A cluster-randomized trial shows telephone peer coaching for parents reduces children's asthma morbidity

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Background: Childhood asthma morbidity remains significant, especially in low-income children. Most often, asthma management is provided by the child's primary care provider.
Objective: We sought to evaluate whether enhancing primary care management for persistent asthma with telephone-based peer coaching for parents reduced asthma impairment and risk in children 3 to 12 years old.
Methods: Over 12 months, peer trainers provided parents with asthma management training by telephone (median, 18 calls) and encouraged physician partnership. The intervention was evaluated in a cluster-randomized trial of 11 intervention and 11 usual care pediatric practices (462 and 486 families, respectively). Patient outcomes were assessed by means of telephone interviews at 12 and 24 months conducted by observers blinded to intervention assignment and compared by using mixed-effects models, controlling for baseline values and clustering within practices. In a planned subgroup analysis we examined the heterogeneity of the intervention effect by insurance type (Medicaid vs other).
Results: After 12 months, intervention participation resulted in 20.9 (95% CI, 9.1-32.7) more symptom-free days per child than in the control group, and there was no difference in emergency department (ED) visits. After 24 months, ED visits were reduced (difference in mean visits/child, −0.28; 95% CI, −0.5 to −0.02), indicating a delayed intervention effect. In the Medicaid subgroup, after 12 months, intervention participation resulted in 42% fewer ED visits (difference in mean visits/child, −0.50; 95% CI, −0.81 to −0.18) and 62% fewer hospitalizations (difference in mean hospitalizations/child, −0.16; 95% CI, −0.30 to −0.014). Reductions in health care use endured through 24 months.
Conclusions: This pragmatic telephone-based peer-training intervention reduced asthma impairment. Asthma risk was reduced in children with Medicaid insurance. (J Allergy Clin Immunol 2015;135:1163-70.)

Key words: *Asthma, randomized controlled trial, self-management, peer training, telephone care*

Abbreviations used

ED: Emergency department
EQIPP: Education in Quality Improvement for Pediatric Practice
ICC: Intraclass correlation coefficient
IQR: Interquartile range
PACQLQ: Pediatric Asthma Caregiver's Quality of Life Questionnaire
PCP: Primary care physician
SFD: Symptom-free day
TTM: Transtheoretical model of behavior change

Childhood asthma affects 1 in 10 children in the United States, with greater morbidity in low-income children (the high-risk population).[1] Daily asthma symptoms limit activities, and disease flare-ups result in missed school, missed work, emergency department (ED) visits, and hospitalizations. The estimated direct annual cost of asthma is more than $15 billion.[2]

The child's primary care physician (PCP) usually provides asthma care.[3] National guidelines recommend a collaborative partnership between the family and the PCP with visits at least every 6 months to monitor and adjust the treatment plan as needed.[4] However, many parents find managing their child's asthma to be demanding and stressful[5] and do so outside of the clinical care system,[2] with few office visits to optimize preventive treatment.[6-8] Although many interventions, both patient and provider focused, to improve asthma management have been developed, few have been evaluated for their effect on patient outcomes in large randomized controlled trials. Of those interventions that have been rigorously evaluated, most did not reduce symptom days (median, 0 days; range, 0-24 days) or ED visits (median, 6.5% reduction; range, 0% to 62%) and all failed to reduce hospitalizations.[9-23] Pragmatic approaches to support parents with asthma management are needed.

Building on our prior work using lay coaches to provide tailored education and social support for parents to reduce childhood asthma morbidity,[24-26] we developed a scalable theory-based intervention delivered exclusively by telephone and integrated into primary care. We hypothesized that the intervention would improve asthma outcomes for the child by improving the parent's asthma management and partnership with the PCP. The objective of this randomized controlled trial was to test this hypothesis in both the general and high-risk asthma populations. To minimize contamination of PCP care, we chose a cluster-randomized design, randomizing PCP practices and assessing the intervention effect on patient-level outcomes.

METHODS

Design and setting

The PARTNER intervention was evaluated in a cluster-randomized design stratified on practice location (urban or suburban) to minimize the imbalance

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of sociodemographic factors across study groups. Clusters were pediatric primary care practices in the St Louis metropolitan area. For the primary analysis, we examined the intervention effect after 12 months on 3 patient-level outcomes: (1) symptom-free days (SFDs) for the child, (2) disease-specific parental quality-of-life score, and (3) number of asthma-related ED/urgent care visits (ED visits). Participants were followed for 24 months and reassessed to identify sustained and/or late intervention effects. The study protocol was approved by the Institutional Review Board at Washington University.

Participants

Eligibility. *Clusters.* Eligible practices were community-based primary care practices providing asthma care to 40 or more children.

