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SPECIAL POPULATIONS

Improving Asthma Management among African-American Children via a Community Health Worker Model: Findings from a Chicago-Based Pilot Intervention

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Objectives. Asthma affects 25–30% of children living in certain disadvantaged Chicago neighborhoods, a rate twice the national prevalence (13%). Children living in poor, minority communities tend to rely heavily on the emergency department (ED) for asthma care and are unlikely to be properly medicated or educated on asthma self-management. A pilot project implemented and evaluated a community health worker (CHW) model for its effectiveness in reducing asthma morbidity and improving the quality of life among African-American children living in disadvantaged Chicago neighborhoods. *Methods.* Trained CHWs from targeted communities provided individualized asthma education during three to four home visits over 6 months. The CHWs also served as liaisons between families and the medical system. Seventy children were enrolled into the pilot phase between 15 November 2004 and 15 July 2005, of which 96% were insured by Medicaid and 54% lived with a smoker. Prior to starting, the study was approved by an institutional review board. Data on 50 children (71.4%) who completed the entire 12-month evaluation phase were analyzed using a before and after study design. *Results.* Findings indicate improved asthma control. Specifically, symptom frequency was reduced by 35% and urgent health resource utilization by 75% between the pre- and post-intervention periods. Parental quality of life also improved by a level that was both clinically and statistically significant. Other important outcomes included improved asthma-related knowledge, decreased exposure to asthma triggers, and improved medical management. The intervention was also shown to be cost-effective, resulting in an estimated $5.58 saved per dollar spent on the intervention. *Conclusions.* Findings suggest that individualized asthma education provided by a trained, culturally competent CHW is effective in improving asthma management among poorly controlled, inner-city children. Further studies are needed to affirm the findings and assess the model's generalizability.

Keywords African American, community health workers, disease management, pediatric asthma

INTRODUCTION

Asthma is the most common chronic condition of childhood, affecting 13.5% of children in the United States (1). Minority children living in inner-city communities suffer disproportionately from asthma, with some of the highest rates having been documented among African-American children (1). Chicago is one of the cities hardest hit by the surging asthma epidemic, with death rates that have been increasing since 1978 and an asthma hospitalization rate that is nearly twice the national rate (2–6). The *Sinai Improving Community Health Survey* (7, 8), conducted in 2002–2003, revealed extraordinarily high proportions of children with asthma in several of the more disadvantaged and predominantly minority Chicago communities surveyed. In one primarily African-American community on Chicago's West Side, 23% of children have asthma (diagnosed or screened positive based on the Brief Pediatric Asthma Screen (9)). Other studies have corroborated these findings (10–12). Not only were children in predominantly African-American Chicago communities more likely to have asthma, but the survey also revealed that 80% of those who had diagnosed symptomatic asthma were not on proper medications (7, 8).

One possible cause of this high burden of asthma is that many inner-city children utilize the emergency department (ED) as their primary source of asthma care (13–16). The focus of asthma management in the ED is on the treatment of acute symptoms, and as a result children who primarily utilize the ED for asthma care are unlikely to be properly medicated or to have been educated on appropriate disease management (16). While the caregivers of children who are seen in the ED or are hospitalized for asthma are encouraged to follow up with their child's physician in the near future, many do not follow through for various reasons. In addition, poor children living in the inner city often have other complicating factors in their lives that make it difficult for even an educated caregiver to properly manage their child's asthma (17, 18).

Community health workers (CHWs) have been supplementing medical care in harder-to-reach or underserved populations for years (19–25). CHWs are frontline public health workers who are trusted members of their community or who have an unusually close understanding of the community served (26). Following a training period, CHWs utilize their knowledge and skills to educate and assist fellow community members in gaining control of their health. CHWs not only use the learned knowledge of a particular health condition to improve health outcomes, but also build relationships of trust. Through these relationships, CHWs empower community members to take control of their health, identify barriers to health, and offer

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the tools necessary to overcome these barriers (27). CHWs have been shown to be effective in improving their clients' abilities to manage chronic conditions, navigate the health-care system, and address other health-care needs (19–25). The CHW model has been utilized effectively in the treatment of HIV and stroke, cancer screening, and management of diabetes and asthma, among others (19–25). There is evidence suggesting CHW models are a cost-effective means of improving disease management (25, 28–30).

Given this evidence, the Sinai Pediatric Asthma Intervention-2 (PAI-2) was developed and implemented by the Sinai Urban Health Institute and Sinai Children's Hospital in Chicago, IL, as a direct response to the disproportionate asthma burden experienced by African-American children living in the poor, inner-city communities served by the Sinai Health System. PAI-2 aimed to pilot test a CHW home visit model with the intent of expanding the model if it proved to be feasible and effective. It was hypothesized that the PAI-2 model would prove an effective means of improving asthma management and quality of life among children with poorly controlled asthma living in targeted communities and would also be associated with significant cost savings. We report on the results of the evaluation of the PAI-2 pilot study.

METHODS

Study Design

This was an intervention study using historical controls. Participants included African-American children aged 2–16 years with severe, poorly controlled asthma per the National Heart, Lung, and Blood Institute standards (31, 32). Children who did not have severe asthma and/or were involved in another comprehensive asthma program in the year prior to the study were excluded from participation. Study participants were recruited between 15 November 2004 and 15 July 2005 from Mount Sinai Hospital's ED, from inpatient units, and via physician referrals. The study obtained a Health Insurance Portability and Accountability Act (HIPAA) waiver of authorization as part of the institutional review board's (IRB) approval of the study. This waiver allowed the researchers to view private health information of potential participants, since the personal health information obtained did not represent more than a minimal risk to privacy. CHWs made the initial contact with each caregiver to assess the child's eligibility for study inclusion. If the child was eligible and the caregiver expressed an interest, a baseline visit was scheduled and participants were followed for 1-year post-baseline.

