self-management.^{11–14} However, little is known about how variation in primary care asthma management at the practice level affects asthma outcomes of individual patients. The objectives of this study were threefold: 1) to describe variation in asthma care provided by primary care pediatric practices; 2) to determine how variation in preventive care among practices affects patient outcomes of asthma impairment (symptom-free days, SFDs and parental quality of life, pQOL) and risk (urgent care in offices or in an Emergency Department (ED) and hospitalization); and 3) determine how variation in delivery of acute care for worsening asthma symptoms among practices affects patient outcomes of risk (ED visits and hospitalization). Our hypothesis was that patients attending practices providing more care would have improved asthma outcomes.

METHODS

We analyzed data pertaining to the year prior to participation in a large cluster randomized controlled trial to evaluate a telephonic peer-training intervention for parents.¹⁵ For this trial, clusters were 22 community-based primary care practices. Demographic information, asthma care, and asthma outcomes for individual practice patients were assessed by telephone interviews and chart review.

Recruitment of Study Participants

Eligible practices were community-based primary care practices providing asthma care to at least 40 children. Eligible families within study practices had a child between 3 and 12 years

old with a physician diagnosis of asthma, and evidence of bothersome asthma within the past year by self-report assessed using three criteria. The first criteria was a prescription for a daily controller medication, the second was 1 acute exacerbation that required an unscheduled office visit, a course of oral steroids, an ED visit or hospitalization, and the third criteria was persistent asthma symptoms.² If the first criteria was not met, the RA proceeded to ask about the second and, if necessary, the third criteria. Each practice used billing data to provide a list of potentially eligible families to the study team. These families were contacted by the study team by mail and phone to invite participation, assess eligibility, and complete the consent process. Parents who provided written consent and completed the consent and the baseline interview were enrolled. Each family was paid \$20 for completion of the baseline interview. The study protocol was approved by the institutional review board at Washington University: written informed consent was obtained from one parent in each family.

Measurement

Measurement occurred during a baseline telephone interview conducted by trained research assistants blinded to study group assignment. Symptom-free days (SFDs) over the prior 12 months were estimated from the frequency of asthma symptoms in the 2 weeks before the interview^{16,17} and parental quality of life (pQOL) was measured using the Pediatric Asthma Caregiver's Quality of Life Questionnaire (PACQLQ).¹⁸ The parent reported the number of ED visits and hospitalizations in the prior 12-months, whether or not the child had seen a specialist for asthma care at least once in the past 12 months, and provided demographic information. Season of enrollment was categorized as: spring – March, April, May; summer – June, July, August; fall – September, October, November; and winter – December, January, and February.

Audits of office charts were conducted by an asthma specialist (RCS). All office visits for care during the 12 months prior to enrollment were assessed and categorized as maintenance care (annual or asthma check-up) or acute care (asthma or other). Visits were defined as preventive care when no acute symptoms were present and were considered to be for asthma care if asthma or asthma medications was mentioned. Assessed asthma care activities included: assessment of asthma control and peak expiratory flow rate; report of controller medications, an asthma action plan (AAP), asthma education (any asthma education noted in the chart), and a follow-up plan. Prescription of albuterol, prednisone and antibiotics was recorded for acute asthma visits.

Statistical Analysis

Patient level data were aggregated for the practice-level measures of asthma outcomes and asthma care. For each practice, all patients in the measurement cohort were used as the denominator to estimate practice measures for asthma outcomes, office visits (total and for asthma care), characteristics of asthma care, and specialist care (the proportion of children for categorical variables and the mean for continuous variables). Practice-level measures were summarized and reported as the median and range.