Participants. Eligible families within study practices had a child between 3 and 12 years of age with a physician's diagnosis of asthma and in the past year had been prescribed a daily controller medication or had 1 or more acute exacerbations that required an unscheduled office visit, a course of oral steroids, an ED visit or hospitalization, or persistent asthma symptoms.[4]

Recruitment and randomization. All potentially eligible practices received a written invitation to participate. The principal investigator met with practice physicians to explain study participation requirements and obtain written consent from 1 PCP per practice. Each practice used billing data to provide the study team with a list of potentially eligible families (those who had received asthma care in the past 2 years, usually identified by International Classification of Diseases, ninth revision, code 493.XX). Subsequently, the practice was randomized to one of 2 study groups by the statistician using a stratum-specific randomization scheme developed with computer-generated random numbers. After randomization, study investigators, PCPs, and parents were aware of study group assignment. All potentially eligible families were contacted by the study team by mail and telephone to invite participation, assess eligibility, and complete the consent process. Parents who provided written consent and completed the baseline interview were enrolled in the study. Each family was paid $20 for the initial interview and $25 for subsequent interviews, and each practice was paid $100 to compensate for administrative time required for study tasks.

After 12 months with 350 families recruited, we extended patient eligibility to include 3- and 4-year-old children to enable us to reach our recruitment milestones. This required us to change our primary measure of asthma impairment from the Asthma Control Questionnaire (not valid if completed by the parent or a child <6 years old)[27] to SFDs that were reported for all trial participants. These changes were approved by the data and safety monitoring board.

Intervention

The content and implementation of the peer-training intervention for the parent was informed by using social cognitive theory[28] and the transtheoretical model of behavior change (TTM),[29,30] which was built on our prior research,[24-26,31] and was delivered exclusively by telephone. Core constructs of the TTM include the stages of change, a series of 5 ordered categories along a continuum of readiness for behavior change (precontemplation, contemplation, preparation, action, and maintenance). Movement along the behavior-change continuum is influenced by cognitive and behavioral processes of change, self-efficacy, and the relative pros and cons of the desired behavior change and can occur in both directions.[30] Targeted asthma management behaviors for the PARTNER intervention included (1) effective use of controller medications, (2) effective use of quick-relief medications, and (3) monitoring of the child's asthma.

Four peer trainers were recruited from the target population, and 3 had experiential knowledge of asthma care. Their initial training occurred over 4 weeks and covered asthma pathophysiology, asthma management, the TTM, building rapport, reflective listening, and communication skills. The peer trainers learned to "stage" a parent for their readiness for each of the targeted behaviors and tailor the intervention to that assessment. Training activities included small-group discussions, experiential learning, and role play. Ongoing training continued with weekly review of taped calls.

An introductory letter and educational materials for use during the intervention were mailed to the parent at the beginning of the program. The assigned peer trainer called within 1 week of enrollment to provide an overview of the program's goals and content; enquire about the child's asthma history, asthma treatment, and treatment goals; and assess the child's level of asthma control (well, partially, or not well controlled) by using 4 questions about the frequency of asthma symptoms and use of quick-relief medications in the past 4 weeks.[4] The parent was asked to read a booklet about asthma in the next week and to provide a confidence score from 1 to 10 to indicate the likelihood this short-term goal would be reached. In this way the peer trainer introduced study processes used during the intervention to facilitate successful behavior change. The second call occurred 1 week later, when the trainer determined whether the parent had achieved his or her short-term goal and further described the program and the 3 targeted asthma management behaviors. In subsequent calls, guided by staging questions and a program manual, the peer trainer provided tailored education, skill training, and support for the 3 targeted asthma management behaviors. Monthly, the trainer assessed the child's level of asthma control and discussed this assessment with the parent. They encouraged PCP visits for routine asthma management at least twice a year, helped the parent prepare for these visits when problems occurred, and, with the parent's permission, provided the PCP a 1-page summary of the child's asthma before each visit and after 6 and 12 months in the program. If needed, the peer trainer provided the parent with contact numbers for community resources.

The program was implemented in a flexible manner, as determined by the parents' needs, circumstances, and preferences and the child's asthma condition. Calls varied in frequency from weekly to monthly, were scheduled at times convenient for the parent, and occurred during office hours from Monday to Friday, with evening appointments available until 8 PM one night per week. Calls were audiotaped and reviewed by the study team to ensure program quality and reviewed by the peer trainers (self-review and peer review) as a learning resource.

Additional features of the intervention targeted the PCPs who provided asthma care. Study physicians (J.M.G. and R.C.S.) conducted 2 site visits to each intervention practice, the first to describe the intervention and determine their preferred communication plan with the peer trainer and the second to discuss management of common problems in asthma care identified by the peer trainers. Asthma management information was also provided in 8 newsletters.

Comparator or control condition

All PCPs in both intervention and control practices were provided with access to the Web-based Education in Quality Improvement for Pediatric Practice (EQIPP) tool from the American Academy of Pediatricians, which was designed to improve asthma care,[32] and a flow chart for recommended administration of albuterol for worsening symptoms. Children in the control group received usual care for asthma from their pediatricians.