Intervention

While the research team consisted of a pediatric pulmonologist, an epidemiologist, intervention coordinator, research assistant, and two half-time CHWs, the CHWs were the main agents of the intervention. CHWs were recruited from inner-city, predominantly African-American Chicago communities, similar to the target communities. The CHWs did not need to have any prior experience with asthma; however, it was important that the CHWs had a cultural connection to the target communities and a passion for positively impacting on the lives of the people living within those communities. Once the CHWs were identified, they participated in a 5-day, intensive asthma training class. The training was conducted by a certified asthma educator and included asthma-related topics: asthma medications and devices; asthma triggers, trigger avoidance, and low-cost ways of reducing triggers; and warning signs of an asthma episode and asthma severity recognition. The CHWs met with the intervention coordinator and a pediatric pulmonologist on a regular basis for continuing education and to reinforce their asthma knowledge and teaching skills.

The CHWs conducted three to four home visits during a 6-month period with each participating family, providing individualized asthma education. Participants provided informed consent and signed a HIPAA authorization form prior to the intervention's initiation. The CHWs' main objectives were to teach children and their families how to more effectively manage asthma. The education was provided in the family's home whenever possible. The in-home education sessions were interactive and tailored to the family's unique needs. The following concepts were taught throughout the 6-month intervention in a format that was easy to understand and culturally sensitive to the family's background: pathophysiology of asthma, recognition of asthma symptoms and early warning signs of an exacerbation, steps to be taken during an asthma attack, recognition of asthma triggers and their avoidance, concept of quick-relief and long-term controller asthma medications, and technique of inhaler and accessory device use. Written materials were provided to each family as reinforcement of the concepts learned during the session.

The second component of the intervention involved facilitating the establishment of a relationship with a primary care provider (PCP). The CHW would ascertain whether participants had been seeing their PCPs appropriately, and if they had not, the CHW would offer encouragement and assistance toward doing so. If a family had an asthma action plan (AAP) which they had received from a physician, the CHW would teach them how to implement the AAP. If the family did not have an AAP, the CHW worked with the PCP to obtain one for the family. An AAP is a written document provided to the family by their physician detailing the appropriate response to asthma symptoms with the intent of warding off an asthma attack and/or managing an attack when it occurs. When necessary, the CHW, in consultation with the appropriate staff, also provided basic case management services.

Data Collection

Data were retrospectively collected for 1 year before the study and prospectively for 12 months after enrollment. Data were primarily collected by a research assistant. The research assistant accompanied the CHW to the baseline visit and collected all the baseline data. She also collected the majority of the remaining data via monthly phone calls through month 6 and then every 2 months through month 12. As the research assistant accompanied the CHWs only on

the baseline visit, the CHWs did collect some data at each of their home visits. The data collected by the CHWs were limited to information that had to be observed, such as medication technique, and data that were useful to their teaching, including the presence of triggers and the Asthma Knowledge Quiz.

Measurements

Primary Outcomes. The primary outcomes were intended to gage improvements in asthma control.

Asthma Symptoms. Participants' primary caregivers were asked four symptom-related questions in person at baseline and during each subsequent data collection phone call (months 1–6 and months 8, 10, and 12). In each instance, the period of reference was the 2 weeks prior to the time of collection. Specifically, symptom questions ascertained the following about the child: (1) number of symptom-free days; (2) number of days on which symptoms were experienced during daytime hours; (3) number of nights during which asthma symptoms interrupted sleep; and (4) number of days on which a child needed to use his/her quick-relief medicine. Data from the 2 weeks prior to baseline were compared with the 2-week average over the course of the 12-month follow-up. A not yet validated measure was used to assess asthma symptoms.

Asthma-Related Health Resource Utilization and Activity-Limited Days. Information on asthma-related health resource utilization and activity-limited days (i.e., number of days on which a child was unable to attend school or carry out usual activities because of asthma) was collected in person retrospectively for 1 year prior to the baseline visit (365-day recall) and then via phone prospectively for the 12 months following the initiation of the intervention (30-day recall for months 1–6 and 60-day recall from months 8, 10, and 12). Caregivers were asked to recall their child's asthma-related health resource utilization pertaining to ED visits, hospitalizations, hospital days, urgent clinic visits, and regular clinic visits. ED visits, hospitalizations, and urgent clinic visits were summed to create a "total urgent health resource utilization" variable. There is no validated measure to assess health resource utilization (short of a medical record review, which can be difficult when care occurs at multiple facilities) or activity-limited days in the literature. The standard practice for community-based interventions is to use recall data.

Caregiver Asthma-Related Quality of Life. The quality of life of the child's primary caregiver was assessed using the *Pediatric Asthma Caregiver's Quality of Life Questionnaire* (33), a validated and extensively used questionnaire. The Likert-scale instrument yields three scores: an overall score, an activity limitation sub-score, and an emotional function sub-score. In each case, the maximum possible score is 7 and a change in the score of 0.5 or more has been shown to be clinically significant (34). Data were collected in person at baseline and over the phone at 6 and 12 months by the research assistant.

Secondary Outcomes. Secondary measures were intended to document the extent to which changes in knowledge and behavior might have resulted in the intended improvement in asthma control.

Asthma-Related Knowledge. Caregiver's asthma-related knowledge was assessed using a 10-question true/false quiz. Topics addressed by questions ranged from medication use to trigger avoidance and to the pathophysiology of asthma. Data were collected in person at the baseline visit by the research assistant and at the 2-week, 3-month, 6-month, and 12-month home visits by the CHW. This instrument was created for the project and has not been validated.

Self-Efficacy. Self-efficacy is a measure of the confidence an individual has in his/her ability to undertake certain actions in managing a prospective situation. The tool that was used to measure self-efficacy is the *Asthma Management Parental Self-Efficacy Scale* (35). This tool specifically asks questions pertaining to the caregiver's self-efficacy toward properly managing his/her child's asthma. The maximum possible score is 24 and all responses are based on a Likert scale. Data were collected by the research assistant in person at the baseline visits and via phone at 3, 6, and 12 months. The *Asthma Management Parental Self-Efficacy Scale* tool has not been validated.

