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Adherence to asthma guidelines in children, tweens, and adults at primary care settings: A practice-based network assessment.

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Abstract

Objective: To assess primary care adherence to 2007 US asthma guidelines.

Patients and Methods: Patients with persistent asthma aged 5 to 65 from 22 primary care participating practices provided the data for this analysis of baseline information from the pragmatic randomized trial, the Asthma Tools Study. Using a combination of abstracted medical record data and patient reported demographic information we assessed the medical record documentation for elements of the 2007 US asthma guidelines. Elements assessed included documentation of 1) assessment of control, 2) factors affecting control (medication adherence evaluation, inhaler technique education, and evaluation for triggers), 3) self-management support (action plan) and 4) asthma medications prescribed (short acting bronchodilators and daily maintenance therapy). The baseline data was collected for the period March 16, 2009 to May 1, 2014.

Results: In 1176 patients (285 children, 211 tweens and 680 adults) from 16 family medicine and 6 pediatric practices across the US, documented guideline adherence was highest for prescription of medications (88.0% for SABA and 70.4% for maintenance medications) and lowest for an asthma action plan (3.1%). Documentation of control (15.0%) and factors affecting control (inhaler technique education 7.6%, medication adherence assessment 32.5% and allergy evaluation 32.5%) were not common and even less common for adults compared to children. 22.2% of the enrolled patients had no asthma-related visit in the year prior to enrollment. Adherence to the non-medication elements were higher in practices located in cities >250,000 people and that used electronic medical records. Increasing patient age was negatively associated with guideline adherence.

Conclusion and Relevance: Adherence to asthma guidelines is poor in primary care practices, leaving many opportunities for improvement.

Background:

Asthma is common in children, adolescents, and adults in the United States. Prevalence rates in children and adolescents range from 6.9% to 19% by high school graduation.^{1,2,3} Among adults, active asthma associated with symptoms, medical visits or medications is present in up to 6.2% of men and 8.3% of women in 2013 in the U.S. (<http://www.cdc.gov/asthma/asthmaadata.htm>) Although asthma-associated mortality may be declining, asthma morbidity and its associated costs remain high.^{4,5,6} Evidence suggests that implementation of the asthma guidelines should decrease asthma morbidity.^{7,8,9} No guideline is applicable to all patients and asthma visits; therefore, anticipated adherence is always less than 100%. However, very low rates of adherence should foster further evaluation of both the guidelines themselves and the efforts to implement them in daily practice,

Prior to release of the 2007 U.S. asthma guidelines, several studies highlighted the limited implementation and physician barriers related to earlier guidelines.^{10–20} Most studies were limited to children or pediatricians' practice and adherence was often assessed by physician or patient/parent self report^{20,15,19} which may over-estimate (physician report) or under estimate (patient/parent) levels of adherence. Conversely, use of billing data⁸ may provide more objective information but data are limited to billable events such as the filling of prescriptions for daily maintenance medications and provide little insight into physician use of guidelines to reach prescribing decisions. In addition, older studies often focus on elements that were not highlighted in the 2007 guidelines such as the use of daily peak flow¹⁸ and do not report on assessment of asthma control status introduced in the 2007 guidelines.⁷

The 2007 National Asthma Education and Prevention Program (NAEPP) asthma guidelines were written to provide guidance for improved asthma diagnosis and management using a new conceptual basis, asthma control. It was hoped that asthma control might provide a simple assessment to foster guideline directed “stepped care” and improve asthma outcomes in the US.⁷ The apparent lack of impact of the 2007 asthma guidelines on outcomes^{5,6} may be due in part to continued limited implementation of national guidelines, especially in primary care practices where the majority of asthma management is provided. However, we found only two recent US studies that reported on adherence to guidelines, one limited to family medicine practices in two states and the other to less than 200 children from a single site. Both reported limited guideline adherence.^{21,22}

