

# Adaptation of an Asthma Management Program to a Small Clinic

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A disproportionate health burden exists due to uncontrolled asthma among inner city children.<sup>1</sup> Many asthma disease-specific programs have proven to be effective in reducing asthma-related morbidity and improving disease control. Most effective strategies, however, provide long-term follow-up using asthma-specific providers who follow national asthma guidelines.<sup>1-8</sup>

The Breathmobile/pediatric asthma disease management program (PADMAP) is an effective disease management and treatment program utilizing teams of asthma and allergy specialists who provide regular care to children with asthma in inner cities across the United States via mobile asthma clinics.<sup>4-9</sup> These clinics have consistently achieved impressive asthma-related metrics for the past 20 years, including highly significant reductions in asthma-related hospitalizations, emergency department (ED) visits, and urgent care visits.<sup>5,6</sup> In addition, the programs have shifted urgent care visits to regular care and increased the number of controller medications prescribed.<sup>4</sup>

As with most clinically effective disease management programs, the Breathmobile/PADMAP program requires significant start-up resources. An estimated \$365,865 per year was required to purchase and operate 1 Breathmobile for the first 7 years.<sup>5</sup> This, however, was recouped in long-term asthma-related health savings during subsequent operating years. In a cost analysis study, the return on investment (ROI) per mobile unit was \$6.73 per invested dollar. The annual estimated ED cost in 4 geographic regions was reduced by \$2,541,639.<sup>10</sup> Therefore, the Breathmobile/PADMAP model is also one of the most cost-effective asthma management programs in the United States. Smaller health systems with smaller budgets and fewer patients may not have the resources to start an effective Breathmobile-like asthma program; yet, these groups have a similar percentage of patients with asthma and, therefore, incur a similar proportion of asthma-associated health and economic burden.

In this study, we describe a collaboration between a tertiary care center with a long established and successful Breathmobile/PADMAP

## ABSTRACT

**OBJECTIVES:** Asthma management programs, such as the Breathmobile program, have been extremely effective in reducing asthma morbidity and increasing disease control; however, their high start-up costs may preclude their implementation in smaller health systems. In this study, we extended validated asthma disease management principles from the Breathmobile program to a smaller clinic system utilizing existing resources and compared clinical outcomes.

**STUDY DESIGN:** Cox-regression analyses were conducted to determine the cumulative probability that a new patient entering the program would achieve improved clinical control of asthma with each subsequent visit to the program.

**METHODS:** A weekly asthma disease management clinic was initiated in an existing multi-specialty pediatric clinic in collaboration with the Breathmobile program. Existing nursing staff was utilized in conjunction with an asthma specialist provider. Patients were referred from a regional healthcare maintenance organization and patients were evaluated and treated every 2 months. Reduction in emergency department (ED) visits and hospitalizations, and improvements in asthma control were assessed at the end of 1 year.

**RESULTS:** A total of 116 patients were enrolled over a period of 1 year. Mean patient age was 6.4 years at the time of their first visit. Patient ethnicity was self-described predominantly as Hispanic or African American. Initial asthma severity for most patients, classified in accordance with national guidelines, was "moderate persistent." After 1 year of enrollment, there was a 69% and 92% reduction in ED/urgent care visits and hospitalizations, respectively, compared with the year before enrollment. Up to 70% of patients achieved asthma control by the third visit. Thirty-six different patients were seen during 1 year for a total of \$15,938.70 in contracted reimbursements.

**CONCLUSIONS:** A large-scale successful asthma management program can be adapted to a stationary clinic system and achieve comparable results.

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## TAKEAWAY POINTS

- ▶ The Breathmobile program is a highly successful mobile asthma disease management system previously shown to improve asthma control and reduce the asthma-related health burden among inner-city children with asthma.
- ▶ This program, however, requires significant start-up resources to purchase initial mobile clinics and fund specialty providers, which may not be available to smaller healthcare systems.
- ▶ Proven and published asthma disease management principles derived from the Breathmobile program can be adapted to smaller multi-specialty clinics using existing resources under the supervision of specialists, resulting in similar clinical and economic outcomes.

program (Los Angeles County + University of Southern California [LAC+USC] Medical Center) in Los Angeles, California, and a stationary clinic system at Harbor- University of California, Los Angeles (UCLA) Medical Center (HUMC) in Torrance, California, to establish a fixed asthma-specific clinic at the HUMC using previously validated strategies. The need for start-up funds was avoided by using the clinic's existing resources. We compared the efficiency of settings, asthma-related morbidity, and asthma control to previously published Breathmobile metrics.<sup>4,5</sup> We also determined whether standard Medi-Cal (California's Medicaid) reimbursements for asthma-related services were sufficient to allow a stationary clinic version of the Breathmobile/PADMAP system to be self-sustaining.