We studied the effect of asthma care assessed at the practice level on asthma outcomes assessed at the individual patient level. These included two impairment outcomes— SFDs and pQOL and two risk outcomes - ED visits and hospitalizations. For each outcome, we first fit a mixed effect model with the measure of care as the only covariate with a random effect for practices. Then, we fit another mixed model with the measure of care and other covariates including the child's age, race, Medicaid insurance, single parent, specialist care, and season as covariates, and with a random effect for practices. These covariates were selected as they are identified as potential confounders in the literature.^{4,19–23} All statistical analyses were done using SAS (SAS Institute.2007. The SAS System version 9.12, Cary, NC). For the continuous outcomes – SFD and pQOL, we used the mixed model procedure and for the count variables – number of ED visits and hospitalizations, we used GLIMMIX procedure with negative binomial distribution for over-dispersion of data. For all analyses, a probability of $p = 0.05$ was used to establish statistical significance (two-sided tests).

RESULTS

Participants

The majority of the 22 participating practices were pediatric group practices (63.6%)(solo or 2-physician 27.3%, multi-specialty group 9.1%) and suburban (81.8%) (Table I). Ten (45.5%) practices had an electronic medical record. Between March 11, 2009 and May 19, 2011, 948 families were recruited from these practices (Median subjects/practice, 35, interquartile range, IQR 25 to 69). Of those eligible, the overall participation rate was 75.8%; the median participation rate across the 22 practices was 74.7% (IQR 71.7% to 82.6%). The majority (80.4%) of subjects were assessed as eligible by parental report of a controller medication prescription within the past 12 months. More detail about subject recruitment is provided elsewhere.¹⁵

All 948 participants completed the baseline interview (93.8% completed by the mother) and 945 (99.7%) office charts were available for audit. In five practices, every participant had 1 visit for asthma care in the 12-month study period. The remaining 17 practices each had participants with no documented asthma visit (range 1.4% to 65.4% of patients/practice, median 4.3%).

Socio-demographic characteristics of study participants are presented in Table I. Thirty-one percent were African American, 24.2% were a single parent, 23.5% had Medicaid insurance for their child, and 21.6% had a child with asthma who was < 5 years old. Thirty percent reported their child had received asthma care from a specialist within the past 12-months.

Asthma outcomes

Individual-level asthma outcomes assessed over 12-months are presented in Table I. For impairment, the mean SFDs/child was 265.4 days (sd 110.3) and the mean pQOL score was 6.4 (sd 0.9). For risk, the mean ED visits/child was 0.69 visits (sd 1.4) and the mean hospitalizations/child was 0.09 (sd 0.36). Practice-level measures of asthma outcomes are presented in Table II. For impairment, the median value of mean SFDs/child was 257 with a 2fold difference across the 22 practices (range 140 to 304). However, there was little

variability in the mean pQOL scores (median 6.43, range 5.88 to 6.79). For risk, the median value of mean ED visits/child was 0.65 with a 10-fold difference across practices (range 0.26 to 2.6), but there was little variation across practices for hospitalization (median value of mean hospitalizations/child 0.06, range 0.00 to 0.28).

Asthma care

Practice-level measures of asthma care for the 12-month study period are presented in Table II and show wide variation (from a 5-fold difference for 1 acute visit to 25-fold difference for a documented follow-up plan). The median of mean total office visits/child was 3.44 (range 0.27 to 6.07). Across all practices, asthma was mentioned in the child's chart for at least 50% of all office visits, regardless of the reason for the visit (median ratio asthma visits/total visits 0.78, range 0.50 to 1.00). Practices provided more visits for acute asthma care (median of mean acute visits/child 1.62, range 0.19 to 3.53) than for maintenance care (median of mean maintenance visits/child 0.90, range 0.08 to 1.16). Although 2 asthma maintenance visit/year are recommended by national guidelines,² this metric was low for study practices (median 0.13, range 0.00 to 0.32). Consequently, we used the proportion of patients/practice with 1 asthma maintenance visit/year (median 0.71, range 0.08 to 0.90) as our primary measure to indicate receipt of asthma maintenance care when investigating the association between care and outcomes.

