The Breathmobile Improves the Asthma Medication Ratio and Decreases Emergency Department Utilization

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ABSTRACT

OBJECTIVES: An Asthma Medication Ratio (AMR) of ≥0.50 has gained recognition as a metric related to improved asthma outcomes. The goals of this study were to evaluate asthma outcomes in relation to this threshold in Hispanic children with high-risk asthma and to compare the effectiveness of the Breathmobile (BM) program with usual care (UC), utilizing the AMR-related emergency department utilization (ED) rate.

STUDY DESIGN: Healthcare utilization and prescription claims recorded January 1, 2011, to June 23, 2014, were evaluated pre- versus post year in 164 Medicaid-enrolled children, aged 2 to 18 years, with high-risk persistent asthma (BM group: n = 72; UC group: n = 92).

METHODS: High risk was defined by ≥2 oral corticosteroid fills, or ≥2 ED visits (*International Classification of Diseases, Ninth Revision, Clinical Modification* [*ICD-9-CM*] codes 493.0-493.9) or ≥1 IP stay (*ICD-9-CM* codes 493.0-493.9) in the pre-year. Poisson regression was utilized to compare asthma outcomes pre- versus post year in BM and UC groups and to describe the average number of ED days per 100 patients treated in relation to AMR.

RESULTS: An AMR of ≥0.50 versus <0.50 was related to 49% fewer ED visits (P <.05). BM proved to be more effective than UC in increasing the percent who achieved an AMR ≥0.50 from a baseline of 47.2% to 80.6% versus 50.0% to 65.2% post year, respectively. This difference was reflected in the significant 52% reduction in average number of ED visits post year for the BM cohort versus 13% for the UC cohort.

CONCLUSIONS: View achievement of the AMR ≥0.50 as an informative metric in program evaluation and for healthcare organizations to measure the quality of care provided to high-risk patients with asthma.

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Asthma, one of the most common chronic diseases in children, is estimated to affect more than 10 million children younger than 18 years in the United States.[1] In those younger than 15 years, asthma exacerbations result in approximately 640,000 emergency department (ED) visits and 128,000 inpatient (IP) stays annually.[2,3] Lifetime total direct medical costs of asthma per annual birth cohort are estimated at $3.2 billion.[4] In addition, asthma is the leading cause of school absenteeism.[5,6] African American and Hispanic children are disproportionately affected by relatively high morbidity rates.[7-12] Morbidity is particularly common among those living in poverty, with poor access to medical care, and in those receiving public insurance.[5,8,11,13] For example, Medicaid-covered children typically have poorer asthma control, greater underutilization of long-term controller medication compared with those receiving commercial insurance, and more frequent ED visits and IP stays.[14-16]

As a result of these poor outcomes, efforts have been made to determine quality-of-care metrics that could predict future exacerbations in order to improve asthma management. These efforts led the National Committee for Quality Assurance to develop the Use of the Appropriate Medication for People with Asthma Metric as part of the Health Effectiveness and Data Information Set (HEDIS) to measure the quality of care provided to patients with asthma by healthcare organizations.[17] There are 3 HEDIS measures that assess asthma care for those with persistent asthma.[18] The initial asthma measure, reported in the year 2000, assessed the percentage of patients with persistent asthma who were prescribed at least 1 canister of controller medication in the measurement year. This idea has been examined by several studies, which failed to demonstrate a correlation of this measure with improved asthma outcomes.[14,18-20] A second asthma HEDIS measure, the Medication Management for People with Asthma (MMA), first publicly reported in 2013, calculates the percentage of asthma controller medication adherence rate per treatment period and was reported in a recent study to not relate to improved asthma outcomes.[18] The third HEDIS asthma measure, the Asthma Medication Ratio (AMR),

has been shown to correlate with improved asthma outcomes in children and adults,[14,21-24] and is currently being used as a quality-of-care metric to assess healthcare programs. However, potential variability in the AMR related to age, ethnicity/race, asthma severity, and type of insurance suggested to us the need for further evaluation in our population of Medicaid-insured Hispanic children with high-risk persistent asthma.