Measurement

Measures were obtained at the individual patient level. Measurement occurred during telephone interviews conducted at baseline and 12 and 24 months by trained research assistants blinded to study group assignment. In addition, a study physician (R.C.S.) audited PCP charts by using a structured audit form to assess maintenance asthma visits during the 12 months before and after enrollment.

SFDs were estimated from the frequency of asthma symptoms in the prior 2 weeks,[10,33] and parental quality of life was measured by using the Pediatric Asthma Caregiver's Quality of Life Questionnaire (PACQLQ).[34] This instrument uses a 7-point scale, with a higher score indicating better quality of life. A change of 0.5 units is considered clinically significant.[35] The parent reported the number of ED visits, hospitalizations, and oral steroid courses in the prior 12 months and their attitudes toward, confidence using, and current use of asthma medications.[36] Collaborative partnership with the PCP was defined as having 2 or more asthma maintenance visits per year[4] or a parental report of PCP review of a written asthma treatment plan in the past 12 months.[37]

PCPs completed surveys to indicate practice characteristics and use of the EQIPP. Those in the intervention group answered questions about the utility of program components.

Statistical analysis

Using pilot data, we determined that 11 practices per study arm with an average of 42 families per practice would allow us to detect a difference in PACQLQ scores of at least 0.3 units with an α level of .017 and a power of at least 89% (assuming an SD of change in PACQLQ score of 0.91 and an intraclass correlation coefficient [ICC] of 0.02).[26]

For the primary analyses, we used cluster-specific methods to evaluate the intervention effect on patient-level outcomes because practices rather than patients were randomized. All subjects who provided outcome data were included in their randomized group. We used mixed models to compare patient-level outcomes between study groups at 12 and 24 months, adjusting for baseline differences in sociodemographic and outcome variables and season of enrollment and accounting for the interdependency of outcomes among subjects in the same practice.[38] To estimate the ICC, we used a variance component model to partition the total variance of each baseline outcome into within- and between-practice components. We also compared the mean value of each of the 3 primary outcomes at the cluster (practice) level between the 2 study groups in an unadjusted analysis using the Wilcoxon test. We used Medicaid insurance as a surrogate for the low-income, high-risk group for a planned subgroup analysis to investigate heterogeneity of the intervention effect, and we conducted exploratory analyses to examine mechanisms through which the intervention might exert its effect by using generalized linear mixed models.

For the 3 primary patient-level outcomes, a *P* value of .017 or less was used to establish statistical significance to control for multiple comparisons. For secondary and exploratory analyses, a *P* value of .05 or less was used. All tests were 2-sided. Continuous variables are reported as the mean (SD) if normally distributed or the median (interquartile range [IQR]) otherwise, and categorical data are reported as percentages. All statistical analyses were done with SAS software (SAS Institute, Cary, NC).

RESULTS

Study population

Between March 11, 2009, and May 19, 2011, 948 families were recruited from 22 pediatric practices (median subjects per practice, 35; IQR, 25-69; Fig 1). Of those eligible, the participation rate was 75.8%, with no difference by study group (intervention, 75.6%; control, 77.6%; $P = .76$). Follow-up interviews were completed for 883 (93.1%; intervention, 90.9%; control, 95.3%) at 12 months and 869 (91.7%; intervention, 89.4%; control, 93.8%) at 24 months (Fig 1).

There were no differences in practice size, type, and location between intervention and control practices (see Table E1 in this article's Online Repository at www.jacionline.org). Nine (14.8%) PCPs participated in EQIPP, with no difference between study groups. Intervention families (n = 462) were more likely than usual care families (n = 486) to have lower baseline values for SFDs and PACQLQ scores; use Medicaid insurance; be African American, single parents, and low income; and have a younger index child (Table I). A comparison of the high-risk subgroup (Medicaid) and the general asthma population (other insurance) is provided in Table E2 in this article's Online Repository at www.jacionline.org.

Implementation and acceptance of the intervention

The median duration of peer training per family was 3.8 hours (IQR, 2.8-5.2 hours), with median calls per family of 18 (IQR, 14-21). Most parents discussed all 3 targeted behaviors (controller medications, 95.2%; quick-relief medications, 95.2%; monitoring, 96.3%). Sixteen (3.5%) parents withdrew from peer training (n = 4, ≤2 calls; n = 5, 3-4 calls; n = 7, 6-13 calls; 5 had Medicaid and 11 had other insurance), most often because they were too busy to participate.

Parents were willing to recommend the intervention to others: 64.6% were extremely willing, 20.4% were very willing, 11.2% were willing, and 3.8% were fairly willing/not willing. PCPs would recommend the program to patients (90.5%) and colleagues (90.5%) and reported they learned useful information from the patient faxes (71.4%), newsletters (79.0%), and site visits (85.0%).