## METHODS

## Study Population

Pediatric patients with asthma were recruited into the study from the Pediatric Allergy-Immunology Clinic at HUMC and the Harbor Medical Foundation (MFI) clinic. These clinics serve the children with Medi-Cal coverage assigned to a large local healthcare maintenance organization (HMO). Patients at the HUMC clinic are referred through the LA County Department of Health Services, EDs, clinics, and inpatient services. Patients at the MFI clinic are referred by HMO asthma disease management coordinators. There were no specific referral guidelines for referring patients to asthma specialty care; however, patients were referred if they were not controlled after being prescribed inhaled corticosteroids, had more than 1 urgent care or ED visit for asthma exacerbation during the last year, or were hospitalized for asthma exacerbation during the last year. All patients had persistent asthma and the majority had previous ED visits and/or were previously hospitalized for asthma exacerbations.

## Clinic Structure and Operation

The HUMC/MFI clinics' operations were modeled identically to that of the Breathmobile/PADMAP system. Staff consisted of 1 allergy-immunology specialist and 2 nursing/asthma educators (1 registered nurse and 1 licensed vocational nurse). One

medical technician coordinated appointments and financial matters in a fashion similar to the patient financial worker on the Breathmobile/PADMAP system.<sup>5</sup> In contrast to the Breathmobile/PADMAP program which uses full-time allergy-immunology staff, the HUMC/MFI clinic used pediatric nurses who also staffed other pediatric subspecialties, including neurology, nephrology, and rheumatology. Each clinic was held 1 half-day per week.

Patients were evaluated and treated in accordance with National Heart, Lung, and Blood Institute Expert Panel Review 3 (NHLBI EPR-3) asthma guidelines.<sup>2</sup> All patients were seen on a regular basis, with follow-up appointments every 6 to 8 weeks. Allergy testing used either skin tests or in vitro-specific-immunoglobulin E (IgE) serum tests (Quest Diagnostics; Madison, New Jersey), as stipulated by the guidelines. Use of in vitro or in vivo testing was left to the discretion of the provider. Generally, patients were allergy tested on their second or third follow-up visit.

The allergy-immunology specialist provider (principal author) had extensive clinical and administrative experience working with the original Breathmobile/PADMAP system. Although the nonprovider staff did not have clinical experience with the Breathmobile/PADMAP system, they were trained by the provider on asthma education in accordance with NHLBI ERP-3 asthma guidelines.

## Care Coordination and Disease Management

Care coordination and disease management strategies and principles were made in collaboration with the LAC+USC Breathmobile/PADMAP system and transferred to the HUMC/MFI asthma clinic. On an ongoing basis, the allergy-immunology specialist provider had regular meetings with the LAC+USC Breathmobile/PADMAP team to ensure collection of the correct data and execution of the correct strategies.

Disease activity was tracked electronically, similar to Breathmobile/PADMAP programs, in real time and using identical asthma metrics. These included: baseline asthma severity, current disease activity, current disease control, step-up or step-down in asthma therapy, ED visits, hospitalizations, systemic steroid rescue, prescribed asthma controller, Asthma Control Test (ACT) score, and spirometry testing. Breathmobile/PADMAP clinical data is recorded in the AsmaTrax electronic health record (EHR), and our clinics entered identical data fields directly into Excel spreadsheets. Criteria for asthma metrics, such as asthma control, were assessed in accordance with NHLBI ERP-3 guidelines.<sup>2</sup>

In general, patients were given follow-up appointments for 6 to 8 weeks; however, earlier appointments were also scheduled depending on disease severity. Asthma control, asthma-related ED visits, and hospitalizations for patients and medications were

reviewed by the provider at the end of each visit. Patients who missed their appointments had these metrics from their previously kept appointment reviewed. An early follow-up visit (2 to 4 weeks) was scheduled for patients who had experienced any of the following conditions since their last visit: 1) more than 3 visits with not well- or very poorly controlled asthma, 2) required ED visit or hospitalization since their last visit, or 3) missed current visit and had not well- or very poorly controlled asthma at their last visit. Patients were given a regular follow-up visit (6 to 8 weeks) if they had all the following conditions: 1) well-controlled asthma at their last visit, 2) fewer than 3 previous visits with asthma control rated as not well- or very poorly controlled, and 3) no ED visits or hospitalizations since their last visit. Patients with missed appointments who also fulfilled all 3 criteria were scheduled for a return visit within 6 to 8 weeks (Figure 1).