Asthma-Related Triggers. A home trigger assessment was utilized to assess cigarette smoke exposure as well as eight other triggers that might be found in the home environment (e.g., pests, damp/moist rooms, mold/mildew, and furry pets). Data were collected in person at the baseline visit by the research assistant and at the 3-, 6-, and 12-month home visits by the CHW. The tool relied on self-report and has not been validated.

Medication Administration. To assess the proper techniques of medication administration, at each of the home visits the CHW asked the child/caregiver (depending on the child's age) to demonstrate how the medication was being used. Results are reported for metered dose inhalers (MDI) only. There were six steps for proper MDI administration: (1) appropriately shakes inhaler prior to use; (2) appropriate placement of device in mouth/on face; (3) begins each puff separately; (4) appropriate inhalation technique; (5) appropriate breathing technique (i.e., holding breath for 10 seconds following inhalation); and (6) appropriate tracking of dose. The CHW observed the child/caregiver and recorded whether or not each of these steps was performed properly. Data were collected in person at the baseline, 2-week, 3-month, 6-month, and 12-month home visits by the CHW. This tool was created by the pediatric pulmonologist on the research team and has been used extensively in his pulmonology clinic. A review of the literature reveals that there is no assessment tool of this kind validated or not.

Data Analysis

The outcome analysis was limited to children who completed the entire 12-month evaluation phase. Frequencies, means, and medians, as appropriate, were calculated for

each outcome variable at baseline and over the follow-up period associated with that outcome. The analysis utilizes a pre–post-test design, with each child serving as his/her own historical control. For several outcomes (e.g., symptom days, attacks, and health resource utilization), the variable was a count and not normally distributed. Therefore, nonparametric tests were used to assess whether observed changes were significant. When the degree of the change was important, the Wilcoxon signed-rank test was used. In situations where the direction but not the magnitude of the difference was important, the sign test was used. For all statistical tests, a *p*-value of .05 or less was considered statistically significant. Two-sided tests of hypothesis were used. Data were analyzed using SAS, version 9.1 (SAS Institute, Inc., Cary, NC, USA) (36).

A cost-savings analysis of the PAI-2 model was conducted. The average reimbursement by the Illinois Department of Healthcare and Family Services (IDHFS; the administrator of Medicaid in the State of Illinois) for asthma-related ED visits, hospitalizations, and urgent clinic visits was multiplied by the average utilization in the year prior to and following the intervention to estimate costs associated with urgent health resource utilization. The average medication costs for PAI-2 participants in the year prior to and following the intervention were also included in health-care-related costs. The average cost savings to IDHFS for health-care utilization could then be approximated by subtracting the average level of reimbursement during the follow-up period from the average during the baseline period. Finally, the net cost savings were calculated by subtracting the cost of conducting the intervention from the cost savings. The cost was estimated per child served under the premise that one full-time CHW can serve 100 children in a calendar year.

Mount Sinai Hospital's IRB reviewed and approved the study protocol.

RESULTS

During the enrollment period, contact was attempted with 277 caregivers of potential participants, of which 152 (54.9%) were screened for their child's eligibility, 135 (88.8% of screened) had a child that was eligible for the program, and 104 (77.0% of eligible) agreed to an initial meeting with the CHW. Seventy children were ultimately enrolled into PAI-2 (67.3% of those agreeing to meet with the CHW). Further recruitment details are provided in Figure 1.

Baseline characteristics are shown in Table 1. All enrolled children were African American. The average participant was 7.3 years old. Ninety-six percent of the enrolled children were insured by Medicaid and 54% lived with a smoker. In the year prior to the intervention, the median number of ED visits, hospitalizations, and/or visits to a physician for worsening asthma symptoms was 4.0. Fifty-eight (82.9%) completed the entire 6-month intervention phase, while 50 (71.4%) completed the entire 12-month evaluation phase.

Asthma Symptoms

When comparing symptom frequency in the 2 weeks preceding the baseline visit with the median over the course of the 12-month follow-up, there were notable improvements for all four symptom variables, with all but nighttime symptoms improving to a statistically significant degree (Figure 2). For example, in the 2 weeks prior to the baseline visit, the median reported daytime symptoms was 2.0, while over the course of the 12-month follow-up, the median reported daytime symptoms decreased to 1.3. This is a 35% reduction when compared with the baseline value (Figure 2).

Asthma-Related Health Resource Utilization and Activity-Limited Days

Table 2 displays the data for asthma-related health resource utilization and activity-limited days at baseline and the year following. All health resource utilization variables decreased significantly between the baseline and follow-up year. Specifically, the median number of ED visits decreased from 2.0 in the year prior to the intervention to 0.0 in the year following the intervention ($p < .0001$). When all urgent health resource utilization was summed into one variable, the median at baseline was 4.0 and the median at 12 months was 1.0, a 75% reduction ($p < .0001$). The number of activity-limited days between baseline and the follow-up year decreased significantly from a median of 7.0 at baseline to 3.5 during the follow-up period ($p = .0184$).

Caregiver Asthma-Related Quality of Life

Figure 3 shows the results pertaining to the caregiver's asthma-related quality of life. The overall quality of life score of caregivers improved from a median value of 5.2 at baseline to 6.5 at month 12. The activity limitation and emotional function sub-scores both improved significantly as well. Each improvement was both statistically ($p < .05$) and clinically significant (0.5 change) ($N = 50$) (34).

Asthma-Related Knowledge. Caregivers answered an average of 7.5 out of 10 questions correctly at baseline, with scores improving steadily through 12 months of follow-up. At 12 months, the average number of questions answered correctly was 8.7 out of 10. This was a statistically significant change ($p < .05$) ($N = 50$). One statement that was frequently marked as "true" incorrectly was "regular daily use of a steroid inhaler medicine for asthma is harmful and should be avoided." At baseline 43.7% of caregivers answered this question incorrectly, which decreased to only 25.0% of caregivers at 12 months.

Self-Efficacy. At baseline, the average caregiver scored 19.2 out of a possible maximum score of 24 on the *Asthma Management Parental Self-Efficacy Scale*. This improved slightly to 20.4 out of 24 ($p < .0032$) ($N = 50$) by 12 months.