TAKEAWAY POINTS

An asthma medication ratio (AMR) of at least 0.50 reflects emergency department (ED) utilization and demonstrates superiority of using the Breathmobile (BM) compared with usual care (UC) in Hispanic children with high-risk persistent asthma.

- The AMR is an effective metric for assessing quality of care provided to asthmatic patients.
- Patients achieving an AMR ≥0.50 versus <0.50 had 49% fewer ED visits, P <.05.
- BM proved to be more effective than UC in increasing the percent of patients who achieved ≥0.50 from a baseline of 47.2% to 80.6% versus 50.0% to 65.2% post year, respectively.
- This AMR difference was reflected in the 52% reduction in ED visits post year in the BM cohort compared with 13% in the UC cohort.

A program utilizing mobile clinics, the Breathmobile (BM) program, has previously demonstrated improvement in asthma control and reduction in healthcare utilization by providing access to preventative asthma care to underserved children.[25-28] However, these studies had limited ability to examine improvement relative to a comparator group and by utilization of claims data.

We were fortunate to collaborate with the Medicaid program in Orange County, California, called CalOptima. They gave us the opportunity to access encounter and pharmacy claims data in order to evaluate asthma morbidity, use of oral corticosteroids (OCS), and AMR scores. In addition, we were able to compare those receiving BM care with a usual care (UC) group. The first goal of this study was to evaluate the AMR as a measure for determining improved asthma outcomes. The second goal was to evaluate the effectiveness of the BM healthcare program by comparing BM care with UC using the AMR quality improvement measure, as well as determining healthcare utilization rates in our population of Hispanic children with high-risk persistent asthma.

METHODS

Population and Design

CalOptima generated an annual list of insured children eligible for participation in the BM program. Parents of eligible children were contacted and offered care. Those who agreed to participate were designated the BM cohort; those who did not, the UC cohort. The reasons for not enrolling in the BM cohort included: unable to contact family (>50%), family preference, those who were scheduled to be seen but did not show up to their appointment, and children who had received care with an asthma specialist in the previous 12 months. All patients were offered the CalOptima disease management intervention prior to referral to the BM program. The intervention included reminder letters for tests and recommended immunizations, quarterly screening and monitoring by a disease management coordinator, quarterly educational paper mailings reviewing self-management techniques, and a list of self-management classes. Patients were referred for care in the BM program from July 2011 to April 2013. Eligibility criteria specific to this study included: being 18 years or younger, diagnosis of asthma (*International Classification of Diseases, Ninth Revision, Clinical Modification* [*ICD-9-CM*] codes 493.0-493.9) documented in encounter data, and being considered high risk. The criteria for being considered high risk are: persistent asthma as defined by HEDIS criteria[29] and validated in the article by Schatz et al,[30] ≥2 courses of OCS, and/or ≥2 ED visits (*ICD-9-CM* codes 493.0-493.9), and/or ≥1 IP stay (*ICD-9-CM* codes 493.0-493.9) in the previous 12 months. Other criteria included Hispanic ethnicity and a measurable AMR over the study period. Continuous CalOptima coverage during the entire study period was also required.

Encounter and prescription claims recorded from January 1, 2011, to June 23, 2014, in an electronic health record system utilized by CalOptima were abstracted for 164 children who met study eligibility criteria (n = 72 BM group and n = 92 UC group). Encounter claims data included age, gender, race, date of service, location of visit, diagnosis code(s), Current Procedural Terminology code, place of service, and whether patient had continuous insurance coverage. Prescription (Rx) claims data included date filled, label name, drug type, and days supplied. National Drug Codes identifying asthma medications and the label name specified in the claim line were evaluated to qualify medication prescribed (Rx) as a reliever, controller, or oral corticosteroid for the purposes of calculating HEDIS AMR ([number of controllers Rx] ÷ [number of controllers Rx + number of relievers Rx]) during respective annual evaluation periods. Claims data were aggregated on an exposure period basis (pre- and post year) to determine total number of defined events. Exposure time for patients in the BM group was determined from date of initial BM visit. In the UC group, pre- and postyear claims data were provided by CalOptima. This protocol was reviewed and approved by the Children's Hospital of Orange County Institutional Review Board.