## Outcomes

Primary outcomes were reduction in ED visits, hospitalizations, and time to achieve asthma control (asthma rated by NHLBI EPR-3 asthma guidelines as “controlled”). Asthma control, ED visits, and hospitalizations since patient’s last appointment were recorded at every clinical encounter and recorded in EHRs (mobile clinics) and paper charts (fixed clinic). Cumulative ED visits and hospitalizations

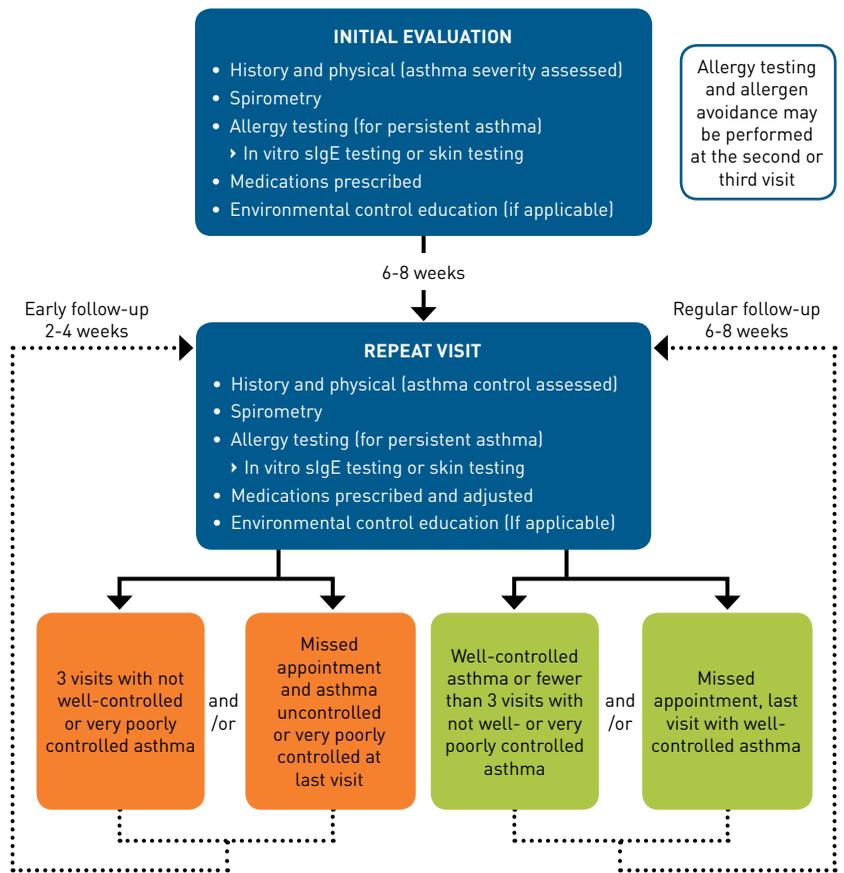
over a period of 1 year after enrollment were totaled from retrospective EHR and chart review. Time-to-achieving asthma control was defined as the number of visits or provider encounters after enrollment until asthma was rated as controlled. A 1-year period was chosen because the study was funded for this period of time.

The secondary outcome was to determine whether current Medi-Cal/Medicaid reimbursements could sustain operations for patients seen at the MFI clinic, which has a contract with a regional HMO. Patients served as their own historic controls when comparing reductions in ED visits and hospitalizations before and after entry into the program. ROIs with regard to reduced ED visits and hospitalizations were also calculated.