Program effectiveness

Primary analyses. Details of the comparison between patient-level outcomes in the 2 study groups at 12 and 24 months are provided in Table I. At 12 months, children in the intervention group reported an average of 20.9 more SFDs (95% CI, 9.1-32.7; ICC, 0.04) than those in the control group. The increase in PACQLQ scores associated with the intervention, although significant, was not clinically meaningful (ICC, 0.05),[34,35] and there was no between-group difference in ED visits (ICC, 0.11; Table II).

Findings from the unadjusted cluster-level comparisons for these 3 primary outcomes showed an average intervention benefit of 24.1 SFDs (95% CI, 10.0-38.2), with no difference for PACQLQ scores (difference, 0.07 units; 95% CI, −0.16 to 0.02 units) or ED visits (difference, 0.45 units; 95% CI, −0.09 to 1.0 units).

Additional analyses of patient-level outcomes. At 12 months, there were no meaningful changes in the frequency or content of asthma maintenance visits or PCP partnership (Table II). Exploratory analyses suggest that the increased numbers of SFDs in the intervention group were at least partially mediated by increased parental self-efficacy for use of quick-relief medications and increased expectation for asthma control but not by increased use of controller medications (Table III).

At 24 months, there were fewer ED visits in the intervention group than in the control group (difference in mean ED visits per child, −0.28; 95% CI, −0.5 to −0.02), indicating a delayed intervention effect (Table I).

Subgroup analysis. At 12 months, the intervention increased numbers of SFDs in both the Medicaid and other insurance subgroups (Table IV). In addition, there were significantly larger intervention effects in the Medicaid subgroup on health care use, with 42% fewer ED visits (difference in mean ED visits per child, −0.50; 95% CI, −0.81 to −0.18) and 62% fewer hospitalizations (difference in mean hospitalizations per child, −0.16; 95% CI, −0.30 to −0.014) and sustained effects or further reductions in health care use at 24 months (Table IV).

DISCUSSION

The peer-training program evaluated in this large, community-based, randomized controlled trial is theory based and provides a patient-centered approach to asthma management that recognizes that behavior change is complex and occurs at different rates in different subjects.[20] About 4 hours of what we call peer training delivered by telephone over 12 months reduced