Characteristics of asthma care included in asthma visits varied across practices for both maintenance care and acute care (Table II). For both visit types, the most common activities included the proportion of children with a recorded controller medication (median 0.52 during maintenance visits and 0.56 during acute visits) or with a recorded follow-up plan (median 0.45 and 0.16, respectively). Asthma education was rarely documented (median 0.18 and 0.14 respectively). The median proportion of children for whom an assessment of asthma control was documented during maintenance visits was 0.30 (range 0.00 to 0.51). For acute asthma care visits, the median proportion of children for whom albuterol, prednisone, and an antibiotic were prescribed was 0.19 (range 0.03 to 0.36), 0.07 (range 0.00 to 0.20), and 0.32 (range 0.00 to 0.80) respectively.

Association of asthma care with asthma outcomes

Results of the univariate and multivariate analyses are summarized in Table III and are highlighted here.

Maintenance Care

Impairment: Children from practices providing more preventive care had more SFDs. For every 10% increase in the proportion of children in the practice with 1 maintenance care visits, the average increase in SFDs/child was 7.6 days ($p=0.02$). However, after adjusting for age, race, Medicaid insurance, single parent status, specialist care and season, the increase in SFDs fell to 4.2 days and was not statistically significant ($p=0.13$). Variation in maintenance care did not affect pQOL.

Risk: Children from practices providing more preventive care had fewer ED visits. For every 10% increase in the proportion of children in the practice with 1 maintenance care

visits, the number of ED visits/child decreased by 16.5% ($1 - \exp(-0.0181 \times 10)$), $p < 0.01$). After adjusting for the covariates, the decrease was 12.2% ($1 - \exp(-0.0107 \times 10)$), $p = 0.001$. Variation in maintenance care visits did not affect hospitalization.

We repeated the analyses for impairment and risk outcomes in the subgroup of children aged 5–12 years ($n = 743$) and our findings were similar (data not shown).

Acute care

Risk: Children attending practices providing more acute asthma care had fewer ED visits and hospitalizations. For every 10% increase in the proportion of children in the practice with 1 visit for acute asthma care, the number of ED visits/child decreased by 18.1% ($1 - \exp(-0.02 \times 10)$), $p < 0.001$ and the hospitalizations decreased by 16.5% ($1 - \exp(-0.018 \times 10)$), $p < 0.001$. After adjusting for the covariates, the decrease in ED visits was 8.6% ($1 - \exp(-0.009 \times 10)$), $p = 0.02$ and the decrease in hospitalizations was 13.9% ($1 - \exp(-0.015 \times 10)$), $p = 0.03$).

Association of specialist care with asthma outcomes

The proportion of children per practice reporting specialist care varied from 0.10 to 0.49 (median 0.30) (Table II). Children from practices with more specialist care had fewer ED visits/child and their parent's had higher pQOL scores. For every 10% increase in the proportion of children having 1 specialist visit for asthma care, ED visits/child decreased by 28.2% ($p = 0.0004$) and pQOL increased by 1.14 units ($p = 0.0085$). Improvement in hospitalizations/child (19.6% decrease, $p = 0.097$) and SFDs/child (7.8 day increase, $p = 0.15$) were not statistically significant. After adjusting for age, race, Medicaid insurance, single parent status, and season, the benefits of more specialist care in the practice on ED visits and pQOL did not persist (decrease in ED visits/child 8.1%, $p = 0.25$; decrease in pQOL 0.2 units, $p = 0.69$).

DISCUSSION

This study revealed large variation in asthma care across 22 urban and suburban pediatric practices that serve patients from diverse socio-demographic groups. Prior studies have shown significant variation in care provided in primary care settings,^{24–27} but little is known about the impact of variation in care on disease outcomes. In this study, variation in preventive care at the practice-level was associated with significant differences in asthma outcomes for individual patients. Specifically, children attending practices who provided more routine preventive care had more SFDs and fewer ED visits. There was no associated improvement in measures of parental QOL or hospitalizations, possibly because of a ceiling effect for pQOL and the rarity of hospitalizations in the study population. In the adjusted analyses, controlling for individual level demographic characteristics, seasonal effects, and specialist care, the association between more preventive care in the primary care office and fewer ED visits persisted. Although the cross-sectional design of this study precludes causal inference, our findings are consistent with previous studies^{28,29} and suggest practice-level interventions to increase implementation of regular preventive asthma care visits may reduce both impairment and risk.