Asthma-Related Triggers. Caregivers were asked how frequently their child is exposed to cigarette smoke. Although most participants at the baseline visit correctly answered

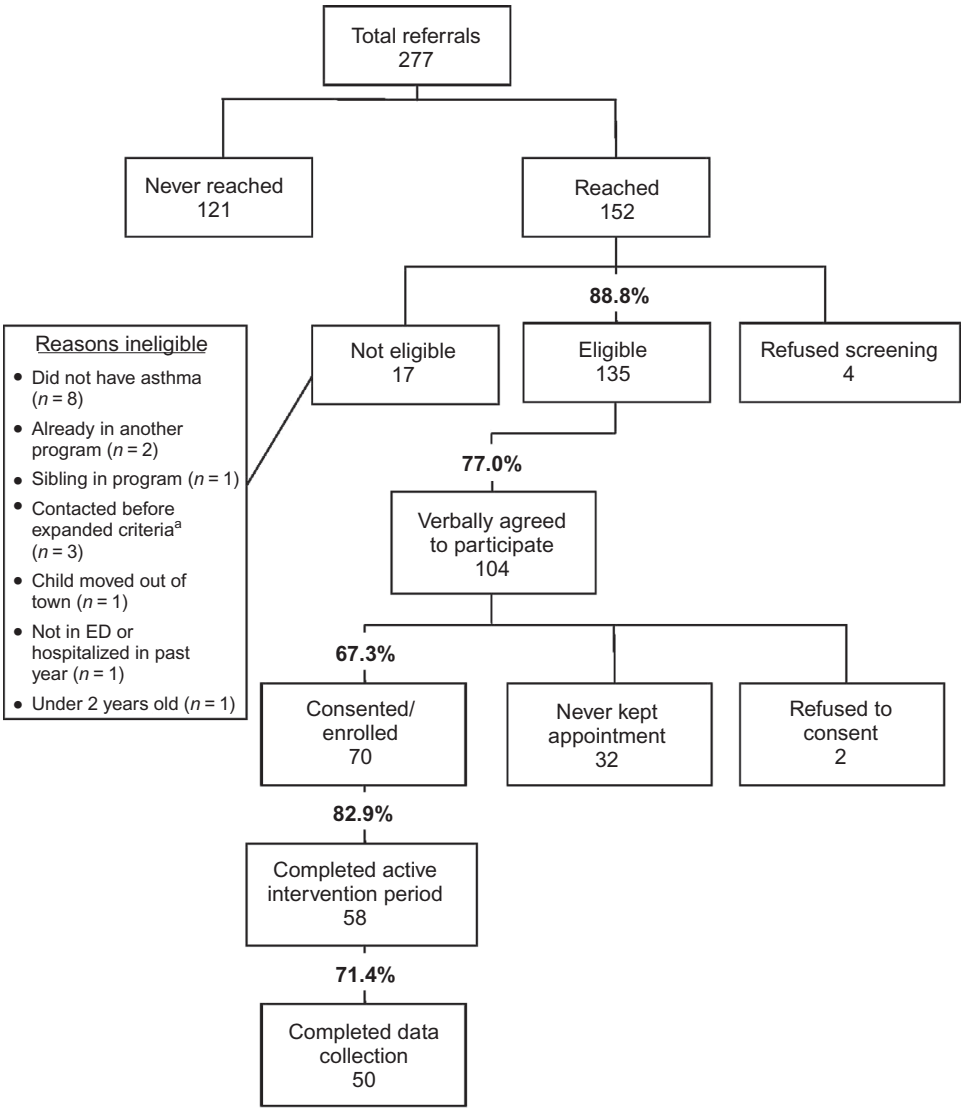

FIGURE 1.—Summary of recruitment and enrollment.
Notes: [a]Original criterion required a child to have one of six primary care physicians. This criterion was dropped on 1 March 2005.

that cigarette smoke is a trigger for asthma per the Asthma Knowledge Quiz, 54% of children lived with a smoker. The proportion of caregivers reporting that their child was exposed to second-hand cigarette smoke at least twice a week decreased significantly from 65.9% at baseline to 36.2% at 12 months ($p < .0001$) ($N = 47$). In fact, at the time of the 12-month follow-up, over half of the caregivers reported that their child was exposed to second-hand cigarette smoke less than once per week.

There was also a slight decrease in the total number of triggers to which a child was exposed in their home environment over the course of the follow-up, from 2.4 triggers on average at baseline to 1.9 at the 12-month follow-up ($p = .043$).

Asthma-Related Medical Management. The intervention was also interested in improving the medical management of enrolled children. Two aspects were measured to determine the effectiveness of the intervention in improving medical management. First, the intervention was interested in increasing the proportion of children who had an AAP that they and their family know how to use. The goal was to have the AAP signed by the child's primary care physician and returned to the family at the 6-month visit so the CHW could teach the family how to use the AAP. Forty-two (84%) of the 50 participating families had an AAP by the 6-month follow-up visit; only 2 children had an AAP at the time of the baseline visit.

Second, the intervention sought to teach participating children and their families how to properly administer their medication(s). At the time of the baseline visit, 37.5% of children/caregivers were using a nonoptimal medication administration technique, specifically, an MDI without a spacer/holding chamber. By the time of the 6-month visit, all children who were using an MDI were using a spacer/holding chamber. Also, children/caregivers showed considerable improvement when evaluated on performing the six steps necessary to properly administer their MDI. At baseline, the average child/caregiver performed 3.3 of the 6 steps correctly. By the 6-month visit, the average child/

TABLE 1.—Demographic and selected health-care characteristics upon enrollment into PAI-2 ($N = 70$).