To expand our knowledge base, we use baseline data from a large multi-centered US pragmatic randomized trial of primary care asthma management²³ to assess rates of guideline adherence across family medicine and pediatric practices in children, adolescents, and adults. We also report the association of assessed guideline adherence with patient and practice characteristics. This information should highlight the opportunities we identified for continued efforts to improve primary care asthma management and outcomes across the age span.^{19,24}

Methods:

We use retrospective and patient reported data from the pre-trial period of the Asthma Tools Study²³ to report rates of adherence with elements of the 2007 NAEPP guidelines. This collection of pre-trial medical record data and patient report of baseline data was a planned part of the Asthma Tools Study used to provide information for assessing differences in rates of improvement in the control and intervention practices and so assess the comparability of the patients in the two study arms in the year prior to study initiation.

Guideline adherence was assessed through medical record review of all visits made by each enrolled patient (n=1176) to the primary care site in the year prior to enrollment. Period covered is 2010 through 2011). Patient and practice characteristics were collected at the time of practice enrollment and on the patient's baseline enrollment survey. The study was approved by Institutional Review Boards (IRB) from each of the enrollment sites as well as the IRB for each investigator. Due to the requirement that all patients have persistent asthma and since this is not available through administrative data or billing codes, it is not possible to estimate the total number of eligible patients at each site. Refusal rates of eligible patients who were invited was 12.8% (range 2.5% to 18.9%). Elements identifiable through medical record review were selected from the 2007 NAEPP asthma guidelines and the definition of each element is summarized in Table 1. We selected evidence based elements such as use of an Asthma Action Plan.^{25,26} plus factors reported to be associated with lack of asthma control²⁷ as highlighted in the 2007 stepped care flow diagrams.^{7,28} Despite its empirical basis, we also selected assessment of asthma control since it is the basis for several clinical decisions within the 2007 NAEPP guidelines. We grouped the elements into 1) control, 2) factors affecting control (medication adherence, inhaler technique education and evaluation for triggers), 3) patient self-management support (asthma action plan), and 4) medication therapy (short acting bronchodilator--SABA and daily maintenance medications). While smoking status documentation was assessed, it is not included as evidence of guideline adherence since it is considered by many a routinely collected vital sign as well as an important factor in asthma management.

Specific definitions of documentation required for each of the data elements were developed and used by trained and experienced nurse abstractors to determine the presence of the elements documented within the medical record in medical and education visit notes, medication lists, and procedure notations. For example, an Asthma Action Plan had to have a completed copy within the medical record to be considered documented. (Table 1) We chose to report documentation of patient smoking status and second hand smoke exposure separately due to the importance of this information and that fact that it is often considered a vital sign and not just an asthma care measure. Asthma control required documentation of any of the three items of frequency of daytime or nighttime symptoms or number of days of missed activity. We required that the information be quantified with a numerator and denominator since comments like often or sometimes or frequently missed activities or symptoms do not easily map to control status. Use of a validated control tool was also accepted and noted. (Table 1)

Patients/Practices:

Between March 2010 and May 2014, we enrolled 1176 patients (285 children ages 5 to 11 years, 211 tweens ages 12 to 18 years, and 680 adults ages 19 to 65 years) with physician-reported persistent asthma from 22 family medicine and pediatric practices across the United States (US).

Practices were selected to represent geographic diversity as well as variations in practice size (solo physician to large multi-specialty group), practice type (academic/residency practices, community-based practices), specialty of the enrolling physicians (family medicine and pediatrics) and size of the city of the practice location (from less than 10,000 residents to over 1,000,000 residents). During this baseline period, 71.8% (15/21) of the practices had an electronic medical record and 42.4% (9/21) had 5 or more physicians in that practice site. None of the practices included a certified asthma educator and none were Federally Qualified Health Centers. Figure 1 summarizes some of the characteristics of the practice sites.