Asthma maintenance visits were infrequent in the study population and their content varied. Although some practices in the study sample documented routine use of some activities recommended by the National Asthma Education and Prevention Program,² our data suggest that many children were not receiving comprehensive guideline-based care. Assessment of care from medical records is difficult, as care provided might not have been recorded. With this in mind, our assessment of care activities was conservative and only required mention at one visit over the 12-month period. For example, documentation of controller medication use included notation of the drug name exclusively in what appeared to be the nurse's intake note. Also, a documented follow-up plan included a note or checked box to return in a year for an annual check-up. Even so, most practices only documented a controller medication and a follow-up plan for half their patients and other key aspects of asthma care were rarely recorded including assessment of asthma control, asthma education, and AAP review. Our findings confirm previously identified gaps between the care provided and guideline recommendations for preventive asthma care,^{7,26, 30} and are consistent with other studies that used audiotaped office visits,³¹ patient interviews^{10,32} or electronic medical records from large healthcare systems²⁶ to assess primary care asthma management.

Ambulatory visits for asthma care have steadily increased³³ and our data suggest the focus of community-based asthma care remains on acute rather than preventive care. However, the acute visit may provide the only opportunity for preventive care, especially for children with more severe disease.¹⁰ Similar to other studies,^{10,30} our findings suggest the opportunity presented by an acute visit to provide preventive asthma care is often missed. Our data suggest two targets for improvement. First, an increase in follow-up visits to evaluate the outcome of the acute episode and to provide on-going preventive care. Our findings are similar to a recent study by Yee et al., in which only 30% of parents reported a follow-up plan after an office visit with a child with persistent asthma symptoms.¹⁰ Second, ensuring adequate management of worsening asthma symptoms before considering antibiotics. Prescription of an antibiotic was common in the study population, with considerably variation across practices. We did not record relevant comorbid conditions, but unjustified antibiotic prescriptions are common among children with asthma.^{34,35}

One approach to improve asthma outcomes is for allergists to assume a leadership role for education and support for primary care providers in their medical neighborhood.^{11,36,37} Features of specialist care that favorably impact asthma outcomes have been suggested to include increased knowledge of guideline recommended care, more aggressive use of inhaled corticosteroids and written asthma action plans, more attention to determining and managing atopic triggers and allergic rhinitis, longer office visits with more frequent follow-up, and education provided by highly trained ancillary staff.^{5,36,38} There are significant barriers to implementation of some of these processes in primary care, but sharing patient care provides the specialist with an opportunity to influence care beyond an individual patient. In this study, consistent with other studies using different methodologies, specialist care was associated with improved outcomes.^{4,5,38,39} Allergists could foster a learning community by providing guidance and mentorship for primary care colleagues on optimizing asthma pharmacotherapy and implementation of guideline recommended care. In addition, they could develop systems to communicate important new findings in asthma management as well as strategies to address common gaps in care identified through

consultations or hospitalizations.^{36,37} Collaborating with primary care providers to identify problems in care delivery could also lead to innovative strategies to address barriers to guideline implementation.

Strengths of this study are the large sample of community-based pediatric practices and the availability of data to allow multivariate analyses to control for patient characteristics known to affect care delivery and asthma outcomes. However, several limitations should be noted. We were unable to adjust for some practice characteristics such as disease severity mix that may influence the frequency of office visits and care delivery.^{10,29,40,41} Data about care activities came from chart review and the medical record often lacks detail of the clinical encounter.^{42,43} Data for asthma outcomes and specialist involvement were self-reported and we cannot confirm their accuracy, and we did not determine the level of care involvement of the specialist if one was reported. In another study from a managed care organization specialists were involved in asthma care for about 34% of patients (similar to our finding of 30%).³⁸ They provided asthma care exclusively for about 60% of these patients and shared care with the primary care provider for about 40%. The number of subjects per practice was modest, and may limit the precision of our estimates.⁴⁴ Also, our findings are from one mid-western metropolitan area and findings may not generalize to other geographic areas.