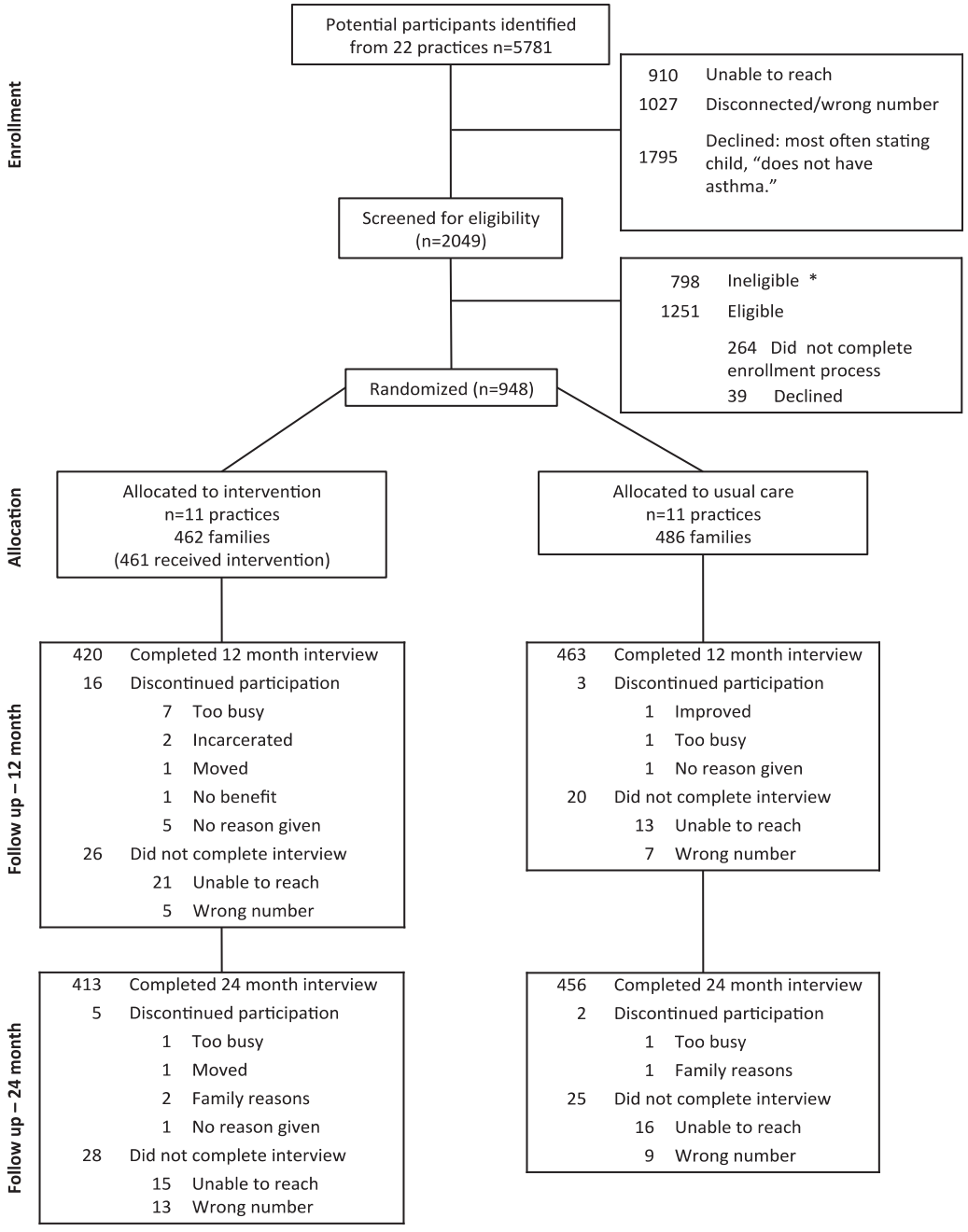

FIG 1. Participant recruitment and flow through the study.

asthma impairment for children from both the general and high-risk asthma populations. Insurance type moderated the intervention effect on risk outcomes, with participation in the peer-training program resulting in significant reductions in ED visits and hospitalizations in the Medicaid subgroup that were sustained at 24 months. These improvements were larger than in other interventions to improve asthma management targeting this high-risk group[9,11,15-19,23] and occurred with lay interventionists and without any face-to-face interactions, home visits, environmental remediation, or PCP training. These findings suggest this peer-training intervention might be an effective strategy to reduce disparities in asthma outcomes.[39,40]

Several features of the intervention likely contributed to the high level of program retention in both the general asthma population and the traditionally hard-to-reach high-risk group. Delivering the intervention by telephone allowed anonymity, was time- and cost-efficient for the patient,[41] and circumvented families' reluctance for home and office visits for education.[16,42,43] Rather than delivering a prescribed curriculum, the peer trainer's focus was on meeting parental treatment goals,

TABLE I. Description of outcome measures at baseline and 12 and 24 months by intervention group (mean [SD] or percentage), with adjusted differences (intervention − control) at 12 and 24 months

	Baseline		After 12 mo			After 24 mo		
	Intervention group (n = 462)	Control group (n = 486)	Intervention group (n = 420)	Control group (n = 463)	Difference (95% CI)	Intervention group (n = 413)	Control group (n = 456)	Difference (95% CI)
Primary outcomes								
SFDs/child	253.3 (116.3)	276.9 (103.2)	315.8 (79.6)	301.8 (89.9)	20.9‡ (9.1 to 32.7)	313.6 (84.5)	311.7 (83.6)	9.0 (−4.0 to 21.9)
Parent QOL, PACQLQ score*	6.2 (1.0)	6.5 (0.8)	6.9 (0.4)	6.8 (0.5)	0.1† (0.02 to 0.19)	6.9 (0.4)	6.9 (0.4)	0.06† (0.009 to 0.11)
ED visits/child	0.7 (1.3)	0.7 (1.5)	0.4 (1.1)	0.4 (1.3)	−0.06 (−0.20 to 0.09)	0.2 (0.6)	0.3 (1.1)	−0.28† (−0.53 to −0.02)
Secondary outcomes								
Hospitalizations/child	0.09 (0.4)	0.10 (0.4)	0.04 (0.2)	0.06 (0.5)	−0.04 (−0.14 to 0.05)	0.05 (0.3)	0.06 (0.4)	−0.008 (−0.06 to 0.05)
Oral steroid courses/child	1.5 (1.8)	1.4 (1.7)	1.0 (1.7)	1.0 (1.6)	−0.04 (−0.31 to 0.22)	0.6 (1.2)	0.7 (1.1)	−0.15 (−0.30 to 0.006)

The reported difference between the intervention and control groups is adjusted for baseline values, Medicaid insurance, maternal race, family income, single-parent family, child's age, and season of enrollment.
QOL, Quality of life.
*Parents' QOL was measured by using the PACQLQ score (range, 1-7), with a higher score indicating a better outcome.
†$P < .05$ and ‡$P < .001$ for adjusted comparisons.