Data collection:

The baseline medical records for each enrolled patient were copied at the practice site and sent to the central study site via Federal Express which was acceptable to IRB as compliant with HIPPA standards for transfer of medical information. Each site was asked to copy all elements of the medical record that contained any information entered during the year of interest to include at least visit notes, medication lists, procedures and results (e.g. spirometry for example) as well as any other section such as copies of hospital or emergency department visit summaries. Adherence to the predefined elements of the asthma guidelines were assessed by reviewing documentation for each encounter as well as all available correspondence. Data collection sheets are available upon request. Inter-rater reliability was assessed before data abstraction began and twice during the data abstraction period. On each occasion, reliability testing was repeated until agreement on selected data points (exact visit date, type of visit—asthma related or not asthma related, and presence or absence of each of the review guideline adherence elements for 4 visits across 4 different patients) was 95% or greater.²⁹

Statistical analyses:

Results were tabled and presented as percentages for total group and by sex and age categories. Some patients had no visits during the year but were still included in the calculation of frequencies of adherence to various guideline elements. Frequencies were compared between age groups using Chi-squared tests, and rates of different procedures by sex within the same age group were tested using McNemar's test. Association of practice and patient characteristics with respect to number of guideline elements assessed was tested using logistic regression with a random effects term for practice sites. The S-Plus statistics package v. 7.0.6 (Tibco Software) was used for all computations.

One practice was a clear outlier; this practice became an urgent care center shortly after study initiation, had no documentation of any guideline elements and very limited continuity

of care (repeat visits) in the baseline year. We therefore performed a sensitivity analysis of the patient and practice characteristics associated with guideline adherence with and without this practice to assess the robustness of our results.

Results:

Baseline medical records were available for review for all 1176 enrolled patients including 285 children ages 5 to 11 years, 211 tween ages 12 to 18 years, and 680 adults 19 to 65 years of age. Girls were 37.5% of the enrolled children, 46.4% of the enrolled tweens and women were 71.9% of enrolled adults. Mean age of each group did not differ by sex. Other demographics of the enrolled patients are displayed in Table 2. Six of the practices were pediatricians' practices with all other being family medicine practices. Four of the family medicine practices were community based residency sites. The median number of patients enrolled by site was 52 (range 1 to 99). Race, age and median family income of the enrolled patients varied by site ($p=0.01$) but not by region of the country of the practice site (south, northeast, midwest and west).

Across all age groups, 22.2% of the patients had no asthma related visits to the primary care office in the year prior to enrollment despite being labeled as persistent asthma at enrollment. With no visits, this group also had no opportunities for adherence to any guideline element. All of asthma related visits made by the 1,033 people who made at least one asthma-related visit were made for evaluation of acute symptoms with no planned asthma care visits found.

Few of the non-medication related guideline elements were documented in more than about one third of the patients' medical record at least once over the year of the study. (Table 3) Asthma control, a major element new to the 2007 NAEPP guidelines as the basis for most treatment decisions was assessed in only 15.0% of the patients; 22.1% of children, 16.1 % of adolescents and 11.6% of adults at least once during the year (p for trend across age groups = $<.001$). When asthma control was documented, a validated instrument was used in 50% of the assessments. Medication adherence was assessed and documented in about one third (33.2%) of all patients' medical records with little variation across the age groups. Asthma triggers, specifically allergens, were assessed and documented in 32.5% of all patients with decreasing frequency of documentation with increasing age of the group (p for trend across age groups = $<.001$). (Table 3) Inhaler technique was uncommonly documented as being taught (7.6% of the total group of patients) and like most other adherence assessments, decreased with increasing age of group. Overall, only 1.3% of patients had any documentation stating that the patient's inhaler technique was observed. Asthma Action Plans were the least commonly documented non-medication element being present in only 3.1% of the records across all age groups but with a peak to 8.9% in children aged 5 to 11 years (p for trend $<.001$) Figure 2 summarizes the adherence to one or more of the non-medication elements of guidelines that we assessed.