Conclusions

There is considerable variation in asthma care across primary care practices and this variation is associated with differences in asthma outcomes. Children attending practices that routinely provided preventive care showed improved asthma outcomes including impairment (more SFDs) and risk (fewer ED visits). Reductions in ED visits persisted after adjusting for known confounders including socio-demographic factors and specialist involvement in asthma care. Study findings suggest practice-level interventions to increase provision of asthma care, both preventive and acute care, may improve asthma outcomes and reduce disparities. Research is needed to assess if allergist led interventions to develop a learning community to increase routine use of effective asthma care are feasible and effective.

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Abbreviations

AA African American

AAP	Asthma Action Plan
ED	Emergency Department
PACQLQ	Pediatric Asthma Caregiver's Quality of Life Questionnaire
pQOL	Parental Quality of Life
SFD	Symptom Free Days

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HIGHLIGHT**What is already known about this topic?**

Evidence to support guideline recommendations for regular asthma maintenance visits comes from studies showing improved patient outcomes with specialist care. The impact of asthma care provided by primary care providers is not known.

What does this article add to our knowledge?

This study revealed large variation in asthma care across pediatric practices that serve patients from diverse socio-demographic groups. Children attending practices providing more asthma care, both preventive and acute, had better impairment and risk outcomes.

How does this study impact current management guidelines?

Study findings support guideline recommendations for regular preventive care visits with primary care providers. They also highlight the need for effective strategies to increase implementation of these recommendations.

Table I**Characteristics of Study Practices and the Study Population**

Practice Characteristics[†]	
N	22
Number of physicians	61
Years in pediatric practice ,	18.0 (7.9)
Type of practice:	
Pediatric group	14
Multi-specialty group	2
Solo or 2-physician	6
Practice location	
Urban, inner city	1
Urban, not inner city	3
Suburban	18
Electronic medical record (EMR)	10
Provide asthma maintenance care 60% of patients with asthma	16
Family Characteristics	
N	948
Respondent was the mother	889 (93.8%)
Single parent family, N (%)	229 (24.2%)
Mother works full-time N, (%)	454 (47.9%)
Mother graduated from college N (%)	553 (58.3%)
Mother's race, N (%)	
Caucasian	625 (65.9%)
African American	290 (30.6%)
Other race	33 (3.5%)
Mother Hispanic, N (%)	18 (1.9%)
Family income (annual), N (%)	
<\$10,000	78 (8.2%)
\$10,000 to \$24,999	84 (8.9%)
\$25,000 to \$49,999	167 (17.6%)
\$50,000 to \$74,999	154 (16.2%)
\$75,000 to \$99,999	129 (13.6%)
\$100,000	307 (32.4%)
Parent has asthma	249 (26.3%)
Someone else at home with asthma	346 (36.5%)
Patient Characteristics	
Male gender, N (%)	594 (62.7%)
Age (years), Mean (sd)	6.9 (2.7)

Practice Characteristics[†]	
<5 years old, N (%)	205 (21.6%)
Medicaid insurance, N (%)	223 (23.5%)
Years with PCP, Mean (sd)	5.7 (2.9)
Asthma history	
Years with asthma	3.9 (2.6)
Asthma specialist in past year	284 (30.0%)
Asthma outcome measures	
Parental QOL, mean (sd) PACQLQ score	6.4 (0.9)
Symptom-free days, mean (sd)	265.4 (110.3)
ED visit in past year, Mean (sd)	0.69 (1.4)
Hospitalization in past year, Mean (sd)	0.09 (0.4)

[†]From physician survey

Abbreviations: sd standard deviation; PCP Primary care provider; ED Emergency Department; QOL Quality of Life; *PACQLQ Pediatric Asthma Caregiver's Quality of Life Questionnaire. Answers were selected on a 7-point categorical scale and scored 1 to 7, with a higher score indicating a better outcome.