Analysis

Study population characteristics were described in terms of valid percent of patients with a defined trait and the significance of between-intervention group (UC vs BM) differences assessed by χ^2 test statistic.

TABLE 1. Baseline Characteristics of Hispanic Children With High-Risk Persistent Asthma (HEDIS criteria), Described by Intervention Group (n = 164)

Valid % or Mean (SD)	High Risk[a]		
Pre-Year	BM (n = 72)	UC (n = 92)	*P*[b]
Age, years: mean (SD)	7.1 (3.8)	7.3 (3.7)	.852
<5	27.8%	22.8%	.515
5-11	54.2%	63.0%	
12-18	18.1%	14.1%	
Male	65.3%	58.7%	.390
HEDIS AMR, mean (SD)	0.42 (0.24)	0.40 (0.25)	.649
HEDIS AMR ≥0.50	47.2%	50.0%	.724
Controller medication Rx (≥1)	86.1%	80.4%	.338
Resource utilization (pre-year)			
A. ED days (any)	37.5%	23.9%	.059
ED days (≥2)	8.3%	7.6%	.865
B. IP days (any)	8.3%	10.9%	.587
C. OCS fills (any)	98.6%	98.9%	.861
OCS fills (≥2)	91.7%	93.5%	.658

AMR indicates Asthma Medication Ratio; BM, Breathmobile; ED, emergency department; HEDIS, Health Effectiveness and Data Information Set; IP, inpatient; OCS, oral corticosteroids; Rx, prescription; SD, standard deviation; UC, usual care.
[a]High risk defined by pre-year experience as ≥2 ED days, and/or ≥1 IP day, and/or ≥2 OCS prescriptions.
[b]*P* <.05, significant between intervention group difference in distribution based on χ^2 test statistic.

AMR was calculated in pre- and postyear periods and described in terms of average value and percentage of members with an AMR ≥0.50. Increased percentage of patients with AMR ≥0.50 in the post compared with the pre-period was assessed for significance using McNemar's test. Correspondence of AMR to ED visits, IP stays, and OCS fills was evaluated using Poisson regression with adjustment for patient age, gender, intervention group, and time period. Inclusion of an interaction effect between group and time determined significance of intervention group differentials in average medication fills. In SAS version 9.2 (SAS Institute Inc, Cary, North Carolina), PROC GENMOD with repeated statement was run to produce robust standard errors for the Poisson regression coefficients, controlling for potential overdispersion. In terms of reduced healthcare utilization, intervention group differentials were nonsignificant, but the small number of events (particularly IP stays) and sample size were factors impacting power to detect significance of interaction effect (results not shown). Calculation of incidence rate ratios (IRRs) were offset by patient-level exposure time for outcomes investigated per person-year in the BM group (pre- vs post period: retrospective look-back up to 365 days from initial BM visit vs elapsed time from initial BM visit to 365 days later or to cohort data end point [whichever occurred first]). Poisson regression analyses were performed using SAS version 9.2 (SAS Institute Inc, Cary, North Carolina) while remaining analyses utilized SPSS version 18.0 (SPSS Inc, Chicago, Illinois).

RESULTS

Patient Characteristics

In the BM group, 65.3% were male and the average age was 7.1 years with 27.8% under 5 years, 54.2% aged 5 to 11 years, and 18.1% aged 12 to 18 years (**Table 1**). The UC group was similar in age and gender composition; however, the percentage of patients in the BM group who required an ED visit (pre-year) was slightly higher than observed in the UC group (37.5% vs 23.9%; *P* = .059). Prior to enrollment in the BM program, 47.2% of high-risk patients met HEDIS criteria (AMR ≥0.50). The percentage was similar in the UC group (50.0%), *P* =.724. Nearly all patients in both groups reported OCS fills pre-year (98.6% in BM and 98.9% in UC group) and most had been prescribed at least 1 controller medication (86.1% and 80.4%, respectively). In terms of engagement in the BM program, 74% of patients had at least 3 visits to the program with a median time from baseline to third visit of 71 days (interquartile range: 57-107 days) by the study endpoint.