Exposure to tobacco smoke was the non-medication element most well documented being present in 83.1% of adults' medical records, and 54.5% of adolescents' medical records. For children ages 5 to 11 years we looked for documentation of exposure to second hand smoke

which can be an important asthma trigger in patients of all ages. Second hand smoke exposure was documented in only 34.0% of children's medical records with lower rates in adolescents and adults (p for trend $<.001$). (Table 3).

Among these patients, all reported to have persistent asthma as a requirement for study participation, 141 patients (12.0% overall) had no documentation of a prescription for any asthma related medication, including no documentation of short acting beta agonist prescription. (Table 4) Daily maintenance medications were prescribed for 70.4% of the total group of patients with highest rates in children (74.0%) and lowest rates in adolescents (63.9%). The prescribing of SABA alone (mono-therapy) was highest in adolescent girls compared to all other age by gender groups with 39% of adolescent girls having documentation of only a short acting beta agonist prescription during the year.

The types of daily maintenance medications prescribed changed with age. Children had the highest rates (57.5%) of receiving only anti-inflammatory therapy (inhaled corticosteroids, leukotriene modifiers (LM) or both] with only 16.5% having prescriptions for combinations that included long acting bronchodilator therapy and an anti-inflammatory. Adolescents and adults had higher rates of long acting beta agonist prescriptions, primarily in combination with an inhaled corticosteroid. Tweens and children had higher rates of Leukotriene modifier prescriptions, either alone or in combination with other drugs (41.0% and 33.9% respectively). Use of a leukotriene modifiers was 30% in adults. (Table 4)

Some practice characteristics, but not the practice's geographic region (southern, northeastern, midwest and west), were associated with documentation of guideline adherence. In the overall analysis, being a family medicine practice was associated with lower rates of documented adherence to non-medication guideline elements. (Table 5). However, in a sensitivity analysis removing the outlier urgent care practice which was labeled as a family medicine practice, that difference was no longer significant ($p = .81$ for practice type). Practices with an electronic medical record and practices in cities of $>250,000$ residents but not larger practices (4 or more clinicians), were more likely to have more guideline elements documented.

Some patient characteristics were also associated with documentation of guideline adherence. Within both pediatric and family medicine practices, tweens versus children and boys versus girls were more likely to have no documented guideline elements. In family medicine practices the age and sex differences extended to adults with adults least likely and women less likely than men to have documentation of guideline adherence within their medical record. When accounting for age and sex, income and race were not significantly associated with documentation of guideline adherence. (Data not shown)

Discussion:

Two to seven years after publication of the 2007 NAEPP national asthma guidelines, adherence to basic elements of the guidelines remained low in these United States primary care practices. Adherence was consistently poorly documented across all age groups but worse in adults compared to children, worse in girls compared to boys, worse among

practices located in communities of <250,000 and in those without electronic medical records demonstrating considerable opportunities for improvement. Assessment of guideline adherence documentation differences in family medicine and pediatric practices were not robust across sensitivity analysis removing the outlier urgent care practice.

The 2007 U.S. NAEPP guidelines were the first to outline the concept of asthma control and to recommend that it become the basis for stepped asthma care.⁷ Yet, in these practices, 75% of children and 90% of adults had no documentation of asthma control assessment at any time during the year of observation. Without assessing control, it is not clear how these physicians were selecting asthma medications or the basis for decisions to step up or step down therapy.^{28,24,13,30,31}

In addition to assessment of control, the 2007 guidelines recommend assessing reasons for inadequate control before stepping up medications. The guidelines specifically suggest assessing triggers, medication adherence, and adequacy of inhaler technique before stepping up medication.⁷ Among these patients and practices, factors affecting control were mentioned in fewer than one third of patients' medical records at any time during the year of observation. This failure may result in over prescribing of higher doses of anti-inflammatory medications as well as combination drugs, which may have limited added effect in the face of poor adherence, continued exposure to triggers and inadequate inhaler technique.