	Percentage or mean/median	N
Race/ethnicity		
Non-Hispanic black	100%	70
Gender		
Male	57.1%	40
Female	42.9%	30
Insurance		
Medicaid/S-CHIP	95.7%	67
HMO/private	2.9%	2
No insurance/self-pay	1.4%	1
Age		
2–5 years	50.0%	35
6–12 years	30.0%	21
13–16 years	20.0%	14
Age (mean)	7.3 years	70
Primary caregiver		
Mother	91.4%	64
Grandmother	5.7%	4
Sister	1.4%	1
Other family member	1.4%	1
Education of caregiver		
<High school	30.8%	20
High school grad.	38.5%	25
Some college[a]	29.2%	19
Refused	1.5%	1
Primary care physician (PCP)		
Yes	97.1%	68
No	2.9%	2
Days since last saw PCP[b]		
Within the past month	51.5%	35
Within the past 1–3 months	23.5%	16
Within the past year (3–12 months)	23.5%	16
More than 1 year ago	1.5%	1
Asthma specialist in past 6 months		
Yes	17.4%	12
No	82.6%	57
ED visits		68
Median	2.0	
Range	0–25	
Sum of urgent HRU[c]		68
Median	4.0	
Range	0–33	
Days with daytime asthma symptoms (past 2 weeks)		69
Median	2.0	
Range	0–14	

Notes: [a]Includes vocational or business school.
[b]Among 68 with a PCP.
[c]Sum of ED visits, hospitalizations, and urgent clinic visits.
HRU, health resource utilization; S-CHIP, State Children's Health Insurance Program; HMO, health maintenance organization.

caregiver performed 5.3 of the 6 steps correctly, a statistically significant increase ($p < .0001$) ($N = 50$).

Cost Savings Associated with the PAI-2 Model. Given the degree of improvement in urgent health resource utilization and the relative low cost of implementing the model, a cost-savings analysis of the PAI-2 model was conducted, the findings of which suggest that the intervention model is associated with significant cost savings to the IDHFS (the administrator of Medicaid in the State of Illinois). The findings suggest that the intervention results in cost savings of $2561.60/participant. Displayed another way, one might expect $5.58 to be saved per dollar spent on the intervention.

DISCUSSION

The main goal of this study was to examine whether a CHW intervention model providing individualized, home-based asthma education to African-American children with poorly controlled asthma is both feasible and effective. Nearly 83% of the enrolled families completed the entire intervention supporting the feasibility of the approach. Furthermore, the outcome evaluation findings suggest that asthma control was improved among participants as evidenced by reductions in symptoms frequency and emergency health resource utilization over the 12 months following the initiation of the intervention. As one poignant example, in the year prior to the intervention, over half of the enrolled children were seen in the ED, were hospitalized, or had visited an urgent care clinic for asthma four or more times. Stated differently, the majority of the children were having asthma attacks severe enough to warrant the need for life-saving intervention at least four times a year. Following participation in the intervention, median urgent health services utilization decreased to 1.0, a 75% reduction. Participants also experienced significant improvements in the quality of life, asthma knowledge, and self-efficacy and decreases in exposure to asthma home triggers and demonstrated improved medication technique following participation in the intervention. These findings suggest that home-based, CHW interventions are effective in improving asthma outcomes among inner-city African-American children with poorly controlled asthma and warrant further study.

The evidence presented herein demonstrates that a model utilizing a culturally competent CHW recruited from the targeted community to educate families about asthma management is well received by the community. The benefit that a trusted lay person from the community brings to a teaching session with a family is invaluable. Asthma information can be taught; culture and experience are more difficult if not impossible to teach.

While a fair number of articles supporting the feasibility of utilizing CHW models in working with the families of children with asthma (25, 37, 38) have been published, only a few have included an outcome analysis (30, 39–42). Krieger et al. (40, 43) found that a high-intensity CHW intervention primarily focused on reducing exposure to indoor asthma triggers was more effective than a lower-intensity (control) intervention in improving pediatric asthma caregiver quality of life and asthma-related urgent health resource utilization among disadvantaged children with persistent asthma living in the Seattle–King County area. The high-intensity intervention included seven home visits consisting of a structured home environmental assessment, education, social support, and the provision of substantial resources intended to reduce exposure to home triggers (e.g., pillow and mattress covers, low-emission vacuums, and cleaning kits). The lower-intensity (control) group received a single visit. It is interesting to note that the intervention described herein was intermediate in intensity between the high-intensity and lower-intensity interventions offered in Seattle–King County,

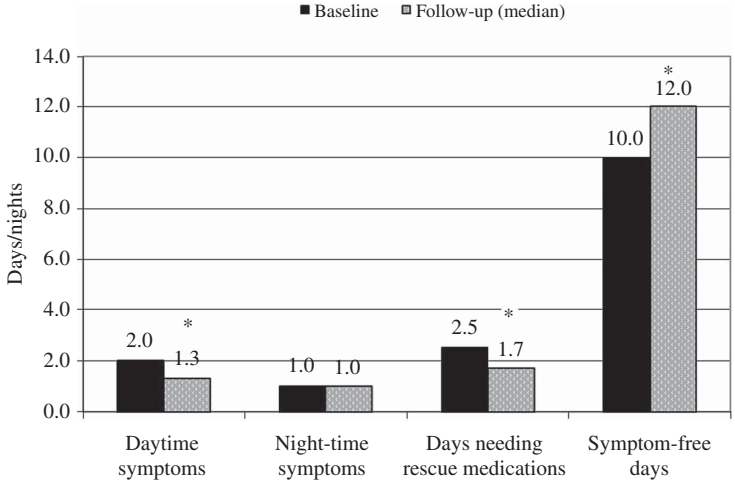

FIGURE 2.—Reported symptom frequency in past 2 weeks—days/nights reported at baseline versus median reported over 12 months of follow-up.
Note: *Statistically significant difference ($p < .05$) from baseline score per Wilcoxon signed-rank nonparametric test.

TABLE 2.—Asthma-related health resource utilization and activity-limited days in the year prior to and following the initiation of the intervention ($n = 50$).