TABLE II. Office-based asthma care (mean [SD] or percentage) by intervention group

	Baseline		After 12 mo		Adjusted difference at 12 mo (intervention group − control group)	
	Intervention group	Control group	Intervention group	Control group	Difference	95% CI
Asthma maintenance visits/child*	1.26 (0.6)	1.31 (0.6)	1.30 (0.6)	1.25 (0.6)	0.14	−0.05 to 0.33
≥2 Asthma maintenance visits/y†	14.5%	15.2%	17.3%	13.0%	OR: 0.66§	0.44 to 0.97
Visits/child with element of maintenance asthma care documented						
Level of asthma control assessed	0.59 (0.6)	0.60 (0.7)	0.69 (0.7)	0.58 (0.6)	0.12	−0.08 to 0.33
Asthma education provided	0.38 (0.6)	0.28 (0.5)	0.43 (0.6)	0.29 (0.5)	0.09	−0.04 to 0.21
Reviewed AAP with PCP in past 12 mo	50.8%	46.6%	32.9%	43.8%	OR: 0.65	0.38 to 1.10
PCP partnership‡	55.2%	58.1%	71.7%	60.3%	OR: 1.64	0.97 to 2.78

The reported difference between the intervention and control groups is adjusted for baseline values, Medicaid insurance, maternal race, family income, single-parent family, child's age, and season of enrollment.
AAP, Asthma action plan; *OR*, odds ratio.
*An asthma maintenance visit was defined as a visit at which asthma symptoms, medications, or management were documented and no acute care was provided.
†Recommended minimum frequency for asthma maintenance visits is every 6 months, with more frequent visits for poorly controlled asthma.
‡Partnership was defined as 2 or more asthma maintenance visits per year, as determined by means of chart audit or parental report, at which the asthma action plan was reviewed with the PCP in the past 12 months.
§$P < .05$.

developing parental skills and confidence to provide effective asthma management, and addressing specific practical and psychological barriers to asthma management.[44] The longitudinal and nonhierarchic nature of the peer trainer–parent relationship allowed sharing of information and experiences about social and other factors that can undermine effective asthma care. This friendly and empathetic relationship has been noted in other peer-coaching studies[24,39] and might explain the lower attrition rate seen here compared with that seen in interventions with similar goals delivered by medically trained personnel.[16,26,45,46] Importantly, program quality was maintained by providing call review and ongoing support for the peer trainers.[26]

Exploratory analyses suggest the intervention improved asthma control at least in part by improving parental self-efficacy for using quick-relief medications and increasing expectations for asthma control. Other studies have demonstrated that increasing self-efficacy and outcome expectancy can improve asthma self-management.[20,28] Although the intervention resulted in a small increase in reported use of controller medications, our exploratory analyses suggest this change did not mediate the increase in numbers of SFDs. Further studies with more reliable measures of medication adherence are needed to better understand these relationships. Disappointingly, there was no evidence that interactions with an empowered and informed parent improved PCP partnership. Consumer demand can improve the quality of care[47] and might have marginally increased the frequency of asthma maintenance visits in the short term. However, planned visits for treatment monitoring and adjustment were infrequent, limiting opportunities for the PCP to provide education and support.

The strengths of this study include the community-based approach; the cluster-randomized design to minimize contamination of PCP care, likely with individual level randomization; blinding for outcome assessment; and the high rate of long-term

TABLE III. Exploratory analyses to identify mediating factors for the interventions' effect on SFDs at 12 months

	Effect of intervention on variable at 12 mo		Effect of variable on SFDs	
	Estimate of between-group difference	*P* value#	Estimate	*P* value#
Possible mediators				
Related to self-efficacy				
Concern about controller score*	0.25	.003	4.09	.07
Confidence to use quick-relief medication†	0.27	.002	5.30	.07
Asthma-related stress‡	OR: 0.66	.02	−44.40	<.001
Expectations for asthma control§	−0.53	<.001	−10.04	<.001
Using controller medication‖	OR: 1.81	<.001	−27.45	<.001
PCP partnership¶	OR: 1.64	.06	−4.64	.45
Overall effect of intervention on SFDs at 12 mo				
Without controlling for possible mediators	20.89	<.001		
Controlling for all possible mediators	16.14	.007		

OR, Odds ratio.

*General concerns about controller medications were assessed as the sum of agreement scores (strongly agree = 1 to strongly disagree = 4) for 2 statements. One affirmed their concern about medication dependence, and the other affirmed their worry about the long-term effects of inhaled corticosteroids. Scores ranged from 2 to 8, with lower scores indicating less concern.

†The average confidence score for 2 questions was used: confidence to initiate albuterol use and confidence to administer albuterol at the correct frequency. The confidence score ranged from 1 (not confident) to 10 (very confident).

‡Asthma-related stress was defined as a parental report of being worried about the child's asthma all or most of the time. Parents rated their frequency of worry about their child's asthma in the past 2 months on a 5-point response scale ranging from all the time to none of the time.

§Expectation for asthma control was assessed as the sum of agreement scores (strongly agree = 1 to strongly disagree = 4) for 4 statements that the child can be symptom free most of the time, attend school, fully participate in activities, and have no ED visits or hospitalizations caused by asthma. Scores ranged from 4 to 16, with lower scores indicating a higher expectation for good control.