Asthma action plans have been shown to decrease emergency visits and hospitalizations for exacerbations in children.²⁶ Yet, less than 10% of the grade school aged children and 3% of adolescents had documentation of an asthma action plan. This suggests that over 90% of these children and over 97% of the tweens likely had no guidance for school personnel or coaches to address asthma problems including asthma "attacks" during school hours. Since children and tweens spend up to half or more of their weekday waking hours in school, failure to provide guidance to the schools is unfortunate and may add risks for increased asthma related morbidity or even mortality among these children.

Across all age groups, over 29% of these patients with physician-reported persistent asthma had no documentation of access to or use of a daily maintenance medication, yet overall more than 40% of them had inadequate asthma control measured as frequent daytime and nighttime symptoms and disruptions of usual activities (Table 2).. When used as a Healthcare Effectiveness Data and Information Set (HEDIS) quality metric, daily maintenance medication is not related to improved asthma outcomes^{32,33} perhaps because HEDIS metrics do not capture adherence assessments. Yet failure to prescribe daily maintenance medications in almost one third of patients reported to have persistent asthma suggests the need for additional education on both assessing "persistence" and asthma medication therapy. It may be that without assessment of asthma control, the primary care physicians are unaware of the burden asthma has on their patients' lives. Physicians, like patients have been shown to significantly underestimate asthma severity and overestimate asthma control^{34,27,35} again highlighting the need for a more standardized approach to asthma management. It is also possible that the physicians labeled patients as persistent asthma when they had only intermittent asthma. While this would potentially lessen the concern about not prescribing daily maintenance medications to incorrectly labeled patients,

it raises the concern about the physician's criteria for the choice of labeling the asthma as persistent.

Some of the elements assessed might be only required at intervals beyond 1 year. For example, allergies and irritants may not change over a few years period of time and therefore may not be required to be documented every year. However, it would be nice for the physician or other clinician seeing the patient to have that data easily available such as on an asthma flow sheet. We found no such flow sheets in any of these practices. Assessing inhaler technique education less than once a year is unlikely to be adequate for many patients since observational and prospective studies have shown that inhaler technique declines within 6 to 12 months for up to a third of people using them for asthma.²⁷

Two other recent studies from the United States report poor adherence to the 2007 guidelines.^{21,22} Abstracting data from medical records from 3 primary care practice-based networks in Oklahoma and New York during 2010, investigators found that prior to a planned intervention to improve guideline adherence, 40% had control assessed, 28% had assessment of environmental triggers/allergies, and 7% had action plans. All findings are similar to our results. Also similar to our results, 82% of patients with physician-reported persistent asthma had documentation of daily maintenance medications.²¹ In a study performed by recruiting 2–12 year-olds waiting to be seen in US pediatrician offices from 2009–2011, investigators found similarly low levels of adherence to 6 elements of the asthma guidelines: step-up care 19%, trigger reduction 40%, action plan 25%, frequency of daytime symptoms noted 41%, frequency of nighttime symptoms noted 45%, follow-up visits planned 31%.²² Studies prior to release of the 2007 NAEPP asthma guidelines also report similarly low rates of adherence to elements of the guidelines that did not change in the 2007 version, e.g. use of action plans and prescribing of daily maintenance medications. For example, among children cared for by physicians enrolled in managed care organizations in Michigan, use of asthma action plans was reported to be documented in 8.4% of children, very similar to the 8.9% we report in the 5 to 11 year old children.³⁶ The prescribing of daily asthma maintenance medication for children has increased from 66% reported in the period (2002–2003) prior to release of the 2007 guidelines³⁶ to 74% among the children in our study (2011–2012).