## Methods

Cox-regression analyses were conducted to determine the cumulative probability that a new patient entering the program would achieve improved clinical control of asthma with each subsequent visit to the program. This incorporated an intent-to-treat approach

**FIGURE 1. Asthma Disease Management Pathways**



sIgE indicates allergen-specific immunoglobulin E.

for each patient, with at least 1 follow-up visit and control status reported at the second visit to the program. To account for the occurrence of multiple events (ie, multiple patients achieving control by a particular visit) and the construct of time as an interval measured as discrete points (ie, achievement of control can occur at any time point between visits), the TIES=EXACT approach was specified in the model statement for the PHREG procedure. This method assumes there is a true but unknown ordering for the tied event times.<sup>12</sup> The age of patients, baseline asthma severity, and the 2 sites of care at Harbor-UCLA were controlled for in the analysis.

## RESULTS

### Patient Characteristics

Patient ages ranged from 3 to 18 years (mean age = 6.4 years; standard deviation [SD] = 4.8 years) at the time of their first visit (Table 1). Patient ethnicity was self-described predominantly

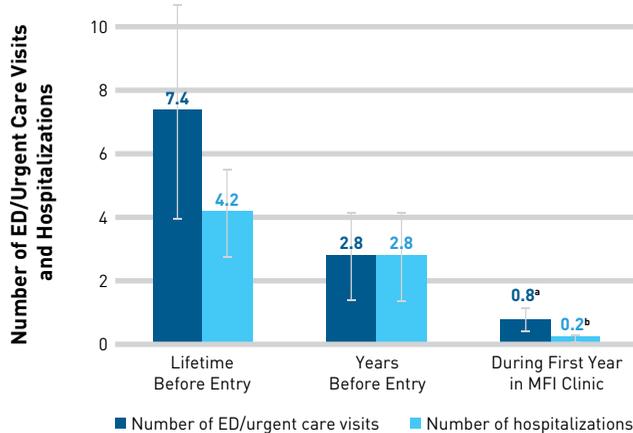
## METHODS

**TABLE 1.** Patient Characteristics

Characteristics	
Total number of patients (N)	116
Age, years: mean (SD)	6.4 (4.8)
Male	59%
Female	41%
Ethnicity	
Hispanic	47%
African American	31%
Caucasian	4%
Asian	6%
Other	12%
Initial asthma severity	
Intermittent	2%
Mild persistent	18%
Moderate persistent	53%
Severe persistent	27%

SD indicates standard deviation.

**FIGURE 2.** Reduction in Asthma-Related Emergency/Urgent Care Visits and Hospitalizations Before and After Entry Into MFI Clinic



ED indicates emergency department; MFI, Harbor Medical Foundation Institute.

\* $P = .03$  compared with 1 year before entry.

\* $P = .01$  compared with 1 year before entry.

as Hispanic or African American. The majority of patients were covered by Medi-Cal and enrolled in HMOs funded by Medi-Cal. Initial asthma severity for most patients—classified in accordance with NHLBI ERP-3 guidelines—was moderate persistent. Seventy percent of visits occurred within 84 days of the previous visit. The mean interval between patient visits to the program was 64 days. Visit intervals did not differ relative to baseline asthma severity.

### Time-to-Achieve Asthma Control

Patients engaged in the clinic were likely to achieve asthma control, and those with milder disease were more likely to achieve control sooner. On average, 50% of mild persistent patients with asthma achieved control by the second visit, and by the third visit, 70% of these patients were in control. Patients with moderate or severe persistent asthma took longer to achieve disease control. Approximately 97% of patients with mild persistent asthma, and approximately 90% with moderate/severe persistent asthma achieved control by their sixth visit (data not shown).

### Allergy Testing and Environmental Control Education

Patients had allergy testing and environmental avoidance education based on results of the allergy testing. Thirty-three percent of patients received in vitro-specific IgE testing for inhalant allergens; the rest received epicutaneous skin testing. There was no statistical difference between patients who had the 2 different types of IgE testing in terms of probability of achieving asthma control by the third visit (data not shown).

### Reduction in Morbidity

Enrollment in the program resulted in a 69% and 92% reduction in ED/urgent care visits and hospitalizations, respectively. This was achieved by comparing the number of ED/urgent care visits and hospitalizations in the 1-year period following enrollment into the program compared with the previous year before entry into the program (Figure 2).

### Cost to Deliver Care

A total of 116 unique patients were seen at HUMC-UCLA during the 1-year period. Based on reimbursement rates at the time of the study, the costs to deliver care for patients using skin and in vitro testing were \$435.50 and \$505.70 per patient per year, respectively (Table 2). (These are standard California Medi-Cal reimbursement rates for asthma specialists for high-complexity visits and follow-up.) Overhead for 1 half day a week of clinic services was \$10,000 per year.