‖Parental report of use of a controller medication in the past 7 days.

¶Partnership was defined as 2 or more asthma maintenance visits per year, as determined by means of chart audit or parental report, at which the asthma action plan was reviewed with the PCP in the past 12 months.

#*P* value for the effect of the baseline variable and 12-month outcome generated by using mixed models adjusted for baseline values, Medicaid insurance, maternal race, family income, single-parent family, child's age, and season of enrollment.

TABLE IV. Description of outcome measures at baseline and 12 and 24 months by intervention group (mean [SD] or percentage), with adjusted differences (intervention − control) at 12 and 24 months by insurance group

	Baseline		12 mo			24 mo		
	Intervention group	Control group	Intervention group	Control group	Difference† (95% CI)	Intervention group	Control group	Difference† (95% CI)
SFDs/child								
Medicaid	225.0 (131.4)	243.7 (117.0)	308.1 (85.6)	281.9 (89.1)	32.7‡ (7.0 to 58.4)	299.9 (101.1)	288.7 (95.0)	8.7 (−18.1 to 35.6)
Other insurance	263.7 (108.6)	285.5 (97.8)	318.2 (77.6)	306.6 (89.6)	17.9‡ (4.8 to 30.9)	318.0 (78.2)	317.1 (79.8)	8.9 (−5.6 to 23.4)
P value for interaction variable*insurance group					.31			.99
Parent QOL, PACQLQ score*								
Medicaid	5.8 (1.2)	6.3 (0.9)	6.8 (0.5)	6.7 (0.8)	0.13 (−0.02 to 0.28)	6.8 (0.6)	6.7 (0.7)	0.16‡ (0.05 to 0.28)
Other insurance	6.4 (0.9)	6.5 (0.7)	6.9 (0.3)	6.8 (0.4)	0.10‡ (0.005 to 0.19)	6.9 (0.3)	6.9 (0.3)	0.04 (−0.02 to 0.09)
P value for interaction variable*insurance group					.67			.05
ED visits/child								
Medicaid	1.3 (1.8)	1.4 (2.5)	0.65 (1.5)	1.2 (2.5)	−0.50‡ (−0.81 to −0.18)	0.31 (0.9)	1.2 (2.2)	−0.88§ (−1.21 to −0.55)
Other insurance	0.53 (1.1)	0.45 (1.0)	0.30 (0.9)	0.22 (0.7)	0.05 (−0.11 to 0.21)	0.15 (0.5)	0.14 (0.4)	−0.07 (−0.31 to 0.16)
P value for interaction variable*insurance group					.002			<.001
Hospitalizations/child								
Medicaid	0.15 (0.5)	0.18 (0.4)	0.10 (0.3)	0.26 (1.1)	−0.16‡ (−0.30 to −0.01)	0.10 (0.5)	0.23 (0.8)	−0.11‡ (−0.22 to −0.004)
Other insurance	0.07 (0.3)	0.08 (0.3)	0.02 (0.2)	0.02 (0.1)	−0.008 (−0.10 to 0.09)	0.04 (0.2)	0.02 (0.1)	0.02 (−0.04 to 0.07)
P value for interaction variable*insurance group					.05			.04

*Parents' QOL was measured by using the PACQLQ score (range, 1-7), with a higher score indicating a better outcome.

†The reported difference between the intervention and control groups is adjusted for baseline values, maternal race, family income, single-parent family, child's age, and season of enrollment.

‡$P < .05$ and §$P < .001$ for adjusted comparisons.

follow-up. Regression to the mean is an unlikely explanation for our findings because we did not selectively enroll patients when their asthma was poorly controlled (eg, in the ED) and we controlled for baseline differences in outcome measures among study groups in the regression models.

However, several study limitations should be noted. Although the sample was large, the study was performed in one Midwestern metropolitan area, and findings might not generalize to other populations. There were several potential sources of bias that might affect study findings. For pragmatic reasons, randomization of clusters occurred before subject recruitment. Although this raises the possibility of postrandomization selection bias,[48] we think this unlikely because the participation rate among eligible families was the same in both study groups. Parents were not blinded to study group assignment, and most outcome data were assessed based on self-report. Although we achieved a high follow-up rate in both study groups (>89%), follow-up rates were approximately 5% lower in the intervention group, and subjects who did not complete follow-up might have had worse outcomes. Our analytic approach controlled for clustering within practices and seasonal effects, yet these differences might have contributed to the measured intervention effect. Finally, we did not control for differential contact between study groups, and it is possible that the observed improvements in patient outcomes were simply due to frequent contact with the peer trainer. We think this unlikely because reductions in health care use occurred in the intervention group 12 months after contact ceased and did not occur in the control group.