Identification of barriers for asthma guideline adherence may lead to targeted improvement efforts. Many factors associated with guideline adherence, such as age and race/ethnicity, are not modifiable. In this study, having an electronic medical record was associated with documentation of guideline adherence, even though none of the practices had any embedded asthma management tools or an electronic asthma registry within their electronic medical records during the baseline period. This study was not able to determine if the electronic medical record by itself was responsible for the association between better documentation of asthma guideline adherence; it is possible that having an electronic medical record simply improved documentation of encounters but not actual delivery of guideline recommendations or that having one serves as a surrogate for other practice-level organizational factors. Methods to improve adherence to asthma guidelines with the ultimate goal of improving asthma outcomes have been tested, and most have failed at the stage of uptake of the tested method whether it be a decision support tool or other type of

intervention.³⁷ Computer decision support, for example, are rarely used and when used, the advice given is rarely followed.³⁸ Decision tools have shown some promise in specific settings, for example in high-risk pediatric populations.³⁹ Wiener-Oglivie et al, using qualitative research methods, identified teamwork and delegation of tasks as characteristics of practices with high adherence to guidelines in primary care settings.⁴⁰ Having a “system” in place to address guideline adherence, perhaps in this study measured in surrogate by having an electronic medical record, may be a modifiable primary care practice-level characteristic that leads to improved guideline adherence.

Our study has both strengths and weakness that should be noted. Our study population is diverse coming from primary care practices across the United States and includes both children and adults. Data on adherence to the elements of the guidelines was abstracted by the same group of five nurse abstractors across all sites allowing us to affirm inter-rater reliability in the abstraction process.²⁹ We have a large sample size and had access to all of the primary care medical records from the enrolling sites for all enrolled patients. It is, however, possible that patients received asthma care outside of the primary care office, particularly for those with no asthma visits recorded during the year of observation. Any patient with an asthma-related visit had an opportunity for guideline adherent care and those making any type of visit during the year had the opportunity for documentation of asthma medications even if prescribed outside of the primary care practice. Although, it is possible that some patients used short acting beta agonist therapy from prescriptions written in previous years and not documented during our year of observation. Prescription data was collected from review of the primary care electronic or paper medical records. It is possible that these patients received medications from other sources such as emergency department or asthma specialist’s visits that were not recorded in the primary care medical record. Most of the sites were not part of a large integrated health plan and few had available prescription fulfillment or billing data. Due to the geographic spread of the sites and the wide diversity of pharmacies used for asthma medications, it was not possible to obtain pharmacy fill data.

Further, it is possible that some types of care were provided but not documented, e.g. inhaler technique education. Yet in a recent study comparing family and patient report about an asthma visit with abstraction of medical records, strong agreement existed for elements of guideline adherence, including 85% agreement on medications, 77% agreement on action plans, and 73% agreement on plans for specific follow up visits.²²

Our study assessed care only 3 to 5 years after the 2007 release of the NAEPP asthma guidelines. This may still be early in the guideline diffusion process.³⁵ While some of the elements of the 2007 guidelines such as asthma control were new concepts, and others like the recommendation of use of asthma action plans were supported by new evidence, many of the other elements such as the need for inhaler technique education, assessment of medication adherence and trigger identification and discussion were not new in the 2007 guidelines and have been recommended in the previous 1997 guidelines and the update in 2002. (<http://www.nhlbi.nih.gov/health-pro/guidelines/archive/asthma-expert-panel-report>; http://www.nhlbi.nih.gov/files/docs/guidelines/asthgdln_archive.pdf).

Conclusion:

Overall adherence to multiple elements of the 2007 NAEPP guidelines was poor among these US primary care practices with adherence to non-medication elements of the guidelines never higher than 33% and ranging as low as 3%. While adherence to medication recommendations was higher than for the non-medication elements, almost one third of these patients with persistent asthma did not have prescriptions for daily maintenance medications. These baseline data suggest extensive opportunities for improvement in implementing asthma guidelines within primary care practices in the United States.