Table II

Variation in office visits for asthma care, specialist care, and asthma outcomes among 22 practices.

	Median	Minimum	Maximum
Office visits			
Mean total office visits/child	3.44	0.27	6.07
Mean total asthma visits/child	2.56	0.27	4.23
Mean asthma maintenance visits/child	0.90	0.08	1.16
Mean acute asthma visits/child	1.62	0.19	3.53
Ratio asthma visits/all visits	0.78	0.50	1.00
Proportion of practice patients with:			
1 asthma maintenance visit	0.71	0.08	0.90
2 asthma maintenance visit	0.13	0	0.32
1 asthma acute care visit	0.72	0.19	0.90
Characteristics of asthma care			
<u>For asthma maintenance visits *</u>			
Asthma control assessed	0.30	0	0.51
Peak flow measured	0.02	0	0.11
Controller medications recorded	0.52	0	0.79
Asthma Action Plan recorded	0.08	0	0.55
Asthma education provided	0.18	0	0.52
Follow-up plan recorded	0.45	0.03	0.75
Characteristics of asthma care			
<u>For acute asthma visits: *</u>			
Peak flow measured	0.02	0	0.17
Controller medications recorded	0.56	0.08	0.83
Asthma Action Plan recorded	0.08	0	0.55
Albuterol prescription	0.19	0.03	0.36
Prednisone prescription	0.07	0	0.20
Asthma education provided	0.14	0	0.26
Antibiotic prescription	0.32	0	0.80
Follow-up plan recorded	0.16	0	0.30
Specialist care **	0.30	0.10	0.49
Asthma outcomes (mean/child)			
Symptom free days	257	140	304
Parent's Quality of Life score ***	6.43	5.88	6.79
ED visits	0.65	0.26	2.60
Hospitalizations	0.06	0.00	0.28

* Proportion of practice patients with evidence in the chart that the activity occurred at 1 asthma-related visit in the 12-month study period.

** Proportion of practice patients who reported ≥ 1 specialist visit for asthma care in the 12-month study period.

Abbreviations: sd standard deviation; ED Emergency Department;

*** PACQLQ Pediatric Asthma Caregiver's Quality of Life Questionnaire. Answers were selected on a 7-point categorical scale and scored 1 to 7, with a higher score indicating a better outcome.

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Table III

Results of the univariate and multivariate analyses for the effect of asthma care measured at the practice level on children's asthma outcomes measured at the individual level (N=948).

Asthma Outcomes	Preventative Care *		Acute Care **	
	Beta coefficient	P-value	Beta coefficient	P-value
Symptom free days				
Unadjusted	0.76	0.02	Not done	Not done
Adjusted ***	0.42	0.13	Not done	Not done
Parent's QOL				
Unadjusted	-0.001	0.74	Not done	Not done
Adjusted ***	-0.004	0.16	Not done	Not done
ED visits				
Unadjusted	-0.018	0.002	-0.02	<0.001
Adjusted ***	-0.013	0.001	-0.009	0.02
Hospitalizations				
Unadjusted	-0.009	0.30	-0.018	<0.001
Adjusted ***	0.004	0.67	-0.015	0.03

* Proportion of patients/practice with 1 asthma maintenance visit in 12-month study period

** Proportion of patients/practice with 1 acute care asthma visit in 12-month study period. Analyses to explore associations between acute care and asthma outcomes were restricted to risk outcomes.

*** Adjusted for child's age, race, Medicaid insurance, single parent, report of asthma specialist care in past 12-months, and season.

Abbreviations: sd standard deviation; ED Emergency Department; QOL Quality of Life; *PACQLQ Pediatric Asthma Caregiver's Quality of Life Questionnaire. Answers were selected on a 7-point categorical scale and scored 1 to 7, with a higher score indicating a better outcome.