	Baseline year	Follow-up year	*P*-value[a]
ED visits			
Median	2.0	0	<.0001
Range	0–25	0–5	
Hospitalizations			
Median	0	0	<.0001
Range	0–6	0–3	
Hospital days			
Median	0	0	<.0001
Range	0–15	0–6	
Clinic visits—urgent[b]			
Median	1.0	1.0	.0003
Range	0–12	0–8	
Clinic visits—regular			
Median	2.5	3.5	.9215
Range	0–40	0–9	
Sum of urgent HRU[c]			
Median	4.0	1.0	<.0001
Range	0–33	0–12	
Activity-limited days			
Median	7.0	3.5	.0184
Range	0–96	0–29	

Notes: [a]Wilcoxon signed-rank nonparametric test used to assess statistical significance.
[b]Excluded outlier of 96; $n = 49$.
[c]Sum of ED visits, hospitalizations, and urgent clinic visits. Excluded outlier of 116; $n = 49$.
HRU, health resource utilization.

yet the degree of improvement was consistent with the higher-intensity approach.

Martin et al. (41, 44) found that Spanish-speaking CHWs from a south side, predominantly Latino Chicago community were effective in reducing exposure to triggers among both adults and children with asthma. There were no statistically significant improvements in any of the other outcomes assessed (asthma severity, health resource utilization, or rescue medication use). However, the intervention provided was limited to a single visit with a pair of CHWs, and the target population included anyone with physician-diagnosed asthma, regardless of the level of severity. These differences from the study described herein likely contribute to the difference in outcomes.

The Clean Air for Kids® partnership utilized community-based CHWs to provide individualized education on trigger avoidance and asthma management to the families of low-income children with moderate to severe asthma (42). A varying number of home visits were conducted depending on the needs of the family (mean = 2.2 visits occurring over 2–26 weeks). Among a convenience sample of families who participated in the evaluation (60 of 197 families), statistically significant improvements were noted in caregiver quality of life, self-reported hospitalizations, and the proportion with an AAP.

The findings suggest that the intervention results in cost savings of $2561.60/participant. Displayed another way, one might expect $5.58 to be saved per dollar spent on the intervention. When the results are projected out, the potential cost savings associated with the intervention are remarkable. For example, given a full-time CHW can effectively serve approximately 100 patients per year, by funding a single CHW, the IDHFS could save approximately $256,160 in a single year. Given that $286.6 million was spent on asthma hospitalizations alone in Illinois in 2005, such cost savings may be seen as essential (45).

Limitations

The study is limited by the absence of a control group against which the findings of this pilot study could be compared. The primary purpose of this initiative was to test the feasibility of the approach in the target population, while also gathering preliminary evidence of effectiveness. As such, the inclusion of a control group was not a justifiable use of the available resources. While the findings strongly suggest that CHWs serving as educators in the inner city help to improve asthma management, without a control group we cannot completely assert that these findings are the result of the intervention itself and not some external factor. The limited sample size further restricts the interpretation of the findings. However, it is notable that

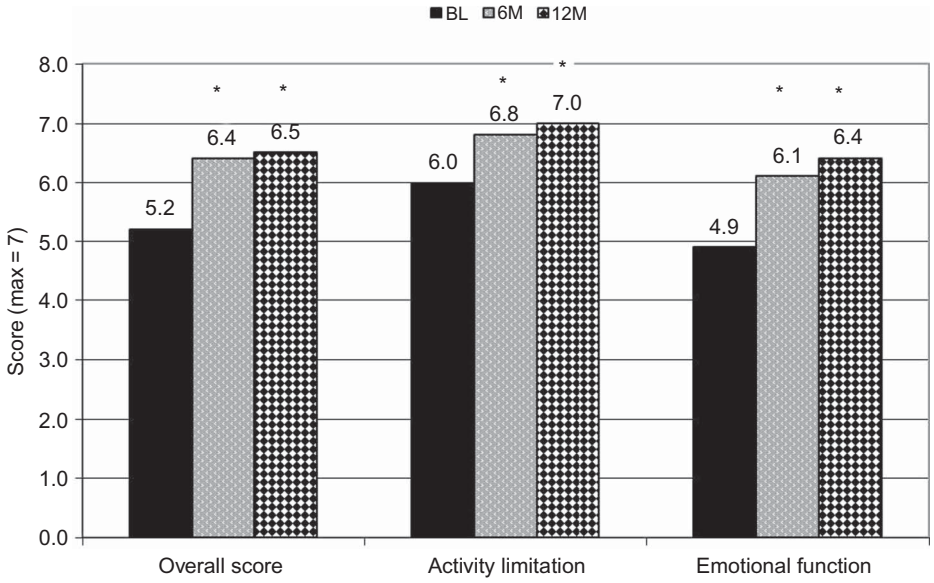

FIGURE 3.—Pediatric asthma caregiver quality of life—median scores at baseline versus 6- and 12-month follow-ups.
Note: *Statistically significant difference ($p < .05$) from baseline score per Wilcoxon signed-rank nonparametric test.

the effect size was large enough that statistical significance was achieved with a relatively small sample size. In addition, the study was carried out with African-American children with severe asthma living in urban, disadvantaged neighborhoods of Chicago. Therefore, the study's findings may not be generalizable to other populations. The analytical approach to this study was to evaluate the impact of a CHW model on the lives of families with children who have asthma; therefore, baseline measures were compared with measures over the course of the follow-up period. This evaluation approach did not account for change over time during various points of the follow-up period and may have either overrepresented or underrepresented the true change of asthma control during the course of the intervention. A repeated measures analysis would be an additional benefit to the outcome analysis of this study.

It is important to note that the data were collected via caregiver self-report and are therefore subject to recall bias. However, the validity of the caregiver-reported health resource utilization has been supported by a recent, large, multicenter, randomized trial in pediatric patients with asthma (46). Lee et al. (46) demonstrated that on a large scale, caregiver reports correlate well with corresponding administrative data. We agree with this recent analysis and feel that due to the traumatic nature of urgent health-care visits in particular, these incidents would be especially salient in the caregiver's memory. Collecting data via self-report also makes it difficult to ascertain whether this information is completely truthful or if the caregiver reported favorably in an attempt to impress the CHW/research assistant collecting the data (i.e., social desirability bias).