## DISCUSSION

This study demonstrated that the Breathmobile/PADMAP asthma disease management system could be implemented in a stationary clinic and achieve similar asthma-related outcomes. Existing resources in a multi-specialty pediatric clinic were used to realize treatment goals and were sustained financially from standard Medi-Cal/Medicaid reimbursements.

Patients engaged in the Breathmobile/PADMAP program(s) saw reductions of asthma-related ED visits or hospitalizations from 37.3% before program entry to 8.7% (76% reduction) within the first 6 visits in the program.<sup>5</sup> In our clinic, there were more children with ED visits (58%), but similar hospitalizations (24%), in the year

prior to program entry. This may be due to the higher number of African American patients within our system. Some evidence suggests that these patients may have poorer response to asthma controllers and relievers compared with patients of other ethnicities.<sup>4-11,13</sup> PADMAP data also showed that African American children with asthma have a higher risk of losing asthma control even after gaining initial disease control. However, there may be other confounding variables to account for this difference—such as household income—that we did not examine in this study. The magnitude of morbidity reduction between PADMAP and our system was, however, similar (68% and 91% reductions in ED visits and hospitalizations, respectively, after program entry compared with the year before).

Traditional asthma metrics emphasize reductions in asthma-related urgent care visits and hospitalizations.<sup>1,2</sup> Many patients, however, experience considerable asthma-related impairment from symptoms without requiring urgent care visits or hospitalizations. These impairments include school and work absences, decreased exercise and activity, and reduced quality of life.<sup>14,15</sup> Therefore, a paramount objective of asthma management is to gain asthma control in an expeditious manner. Breathmobile/PADMAP was the first asthma disease management system to demonstrate that regardless of initial asthma severity, up to 70% of children with asthma could achieve asthma control after 3 visits if they remained engaged in the program and were treated in accordance with NHLBI ERP-2 and ERP-3 asthma guidelines.<sup>4</sup>

In our clinic, 70% to 80% of patients achieved asthma control as defined by NHLBI ERP-2 and ERP-3 asthma guidelines after 3 clinic visits. Significantly more patients with an initial diagnosis of mild persistent asthma achieved asthma control compared with those initially diagnosed with moderate or severe persistent asthma by visit 3. However, by visit 6, the probability of asthma control was similar across the 3 groups. Results from Breathmobile/PADMAP and our study highlight the necessity of scheduling regular visits in order to successfully control asthma.

The PADMAP/Breathmobile program is perhaps the most effective ongoing asthma-specific disease-management system in the United States. We chose to extend the services of this successful program to an area where patient demographics were similar. Each Breathmobile is staffed by an asthma specialist provider, 1 RN, 1 respiratory therapist, and a patient financial worker. Since the Breathmobile program's operational history spanned the publication of 2 editions of national asthma guidelines, care was delivered in accordance with NHLBI ERP-2 and ERP-3 asthma guidelines

**TABLE 2.** Reimbursement Using 2015 Medi-Cal Fee Schedule

Patients Tested Using Allergy Skin Tests			
Test Characteristics		Reimbursement Rate	Billed
Number of initial visits	35	(× \$82.70/visit)	\$2894.50
Number of follow-up visits	137	(× \$52.70/visit)	\$7219.90
Number of allergy tests <sup>a</sup>	34	(× \$43.70/visit)	\$1485.80
Number of spirometry tests	148	(× \$24.60)	\$3640.80
Total per year			\$15,241
Total per patient per year <sup>b</sup>			\$435.50

Patients Tested Using In Vitro Allergy Tests			
Test Characteristics		Reimbursement rate	Billed
Number of initial visits	81	(× \$82.70/visit)	\$6698.70
Number of follow-up visits	292	(× \$52.70/visit)	\$15,388.40
Number of allergy tests <sup>a</sup>	81	(× \$131.10/visit)	\$10,619.10
Number of spirometry tests	333	(× \$24.60)	\$8191.80
Total per year			\$40,957.50
Total per patient per year <sup>b</sup>			\$505.70

<sup>a</sup>Twenty-three allergens were tested per patient.

<sup>b</sup>Eighty-one patients were treated.

(dependent on time period).<sup>4-10,15-17</sup> We recreated this system within an existing multi-specialty clinic that serves the same inner city children and uses the same diagnosis and treatment guidelines delivered by an asthma specialist. However, due to the smaller size of this clinic, there were not sufficient resources to provide adequate staff for optimal asthma care, and our clinic relied on nurses who also staffed other pediatric subspecialties.