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Abbreviations:

NAEPP National Asthma Education and Prevention Program

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Large dots indicate urban location, pop>250K (N=4)

Hollow dots indicate residency practice (N=4)

Red indicates FM (N=15), green Pediatrics (N=6)

e indicates EMR in use (N=16)

4 indicates 4 or more physicians (N=12)

Figure 1.

Map of sites enrolling patients in the Asthma Tools Study.

Figure 2:
Adherence to non-medication element guidelines: number of guideline elements documented during year of study in overall population and by age group.

Table 1.

Elements of the guidelines assessed for adherence

Indicator	Required documentation	Comments
<i>Control</i>		
Asthma control	Validated control score Elements of control Days with symptoms, # of days Nights with symptoms, # of nights Activity limitations, frequency in #s	Name of test and score A number with denominator, e.g. # days per week or times per month
<i>Factors associated with control</i>		
Asthma Medication Adherence	Medication adherence discussed	Specific comments on assessment of adherence or discussion of reasons for nonadherence
Inhaler technique	Documentation of teaching Review of patient's inhaler technique	Documentation that someone observed patient's inhaler technique
Allergy/irritant assessment	Documentation of allergy discussion or allergy testing Comments on patient smoking status Comment on household members smoking status	Notation of receiving desensitization therapy was included as documented
<i>Self management support</i>		
Asthma Action Plan	Copy of the Asthma Action Plan in the medical record	Did not require updating during the baseline period
<i>Medications</i>		
Short-acting beta agonist prescribed	Prescription recorded during baseline year, SABA use documented in visit note or on medication list as "active"	"Active" meant that medication was listed and not noted to be discontinued
Daily maintenance medication	Prescription for one or more maintenance medications recorded during baseline year, one or more daily maintenance medications documented in visit note or on medication list as "active"	"Active" meant that medication was listed and not noted to be discontinued

Table 2.

Demographics of the enrolled patients.

	Age	Race			Hispanic	Income							Asthma Control
By group and sex	Mean, (range) in yrs	White %	Black %	Other %	% yes	<\$10,000	\$10,000 to \$24,999	\$25,000 to \$49,999	>\$50,000				Self reported % Asthma APGAR >2
Children	5.0–11.99 years of age, N = 285, 107 girls and 178 boys												
All	8.4 (5.0–11.9)	66.7	26.7	6.6	24.7	15.9	21.0	20.1	39.7				56.1
Boys	8.5 (5.1–11.9)	64.7	26.7	8.6	26.3	17.0	20.7	17.1	40.8				58.5
Girls	8.3 (5.0–11.8)	67.1	25.3	7.0	29.1	13.9	21.5	25.3	38.0				51.9
Tweens	12.0–18.99 years of age, N = 211, 99 girls and 112 boys												
All	15.2 (12.0–18.9)	78.4	14.4	7.2	24.8	13.8	17.1	16.4	45.4				52.0
Boys	14.7 (12.0–18.8)	75.6	20.0	4.4	22.1	8.2	18.8	15.3	49.5				45.9
Girls	15.8 (12.0–18.9)	82.1	11.9	6.0	24.8	20.9	14.9	17.9	10.3				59.7
Adults	19.0–64.99 years of age, N = 680, 489 women and 191 men												
All	40.6 (19.0–61.0)	89.3	7.9	2.8	3.9	16.5	16.5	19.2	45.9				62.7
Men	39.8 (19.0–60.1)	88.6	8.4	3.0	5.5	10.9	10.9	20.3	56.3				53.1
Women	40.9 (9.1–61.0)	88.6	8.4	3.0	4.2	18.3	18.3	18.3	18.7				63.9

* Asthma control as reported by patients on baseline survey

Table 3.

Adherence to non-medication elements of the asthma guidelines.