Finally, not all the data collection instruments used in the study had been previously assessed for reliability and validity. Several of the tools were designed by the investigators, either because similar tools were not available in the literature (i.e., assessment of asthma medication administration) or because standard questions were widely used and cited in the literature in the absence of a validated tool (i.e., questions regarding asthma-related health resource utilization). When assessing asthma symptoms, a validated measure was not used. In 2000, Lara and colleagues (47) published the Pediatric Asthma Symptom Scale, an eight-item scale, using Likert-like responses, which can be used to measure asthma control. The Pediatric Asthma Symptom Scale was shown to be reliable and valid in English- and Spanish-speaking populations and would be appropriate for future studies. Additionally, the Pediatric Asthma Caregivers Quality of Life Questionnaire had been previously validated with caregivers of children 7–17 years, but has not been used earlier with caregivers of children younger than 7 years.

Implications for Future Research

While this study lends support for the use of CHWs as a cost-effective means of improving asthma management among an inner-city African-American population, it does not provide evidence as to whether the changes seen are sustainable for longer periods of time after the work with the CHW is finished. While there have been several studies that have suggested that a CHW approach may be an effective means of improving the management of different chronic diseases (19–25), none of them have looked at whether improvements in knowledge, self-efficacy, behaviors, and morbidity are maintained over longer time intervals. We believe this is an important attribute of the CHW model that has yet to be investigated and hope that this study's evidence of the short-term efficacy of the model will lead to future studies which include long-term outcome data.

Conclusions/Key Findings

While a fair number of articles discuss the feasibility of utilizing a CHW model in working with urban minority families of children with asthma, very few include an outcome analysis substantiating the impact of the intervention approach (30, 40, 41). Our findings suggest that the PAI-2 model is both feasible and effective in improving asthma control. Specifically, symptom frequency was reduced by 50% and urgent health resource utilization by 69% between the pre- and post-intervention periods. Parental quality of life also improved by a level that is both clinically and statistically significant. Several secondary outcomes (asthma-related knowledge, exposure to asthma triggers, self-efficacy, etc.) also improved significantly. The intervention was found to result in an estimated $2562 saved per participant or $5.58 saved per dollar spent on the intervention. The evidence presented demonstrates that the model is well received by the community. Furthermore, the implicit benefit to the community resulting when community residents are hired and trained to perform a duty cannot be undervalued. Such benefits include improved economic stability as jobs are created, increased power and control over health, and an increased knowledge base in the community.

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Declaration of Interest

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References

1. Centers for Disease Control and Prevention. Lifetime asthma prevalence percents by age, United States: National Health Interview Survey, 2006 [Internet, cited April 13, 2011]. Available at: http://www.cdc.gov/asthma/nhis/06/table2-1.htm. Accessed April 27, 2009.
2. Mannino DM, Homa DM, Akinbami LJ, Moorman JE, Gwynn C, Redd SC. Surveillance for asthma – United States, 1980–1999. MMWR 2002; 51(SS01):1–13.
3. Marder D, Targonski P, Orris P, Addington W. Effect of racial and socioeconomic factors on asthma mortality in Chicago. Chest 1992; 101(Suppl. l):426S–429S.
4. Targonski PV, Persky VW, Orris P, Addington W. Trends in asthma mortality among African Americans and whites in Chicago. Am J Publ Health 1994; 84:1830–1833.
5. Thomas SD, Whitman S. Asthma hospitalizations and mortality in Chicago: an epidemiologic overview. Chest 1999; 116(4S):135S–140S.
6. Weiss KB, Wagener DK. Changing patterns of asthma mortality: identifying target populations at high risk. J Am Med Assoc 1990; 264:1683–1687.
7. Whitman S, Williams C, Shah AM. Sinai Health System's Community Health Survey: Report 1. Chicago, IL: Sinai Health System, 2004.
8. Whitman S, Shah AM, Benjamins M. Urban Health Combating Disparities with Local Data. Oxford: Oxford University Press, 2010.
9. Wolf RL, Berry CA, O'Connor T, Coover L. Validation of the brief pediatric asthma screen. Chest 1999; 116(4 Suppl. 1):224S–228S.
10. Quinn K, Shalowitz MU, Berry CA, Mijanovich T, Wolf RL. Racial and ethnic disparities in diagnosed and possible undiagnosed asthma among public-school children in Chicago. Am J Publ Health 2006; 96:1599–1603.
11. Shalowitz MU, Sadowski LM, Kumar R, Weiss KB, Shannon JJ. Asthma burden in a citywide, diverse sample of elementary school children in Chicago. Ambul Pediatr 2007; 7:271–277.
12. Gupta RS, Zhang X, Sharp LK, Shannon JJ, Weiss KB. Geographic variability in childhood asthma prevalence in Chicago. Allergy Asthma Clin Immunol 2008; 121(3):639–645.
13. Halfon N, Newacheck PW, Wood DL, St. Peter RF. Routine emergency department use for sick care by children in the United States. Pediatrics 1996; 98:28–34.
14. Weiss KB, Gergen PJ, Wagener DK. Breathing better or wheezing worse? The changing epidemiology of asthma morbidity and mortality. Annu Rev Public Health 1993; 14:491–513.
15. Rand CS, Butz AM, Kolodner K, Huss K, Eggleston P, Malveaux F. Emergency department visits by urban African American children with asthma. J Allergy Clin Immunol 2000; 105:83–90.
16. Singh AK, Woodruff PG, Ritz RH, Mitchell D, Camargo CA. Inhaled corticosteroids for asthma: are ED visits a missed opportunity for prevention? Am J Emerg Med 1999; 17:144–148.
17. Finkelstein JA, Brown RW, Schneider LC, Weiss ST, Quintana JM, Goldmann DA, Homer CJ. Quality of care for preschool children with asthma: the role of social factors and practice setting. Pediatrics 1995; 95:389–394.
18. Marder D, Targonski P, Orris P, Persky V, Addington W. Effect of racial and socioeconomic factors on asthma mortality in Chicago. Chest 1992; 101(Suppl.):426S–429S.
19. Norris SL, Chowdhury FM, Van Le K, Horsley T, Brownstein JN, Zhang X, Jack L, Satterfield DW. Effectiveness of community health workers in the care of persons with diabetes. Diabet Med 2006; 23(5):544–556.
20. Brownstein JN, Bone LR, Dennison CR, Hill MN, Kim MT, Levine DM. Community health workers as interventionists in the prevention and control of heart disease and stroke. Am J Prev Med 2005; 29(5 Suppl. 1):128–133.
21. Persily CA. Lay home visiting may improve pregnancy outcomes. Holist Nurs Pract 2003; 17(5):231–238.
22. Andrews JO, Felton G, Wewers ME, Heath J. Use of community health workers in research with ethnic minority women. J Nurs Scholarsh 2004; 36(4):358–365.
23. Lewin SA, Dick J, Pond P, Zwarenstein M, Aja G, Van Wyk B, Bosch-Capblanch X, Patrick M. Lay health workers in primary and community health care. Cochrane Database Syst Rev 2005;(1):CD004015. DOI: 10.1002/14651858.
24. Nemcek MA, Sabatier R. State of evaluation: community health workers. Publ Health Nurs 2003; 20(4):260–270.
25. Swider SM. Outcome effectiveness of community health workers: an integrative literature review. Publ Health Nurs 2002; 19:11–20.
26. Witmer A, Seifer SD, Finocchio L, Leslie J, O'Neil EH. Community health workers: integral members of the health care workforce. Am J Publ Health 1995; 85(8):1055–1058.