Using existing resources in an established pediatric clinic eliminates the need to raise the large amount of funding necessary to purchase and equip a mobile clinic, which is estimated to be up to \$80,000. A Breathmobile unit may cost up to \$241,950 per year to operate for the first 7 years if patients are treated 5 days per week, excluding the salary of the asthma specialist. This translates to \$465 per half-day session.<sup>5</sup> In our private practice clinic, the total cost—including overhead and excluding compensation for allergy specialists—was \$192 per half day. The operating cost for our system was similar to that of the Breathmobile program. Both systems used allergy specialists and nurse practitioners as providers, and outcomes were similar between PADMAP<sup>5</sup> and our clinic (data not shown). As patients in this study were all Medi-Cal-enrolled, we postulate that this successful system can be generalized and adapted to other Medicaid populations in the United States.

In a recent study, the ROI for 4 Breathmobiles in southern California in 2010 was \$6.73 saved for each \$1 invested.<sup>10</sup> Calculations were based on savings resulting from fewer ED visits/hospitalizations, reduced school absenteeism, and quality-adjusted life-years saved. Breathmobiles operated an average of 3.7 days per week, treating almost 600 unique patients per unit to achieve

## METHODS

**TABLE 3.** Return-on-Investment Analysis to Manage 116 Patients With Asthma in HUMC/MFI Clinic<sup>a</sup>

Total number of patients seen/year	N = 116
Percent reduction in ED visits	40%
Percent reduction in hospitalizations/year	22%
Cost per ED visit	\$923
Cost per hospitalizations/year	\$2765
Number of ED visits reduced	46
Cost saved in ED visits/year	\$42,458 (46 visits × \$923/visit)
Cost saved in hospitalizations/year	\$60,830 (22 hospitalizations × \$2765/hospitalization)
Total cost saved in ED visits/hospitalizations/year	\$103,288
ROI	\$62,330 (\$103,288 – \$40,958) <sup>b</sup>
ROI per patient	\$537 (\$62,330 / 116 patients)

ED indicates emergency department; HUMC/MFI, Harbor-UCLA Medical Center/Harbor Medical Foundation Institute; ROI, return on investment.

<sup>a</sup>Total length of study was 1 year.

<sup>b</sup>Cost saved = total cost saved per year for 116 patients – cost to treat 116 patients/year

these benchmark outcomes. In our study, we were not able to perform such an extensive cost analysis because we only had data on actual cost to deliver care at 1 of the clinical sites, the MFI clinic, and not the HUMC clinic. However, based upon 2015 reimbursement rates for California Medi-Cal, there was a significant ROI in the context of reduced ED visits and hospitalizations (Table 3).

In this study, the cost of care for patients with asthma for a period of 1 year included reimbursements for allergy testing using skin and in vitro allergy testing (Table 2). Both modalities have similar sensitivity and specificity.<sup>2</sup> The cost per patient tested with skin testing was slightly lower than similar ones using in vitro tests. Medi-Cal reimbursement rates for allergy skin testing were lower compared with payments for in vitro allergy tests.<sup>18</sup> It must be noted, however, that reimbursement rates for both skin prick tests and in vitro allergy tests can vary significantly, depending on the payer. In states such as New Jersey and Illinois, Medicaid payments for skin prick tests and in vitro allergy tests are reimbursed at similar rates.<sup>19,20</sup> In other states, such as North Dakota, and Montana, Medicaid payments for skin prick testing (\$9.28 and \$6.50, respectively) are reimbursed at higher rates compared with in vitro allergy testing (\$6.53 and \$3.94, respectively).<sup>21,22</sup> In systems operating with capitated laboratory services arrangements, in vitro allergy testing is customarily included in the per-patient per-month fee, making use of these tests more cost-effective than skin testing, which may require additional payments.

Finally, due to shortage of asthma specialists to perform skin testing, use of in vitro allergy tests may be necessary in population-level primary care-focused asthma disease management strategies. These limitations are particularly applicable to Medicaid beneficiaries and underserved communities.

The Breathmobile/PADMAP system provides excellent disease management and significant ROI. However, it must operate on a large scale with a full-time dedicated staff to achieve these goals. Smaller health systems lacking large numbers of patients could not afford such large-scale programs. Utilizing existing staff, our system achieved similar health outcomes at current reimbursement levels with the flexibility of being deployed on a smaller scale of 1 half day per week.