HEDIS AMR Related to ED Visit Rate

Achieving an AMR ≥0.50 corresponded to 49% fewer ED visits per 100 patients treated, after adjustment for age, gender, intervention group, and time period (*P* = .018) (**Figure 1**). Average number of ED days per 100 patients ranged from 50 in high-risk patients not using any controller medication (AMR = 0.00) down to an estimated 19 days in those using controller medication(s) without the requirement of relievers (AMR = 1.00). Each 0.10 increase in AMR resulted in 9% fewer ED days (*P* = .059). AMR did not show a statistically significant relationship to OCS fills and IP stays during the concurrent period (*P* >.05) (data not shown).

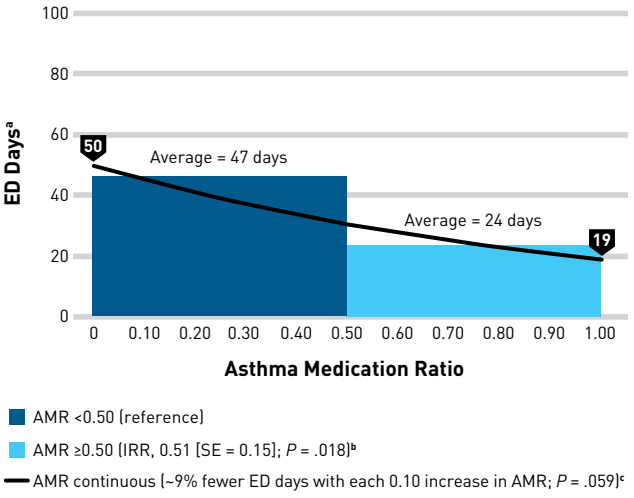
Reduced Healthcare Utilization and Improved Pharmacological Outcomes

Among children whose parents accessed care offered through CalOptima in the CHOC Health Alliance BM, reduced average number of total claims (non-Rx), ED visits, IP stays, oral corticosteroid prescriptions, and increased controller medication use in the post compared with pre-period were significant (*P* <.05) (**Table 2**). Positive trends were observed in the UC group, but to a lesser extent, with the exception of reduction in patients requiring an IP stay. The BM group had 52% fewer ED days per 100 patients treated post year (*P* = .050) compared with only 13% fewer in the UC group (*P* = .662). Overall, the total claims (non-Rx) rate showed a greater reduction in the BM compared with UC cohort ([IRR, 0.59; [standard error (SE) = 0.08] versus IRR, 0.65 [SE = 0.07], respectively). In our population of

patients who met the criteria for high-risk disease (baseline), only 22.6% of BM patients continued to have high-risk disease post year. In the UC cohort, improvement was also observed, although the percentage remaining at risk was slightly higher at 32.6%.

The percentage of patients who met HEDIS AMR ≥0.50 increased from 47.2% to 80.6% in the BM group (P <.001) and from 50.0% to 65.2% in the UC group (P = .013) (**Figure 2**). Although BM and UC groups were similar in their average AMR pre-year (0.42 [standard deviation (SD) = 0.24] and 0.40 [SD = 0.25], respectively; P = .649), the BM group had significantly higher average AMR post year compared with the UC group (0.60 [SD = 0.22] and 0.47 [SD = 0.28], respectively; P =.002). A significant shift in the medication usage pattern helped approach the benchmark of OCS Rx <1 per year in the BM group (pre vs post: 2.6 vs 1.0; P <.001) (Table 2). Trends were directionally similar in the UC group (2.9 vs 1.4; P <.001). This translated to 60% fewer OCS fills per 100 patients treated in the BM group compared with 52% fewer in the UC group. Increased controller medication fills in the BM group was in line with expectations post year for treating individuals with high-risk disease (7.6 compared with 3.9 pre-year; P <.001), whereas, a slight decrease in controller medication fills was observed in the UC group from 3.9 to 3.5 per year (P = .164). The difference in pharmacological therapy approach between the BM and UC groups was significant (P <.05).