27. American Public Health Association Community Health Workers Section (2009). Available at: http://www.apha.org/membergroups/sections/aphasections/chw. Accessed August 22, 2011.
28. Barnes-Boyd C, Fordham D, Nacion K. Promoting infant health through home visiting by a nurse-managed community worker team. Publ Health Nurs 2001; 1(4):225–235.
29. Sox CH, Dietrich A, Colman D, Provost E. Improved access to women's health services for Alaska natives through community health aide training. J Community Health 1999; 24(4):313–323.
30. Karnick P, Margellos-Anast H, Seals G, Whitman S, Aljadeff G, Johnson D. The pediatric asthma intervention: a comprehensive cost-effective approach to asthma management in a disadvantaged inner-city community. J Asthma 2007; 44:39–44.
31. National Blood, Lung and Heart Institute. Morbidity & mortality: 2007 chart book on cardiovascular, lung and heart diseases [Internet]. National Institutes of Health, June 2007. Available at: http://www.nhlbi.nih.gov/resources/docs/07-chtbk.pdf. Accessed April 19, 2011.
32. National Institutes of Health. Executive Summary of the National Asthma Education and Prevention Program Expert Panel Report. Guidelines for the Diagnosis and Management of Asthma Update on Selected Topics 2002. Bethesda, MD: National Institutes of Health (US), 2002, publication no. 02-5075.
33. Juniper EF, Guyatt GH, Feeny DH, Ferrie PJ, Griffith LE, Townsend M. Measuring quality of life in the parents of children with asthma. Qual Life Res 1996; 5:27–34.
34. Guyatt GH, Juniper EF, Walter SD, Griffith LE, Goldstein RS. Interpreting treatment effects in randomized trials. BMJ 1998; 316:690–693.
35. Telleen S. Use of Child Health Services by Hispanic Families: Final Report Prepared for the Maternal and Child Health Research Program. Springfield, VA: National Technical Information Services Department of Commerce (US), 2000.
36. SAS Institute Inc. SAS 9.1. Cary, NC: SAS Institute, 2000–2004.
37. Butz AM, Malveaux FJ, Eggleston P, Thomson L, Schneider S, Weeks K, Huss K, Murigande C, Rand CS. Use of community health workers with inner-city children who have asthma. Clin Pediatr 1994; 33:135–141.
38. Baier C, Grant EN, Daugherty SR, Eckenfels EJ. The Henry Horner Pediatric Asthma Program. Chest 1999; 116(Suppl. 1):204S–206S.
39. Stout JW, White LC, Rogers LT, McRorie T, Morray B, Miller-Ratcliffe M, Redding GJ. The Asthma Outreach Project: a promising approach to comprehensive asthma management. J Asthma 1998; 35:119–127.
40. Krieger JW, Takaro TK, Song L, Weaver M. The Seattle-King County Healthy Homes Project: a randomized, controlled trial of a community health worker intervention to decrease exposure to indoor asthma triggers. Am J Public Health 2005; 95:652–659.
41. Martin MA, Hernández O, Naureckas E, Lantos J. Reducing home triggers for asthma: the Latino community health worker approach. J Asthma 2006; 43:369–374.
42. Primomo J, Johnston S, DiBiase F, Nodolf J, Noren L. Evaluation of a community-based outreach worker program for children with asthma. Publ Health Nurs 2006; 23(3):234–241.
43. Krieger J, Takaro TK, Allen C, Song L, Weaver M, Chai S, Dickey P. The Seattle-King County Health Homes Project: implementation of a comprehensive approach to improving indoor environmental quality for low-income children with asthma. Environ Health Perspect 2002; 110 (Suppl. 2):311–322.
44. Martin M, Hernández O, Naureckas E, Lantos J. Improving asthma research in an inner-city Latino neighborhood with community health workers. J Asthma 2005; 42:891–895.
45. Blagojevich RR, Whitaker EE. Burden of Asthma in Illinois, 1995–2006. Springfield, IL: The Illinois Department of Public Health, 2007.
46. Lee TA, Fuhlbrigge AL, Sullivan SD, Finkelstein JA, Inui TS, Lozano P, Weiss KB. Agreement between caregiver reported healthcare utilization and administrative data for children with asthma. J Asthma 2007; 44(3):189–194.
47. Lara M, Sherbourne C, Duan N, Morales L, Gergen P, Brook RH. An English and Spanish Pediatric Asthma Symptom Scale. Med Care 2000; 38(3):342–350.