The Breathmobile is a mobile specialty clinic in which routine care is brought to neighborhood schools during school hours, making it more convenient for patients to keep their appointments. As appointment adherence is associated with greater asthma control, it follows that the mobile units will have better outcomes compared with a fixed clinic in which patients must be excused from school for the appointment. The results of this study, however, showed that a fixed clinic achieved similar asthma control compared with the more convenient mobile clinic.

NHLBI EPR-3 asthma guidelines recommend allergy testing for inhalant allergens in patients with persistent asthma as a basis for allergen identification and avoidance education.<sup>1,2</sup> Breathmobile/PADMAP predominantly utilized skin testing; however, our clinic used both skin testing and in vitro-specific IgE testing.<sup>23</sup> There was no difference in the ability to control asthma among patients who received skin testing versus those who had in vitro testing. The flexibility of using a diagnostic test not restricted to allergy specialists aided in delivering patient-specific allergen control measures as indicated by the NHLBI EPR-3 asthma guidelines.<sup>24</sup>

### Limitations

The results of this study must be interpreted with caution. Our asthma clinic was set up with direct input from, and collaboration with, a well-established and successful disease management program. Further, there were ongoing consultations and clinical decision making guidance from asthma specialists. Systems without such supervision may not achieve similar results. The stationary clinic enrolled patients for a shorter timeframe before outcomes analyses were performed compared with 6 years of reported Breathmobile/PADMAP program data.<sup>5</sup> Patients are likely more compliant during their initial engagement; therefore achieving better disease control initially, before gradually losing control in the ensuing years, may be an important contributing factor. Our patient census was lower, which enabled more personalized treatment and education per patient. We had a slightly lower operating cost per half day of operation compared with the Breathmobile system. However, the HUMC clinic only operated 1 half day per week

compared with the 5 full days of the Breathmobiles. It is unknown whether operating costs would increase to become commensurate with those of the Breathmobiles if our asthma clinic was expanded in terms of treatment hours.

In regard to patient outcomes, patients served as their own historical controls (for improvements in asthma control and healthcare utilization). We did not follow a control cohort as this was a real-world clinical treatment study. Regression to the mean is a significant problem with this research design, and may have had a significant impact on our results, making them less likely to generalize to other populations. Finally, there may be confounding variables in our analysis, specifically, time-to-achieve control, as we did not control for previous asthma utilization and adherence.

## CONCLUSIONS

A large-scale, successful mobile asthma disease management system can be adapted to a stationary multi-specialty clinic system on a sustainable part-time basis and achieve similar asthma-related health outcomes. ■

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**Authorship Information:** Concept and design (KYK, NR, LS, BY, ST); acquisition of data (KYK, LS); analysis and interpretation of data (KYK, NR, LS, BY, ST); drafting of the manuscript (KYK, NR, BY, ST); critical revision of the manuscript for important intellectual content (KYK, ML, NR, LS, BY, ST); statistical analysis (KYK, ML, LS); provision of patients or study materials (KYK, LS); obtaining funding (KYK, BY); administrative, technical, or logistic support (KYK, ML); and supervision (KYK).