FIGURE 1. Average Number of ED Days per 100 Persons Treated Estimated in Adjusted Models at Distribution of Covariates in Population



AMR indicates Asthma Medication Ratio; ED, emergency department; IRR incidence rate ratio; SE, standard error.

[a]Average ED days determined from adjusted models at covariate values representative of distribution in study population: 43.9% Breathmobile intervention, 38.4% female, average age of 7 years, and time period distributed equally.

[b]Model 1 treated AMR as a dichotomous variable (<0.50 vs ≥0.50).

[c]Model 2 treated AMR as a continuous variable (estimated average ED days ranged from 50 to 19 days at values of AMR = 0.00 and 1.00, respectively).

DISCUSSION

In this report, we have demonstrated the AMR to be an effective metric by assessing its relationship to improved asthma outcomes, particularly reduced ED visits in Hispanic children with high-risk persistent asthma. Utilizing the established optimal AMR threshold of ≥0.50, there were 49% fewer ED days per 100 patients compared with those with an AMR <0.50 (P <.05). Furthermore, using the change in the AMR as a quality improvement metric found that BM increased the percentage with an AMR ≥0.50 from 47.2% to 80.6%

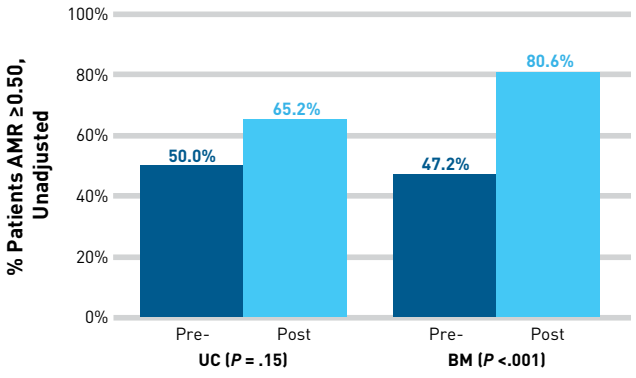
TABLE 2. Healthcare Utilization and Prescription Fill Rates, Described by Intervention Group and Time Period (n = 164)[a]

	BM (n = 72)				UC (n = 92)			
	Expected Number Events per Patient		IRR (SE)	*P*	Expected Number Events per Patient		IRR (SE)	*P*
Health resource utilization	Pre-	Post			Pre-	Post		
Total claim lines (non-Rx)	44.5	26.4	0.59 (0.08)	<.001	36.9	23.8	0.65 (0.07)	<.001
ED days (DX1 = asthma)	0.51	0.25	0.48 (0.18)	.050	0.33	0.28	0.87 (0.28)	.662
IP days (DX1 = asthma)	0.27	0.08	0.28 (0.27)	.181	0.38	0.08	0.20 (0.14)	.021
Pharmacological outcomes								
A. OCS Rx claims	2.6	1.0	0.40 (0.06)	<.001	2.9	1.4	0.48 (0.06)	<.001
B. Controller Rx claims	3.9	7.6	1.91 (0.26)	<.001	3.9	3.5	0.91 (0.08)	.298
C. Reliever (SABA) Rx claims	3.4	3.4	1.01 (0.05)	.774	3.6	3.0	0.83 (0.03)	<.001
B+C (controllers and relievers)	8.1	11.3	1.39 (0.13)	<.001	7.7	6.4	0.83 (0.06)	.009
A+B+C (asthma med claims)	10.7	12.4	1.16 (0.09)	.078	10.6	7.8	0.73 (0.05)	<.001

BM indicates Breathmobile; DX1, diagnosis 1 (primary); IP, inpatient; IRR incidence rate ratio; med, medication; OCS, oral corticosteroids; Rx, prescription; SABA, short-acting beta agonist; SE, standard error; UC, usual care.

[a]Poisson regression utilized to assess expected number of events and determine significance of IRR value within each group and intervention group difference in event rate change pre- versus post year.