Elements of the guidelines assessed and documented	Adherence N (%) for all and by age group ¹					
	All n (%) N = 1176	Children (5–11 yrs) n (%) N = 285	Tweens (12–18 yrs) n (%) N = 211	Adults (19–65 yrs) n (%) N = 680	P value for difference across age groups	P value for difference across age groups, adjusting for site using random effects model
Asthma control Validated tool used	176 (15.0) 88 (7.5)	63 (22.1) 32 (11.2)	34 (16.1) 15 (7.1)	79 (11.6) 41 (6.0)	<.001	.028
Asthma Medication Adherence discussed	390 (33.2)	90 (31.6)	68 (32.2)	232 (34.1)	.71	.18
Inhaler technique Taught Observed	89 (7.6) 15 (1.3)	40 (14.0) 8 (2.8)	16 (7.6) 2 (0.9)	33(4.8) 5 (0.7)	<.001 .20	.002 <.001
Trigger/irritants Allergies discussed Allergy testing Patient smoking status Others smoking in home	382 (32.5) 24 (2.0) 681(76.3 *) 221 (18.8)	123 (43.2) 9 (2.8) NA 97 (34.0)	69 (32.7) 6 (2.8) 115 (54.5) 47 (22.3)	190 (27.9) 9 (1.2) 566 (83.1) 77 (11.3)	<.001 .12 <.001 <.001	>.002 .19 <.001 <.001
Asthma action plan	37 (3.1)	25 (8.9)	5 (2.4)	7 (1.0)	<.001	<.001

Overall, 9.1% of children, 10.9% of adolescents and 11.2% of adults who were enrolled had no asthma visits in the baseline year.

*

This percent is of only tweens and adults in whom smoking status was assessed.

Table 4.

Medications prescribed in the primary care practices by age group.

Medications prescribed	All n (%) N = 1176	Children (5–11 yrs) n (%) N = 285	Tweens (12–18 yrs) n (%) N = 211	Adults (18+ yrs) n (%) N = 680	P value for difference across age groups	P value for difference across age groups, adjusting for site using random effects model
None documented	141 (12.0)	35 (12.3)	31 (14.7)	75 (11.0)	.35	.06
SABA only	158 (13.4)	31 (10.9)	35 (16.6)	92 (13.5)	.18	.16
Daily maintenance	827 (70.4)	211 (74.0)	135 (63.9)	481 (70.6)	.05	.06
Daily anti-inflammatory ¹	410 (34.9)	164 (57.5)	80 (37.9)	166 (24.4)	<.001	<.001
Combination therapy ²	417 (35.5)	47 (16.5)	55 (26.0)	315 (46.2)	<.001	<.001

¹Includes inhaled corticosteroids (ICS), leukotriene modifier (LM) or both combined

²Includes combination of anti-inflammatory and long acting bronchodilator (LABA) e.g. (ICS+LABA) or (LM + LABA) or (ICS+ LM + LABA)

Table 5.

Association of practice and patient factors on guideline adherence (documentation of 3 or more guideline elements).

Analysis using all practices							
Factor	OR	CI ₉₅	P value				
Practice size (<4 referent)	0.79	(0.48, 1.27)	.33				
Practice type (pediatric referent)	2.13	(1.18, 3.83)	.01				
Use of EMR (no EMR referent)	7.92	(3.37, 18.62)	<.001				
Size of city (<250,000 referent)	4.48	(1.73, 11.61)	.002				
Geographic region (South referent)	1.11	(0.53, 2.33)	.79				
Northeast							
Midwest	1.53	(0.69, 3.38)	.29				
West	0.97	(0.49, 1.92)	.93				
Patient age group (Age 5–11 referent)	1.02	(0.59, 1.75)	.94				
Age 12–18							
Age 19+	0.57	(0.33, 1.00)	.05				
Patient race (Black referent)	1.01	(0.59, 1.72)	.97				
Patient sex (women referent)	0.87	(0.59, 1.27)	.46				
Patient SES (<\$25,000/yr referent)	0.93	(0.63, 1.36)	.71				