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## REFERENCES

1. Adkinson NF, Yunginger JY, Busse WW, Bochner BS, Holgate ST, Simons ER, eds. *Middleton's Allergy: Principles and Practice*. 6th ed. St. Louis, MO: Mosby; 2003.
2. National Asthma Education and Prevention Program. Guidelines for the diagnosis and management of asthma (ERP-3). National Heart Lung and Blood Institute website. <https://www.nhlbi.nih.gov/health-pro/guidelines/current/asthma-guidelines>. Published July 2007. Accessed June 27, 2017.
3. Leung DYM, Sampson HA, Geha RS, Szefer SJ. *Pediatric Allergy: Principles and Practice*. St. Louis, MO: Mosby; 2003.
4. Jones CA, Clement LT, Morpew T, et al. Achieving and maintaining asthma control in an urban pediatric disease management program: the Breathmobile program. *J Allergy Clin Immunol*. 2007;119(6):1445-1453.
5. Jones CA, Clement LT, Hanley-Lopez J, et al. The Breathmobile program: structure, implementation, and evolution of a large-scale, urban, pediatric asthma disease management program. *Dis Manag*. 2005;8(4):205-222.
6. Scott L, Morpew T, Bollinger ME, et al. Achieving and maintaining asthma control in inner-city children. *J Allergy Clin Immunol*. 2011;128(1):56-63. doi: 10.1016/j.jaci.2011.03.020.
7. Morpew T, Heri B, Jones F, Galant SP. Helping underserved children breathe easier: Children's Hospital of Orange County (CHOC) Children's Breathmobile. *Calif Pediatrician*. 2011;27(1):20-24.
8. Kachru R, Morpew T, Kehl S, et al. Validation of a single survey that can be used for case identification and assessment of asthma control: the Breathmobile program. *Ann Allergy Asthma Immunol*. 2006;97(6):775-783.
9. Jones CA, Morpew T, Clement LT, et al. Breathmobile program. A school-based case identification process for identifying inner city children with asthma: the Breathmobile program. *Chest*. 2004;125(3):924-934.
10. Morpew T, Scott L, Li M, et al. Mobile health care operations and return on investment in predominantly underserved children with asthma: the Breathmobile program. *Popul Health Manag*. 2013;16(4):261-269. doi: 10.1089/pop.2012.0060.
11. Kwong KY, Morpew T, Scott L, Guterman J, Jones CA. Asthma control and future asthma-related morbidity in inner-city asthmatic children. *Ann Allergy Asthma Immunol*. 2008;101(2):144-152. doi: 10.1016/S1081-1206(10)60202-5.
12. Allison PD. Missing data techniques for structural equation modeling. *J Abnorm Psychol*. 2003;112(4):545-557.
13. Finkelstein Y, Bournissen FG, Hutson JR, Shannon M. Polymorphism of the ADRB2 gene and response to inhaled beta-agonists in children with asthma: a meta-analysis. *J Asthma*. 2009;46(9):900-905. doi: 10.3109/02770900903199961.
14. Sadatsafavi M, Rousseau R, Chen W, Zhang W, Lynd L, FitzGerald JM. The preventable burden of productivity loss due to suboptimal asthma control: a population-based study. *Chest*. 2014;145(4):787-793. doi: 10.1378/chest.13-1619.
15. Bonilla S, Kehl S, Kwong KY, Morpew T, Kachru R, Jones CA. School absenteeism in children with asthma in a Los Angeles inner city school. *J Pediatr*. 2005;147(6):802-806.
16. Liao O, Morpew T, Amaro S, Galant SP. The Breathmobile: a novel comprehensive school-based mobile asthma care clinic for urban underprivileged children. *J Sch Health*. 2006;76(6):313-319.
17. Eakin MN, Rand CS, Bilderback A, et al. Asthma in Head Start children: effects of the Breathmobile program and family communication on asthma outcomes. *J Allergy Clin Immunol*. 2012;129(3):664-670. doi: 10.1016/j.jaci.2011.10.013.
18. Medi-Cal rates. Department of Health Services Medi-Cal website. <https://files.medi-cal.ca.gov/pubsdoco/rates/rateshome.asp>. Accessed July 6, 2015.
19. Rate information. New Jersey Medicaid Management Information System website. <https://www.njmmis.com/hospitalinfo.aspx>. Accessed July 6, 2015.
20. 2015 fee schedule. Illinois Department of Health and Family Services website. <https://www.illinois.gov/hfs/MedicalProviders/MedicaidReimbursement/FeeSchedule/Pages/2015FeeSchedule.aspx>. Accessed July 6, 2015.
21. ND Medicaid provider information. North Dakota Department of Human Services website. <https://www.nd.gov/dhs/services/medicalserv/medicaid/provider-fee-schedules.html>. Accessed July 6, 2015.
22. Montana Healthcare Programs provider information: lab and imaging. Montana Department of Public Health and Health Services website. <https://medicaidprovider.mt.gov/40#184752565-provider-manuals>. Accessed July 6, 2015.
23. Morpew T, Kwong KY, Yang B, Galant SP. The relationship of aeroallergen sensitization phenotypes to asthma control in primarily Hispanic asthmatic children. *J Asthma*. 2014;51(3):253-259. doi: 10.3109/02770903.2013.863332.
24. Fromer LM, Valcour A. Using specific IgE testing to optimize management of allergic diseases in the primary care setting. *J Fam Pract*. 2014;63(4):1-8.

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