FIGURE 2. Percentage of Patients Who Met HEDIS Asthma Medication Ratio Criteria (≥0.50) in Year 1 Compared With Year 2, Examined by Intervention Group[a]



AMR indicates Asthma Medication Ratio; BM, Breathmobile; HEDIS, Health Effectiveness and Data Information Set; UC, usual care.

[a]*P* value based on McNemar's test.

in the post year observation, whereas the comparator, UC, showed an increase from 50.0% to 65.2%. This difference was reflected in the significant 52% reduction in average number of ED visits for the BM cohort versus 13% for the UC cohort. The impact of the BM program was also shown by the reduction of OCS courses in the post year to approximately 1 compared with 1.4 in the UC group, suggesting continued risk of poor asthma control in the latter.

The concept wherein a provider proactively monitors their patient's health status outside of the office setting, particularly electronically, enables them to interact before severe asthma exacerbation or loss of asthma control occurs. This is particularly important with a disease like asthma where signs and symptoms may be episodic and healthcare utilization high. For that reason, administrative data are used in HEDIS and by the National Committee on Quality Assurance to assess the quality of care by health plans, such as Medicaid, and are increasingly incorporated into the pay-for-performance reimbursement model, which encourages a preventative approach to asthma therapy.

Of the 3 HEDIS process measures for persistent asthma, the AMR has shown superiority to ≥1 controller medication prescriptions per year.[21] This was also evident in our population, as ≥80% of high-risk children had received ≥1 controller in the pre-year. Yoon et al recently evaluated the MMA as a quality-of-care metric and found the MMA was not related to improved asthma outcomes assessed by rescue medication prescriptions, ED visits, and IP stays.[18]

One potential reason given for the superiority of the AMR, compared with the first 2 HEDIS process measures, is that they lack measure of short acting beta-agonist (SABA) prescriptions, which may indicate asthma exacerbations and poor asthma control. Schatz et al found the 2 measures that correlated with asthma outcomes were the number of SABA prescriptions and the AMR[30]—the latter includes both controller and rescue medication. These authors reported that the number of SABA prescriptions per year was inversely correlated with asthma outcomes. We hypothesized that the lack of change in SABA use in our BM cohort, which was less than 4 prescriptions, a threshold associated with increased risk of ED visits and OCS use,[30] may reflect general recommendations for use as a safety precaution prior to vigorous exercise (eg, running or basketball).

In the pediatric population, particularly in those with persistent asthma, several studies have shown the AMR to be a useful quality-of-care metric in relationship to improved asthma outcomes. Rust et al evaluated a Medicaid population of children aged 5 to 12 years with either 1 hospitalization or 2 outpatient visits for asthma and found that only 33.4% had an AMR ≥0.50 over a 90-day follow-up period. Those with an AMR ≥0.50 had a 17% reduced odds of a future ED visit.[31] The positive impact of achieving AMR ≥0.50 was also found in our cohort with the 49% reduction in average number of concurrent ED visits. Rust et al noted that the proportion of prescribed days (≥50% vs <50%), similar to the MMA, did not correspond to improved asthma outcomes,[31] which mirrored the findings of Yoon et al.[18] In a subsequent paper by Rust et al, utilizing the same population, these investigators established the cost savings with a greater percentage reaching ≥0.50 AMR as a marker of greater adherence.[32] For example, they projected a cost savings of $523.53 per patient due to reduced healthcare utilization by increasing the percentage reaching this threshold from 33.5% to 70%. This 36.5% absolute percentage point increase is similar to the 33.4% improvement (from 47.2% to 80.6%) observed in our BM cohort. Prior cost-benefit evaluations of the BM program showed similar positive cost reductions but preceded standardization on achieving AMR ≥0.50 and evaluation of attributable cost savings.[28,33]

In a novel approach, Beck et al calculated a pharmacy-level AMR (PH-AMR) and found children in census tracts with a PH-AMR reaching the ≥0.50 threshold had significantly less utilization than those with PH-AMR <0.50 ($P = .001$).[23] They reported that for every 0.1 increase in the PH-AMR, the asthma emergent care utilization rate decreased by 9.5 events per 1000 children ($P = .03$). After adjusting for poverty level and access to care, they concluded that the pharmacy may be a community leverage point to improve population-level asthma control through targeted interventions. For every 0.1 increase in AMR in our community setting, the rate of ED visits per 100 high-risk patients decreased approximately 9% ($P = .06$).

Stanford et al found that the optimal AMR threshold, depending on population, type of insurance, and timeframe being evaluated, ranged from ≥0.50 to ≥0.70.[24] However, AMR defined at commonly used and effective thresholds of ≥0.50 and ≥0.70 was found to be a significant predictor of subsequent exacerbations and OCS usage in both children and adults. This relationship was also seen in those receiving either Medicaid or commercial insurance, particularly in those defined as being high-risk for persistent asthma.

The Breathmobile Program

The concept of providing mobile healthcare to patients who have poor accessibility to adequate medical care is not new and has been successful in several rural and low socioeconomic status (SES)/underserved communities for both adults and children.[25,27,34,35] The concept of the BM model of healthcare delivery was originated in Los Angeles by Jones et al in 1995.[25] This program addressed several major barriers to preventative care including accessibility, cultural compatibility, affordability, and continuity of care. Outcomes shown by several BM programs distributed in underserved communities throughout the United States have consistently shown self-reported reduction in healthcare utilization, improvement in asthma control, and reduced school absenteeism.[25-27,28,33]

Limitations

Most studies evaluating the AMR as a population-based healthcare metric have utilized extensive Medicaid databases, while our study evaluated far fewer patients selected on the basis of being high risk for asthma exacerbations. This limitation may have affected our power to detect the significance of clinically meaningful differentials in health resource use reductions between intervention groups in the post period.

Restricting our study to low-SES Hispanic patients may have limited the generalizability of our findings. Although our study was not a randomized clinical trial, selection bias was expected to be minimal as both BM and UC patients met criteria for high-risk asthma and were similar in distribution of baseline characteristics described in Table 1. Access to disease management strategies offered through CalOptima may have contributed to the higher-than-expected baseline percentage of patients whose AMR value was ≥0.50 in both BM and UC cohorts (pre-year: 47.2% and 50.0%, respectively), based on the much lower percentage reported for a similar population in the Rust article (33.4%).[31] Our approach differed from some other AMR studies in that it was not designed sequentially to predict changes in the postintervention observational period,[18,24] but rather concomitantly to determine the relationship of AMR to healthcare utilization and pharmacological outcomes.[22,23] Outcome improvement may occur during subsequent years as shown by others.[18,24] Population health metrics, such as the AMR, provide insightful and comparative data for application in evaluation of disease management programs; approaches to increase accessibility to parameters necessary to calculate this measure across multiple settings and populations should be explored.

CONCLUSIONS

We have demonstrated that the AMR is a useful quality-of-care metric because it is significantly related to improved asthma outcomes. In our study, those with an AMR ≥.50 had 49% fewer ED visits compared with those with an AMR <.50 (P <.05) in 164 high-risk Medicaid-insured Hispanic children. Our data suggest that the BM model of care was superior to UC by increasing the percent of patients who achieved an AMR ≥0.50 from a baseline of 47.2% to 80.6% versus 50.0% to 65.2% post year, respectively. This was associated with a reduction of 52% in ED visits in the BM program (P <.05) compared with 13% in the UC cohort (P ≥.05). Although the AMR has been applied to assess large healthcare organizations, we have shown in a smaller cohort that it is an effective metric on quality of asthma care. Our findings should lead others to view achievement of the AMR ≥0.50 as an informative metric in program evaluation and for healthcare organizations to measure the quality of care provided to patients with asthma. ■

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Authorship Information: Concept and design (TM, WA, SLB, SPG); acquisition of data (TM, WA, SLB, SPG); analysis and interpretation of data (TM, WA, SPG); drafting of the manuscript (TM, WA, SLB, SPG); critical revision of the manuscript for important intellectual content (TM, WA, SLB, SPG); statistical analysis (TM); provision of patients or study materials (WA, SPG); obtaining funding (WA, SPG); administrative, technical, or logistic support (SPG); and supervision (WA, SPG).

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