Reductions in expensive asthma-related ED visits and hospitalizations occurred among children with Medicaid insurance, suggesting telephone-based peer training might be a cost-effective way to reduce asthma disparities. We estimate the return on investment for this program for children with Medicaid insurance to be 1:3 and recommend that the intervention be implemented at a system level (eg, an accountable care organization or insurance provider) rather than an individual practice level. A centralized approach for program delivery would facilitate the ongoing monitoring, training, and support needed to maintain program quality, and cost savings from reduced ED visits and hospitalizations could pay program costs. In addition, the Patient Protection and Affordable Care Act allows states to choose to provide Medicaid reimbursement for nonmedical providers to deliver preventive services, such as asthma skill training. To aid implementation, we have developed a program manual and a training program (http://partnerstudy.wustl.edu/Pages/Default.aspx).

In conclusion, evidence from this large randomized trial suggests that a peer-training program delivered exclusively by telephone was effective in improving children's asthma control and was popular with parents and physicians. We recommend this intervention be implemented for children with Medicaid insurance who have poorly controlled asthma. Future study will determine whether this novel approach to augment the primary care management of childhood asthma reduces disparities in asthma outcomes and health care costs, as suggested by findings from this study.

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Clinical implications: Telephone-based peer training for parents reduced childhood asthma impairment. Significant sustained reductions in ED visits and hospitalizations occurred in children with Medicaid, suggesting this approach might reduce disparities in asthma outcomes.

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TABLE E1. Characteristics of study practices and the study population at baseline

	Intervention group	Control group
Practice characteristics*		
No.	11	11
No. of physicians	34	27
Years in pediatric practice (mean [SD])	20.5 (2.2)	15.2 (2.5)
Type of practice		
Pediatric group	8	6
Multispecialty group	1	1
Solo or 2-physician group	2	4
Practice location		
Urban, inner city	1	0
Urban, not inner city	1	2
Suburban	9	9
Electronic medical record	5	5
Provide asthma maintenance care to ≥60% of patients with persistent asthma	8	8
Family characteristics		
No.	462	486
Respondent was mother	438 (95.8%)	451 (93.2%)
Single-parent family, no. (%)§	139 (30.1)	90 (18.5)
Mother works full time, no. (%)	229 (49.6)	225 (46.3)
Mother graduated from college, no. (%)	257 (55.8)	296 (61.0)
Mother's race, no. (%)§		
White	245 (53.0)	380 (78.2)
African American	198 (42.9)	92 (18.9)
Other	19 (4.1)	14 (2.9)
Mother Hispanic, no. (%)‡	2 (0.4)	16 (3.3)
Family income (annual), no. (%)†		
<$10,000	47 (10.6)	31 (6.5)
$10,000 to $24,999	48 (10.9)	36 (7.6)
$25,000 to $49,999	89 (20.1)	78 (16.4)
$50,000 to $74,999	66 (14.9)	88 (18.5)
$75,000 to $99,999	60 (13.6)	69 (14.5)
>$100,000	132 (29.9)	175 (36.2)
Parent has asthma	124 (26.9)	125 (25.8)
Someone else at home with asthma	173 (37.5)	173 (35.7)
Patient characteristics		
Male sex, no. (%)	295 (63.9)	299 (61.5)
Age (y), mean (SD)‡	6.6 (2.6)	7.1 (2.8)
<5, no. (%)	106 (22.9)	99 (20.4)
Medicaid insurance, no. (%)†	124 (26.8)	99 (20.5)
Years with PCP, mean (SD)	5.6 (2.7)	5.8 (3.0)
Asthma history		
Years with asthma	3.8 (2.5)	4.0 (2.7)
Asthma specialist in past year, no. (%)	131 (28.6)	153 (31.7)
Controller medication use, no. (%)		
ICS only	136 (29.4)	140 (28.8)
LTRA only	71 (15.4)	78 (16.1)
ICS and LTRA	83 (18.0)	74 (15.2)
None	172 (37.2)	195 (39.9)
Baseline outcome measures		
Parental QOL, mean (SD) PACQLQ score§	6.2 (1.0)	6.5 (0.8)
SFDs, mean (SD)§	253.3 (116.3)	276.9 (103.2)
ED visit in past year, mean (SD)	0.7 (1.3)	0.7 (1.5)

Answers were selected on a 7-point categorical scale (range, 1-7), with a higher score indicating a better outcome.

ICS, Inhaled corticosteroid; *LTRA*, leukotriene receptor antagonist.

*From physician survey.

†$P < .5$.

‡$P < .01$.

§$P < .001$.

TABLE E2. Comparison of baseline characteristics between those with Medicaid insurance (the high-risk population) and those with other insurance (general asthma population)

	Medicaid insurance	Other insurance
Family characteristics		
No.	223	725
Single-parent family, no. (%)‡	131 (58.7)	98 (13.6)
Mother works full time, no. (%)‡	68 (30.5)	385 (53.3)
Mother graduated from college, no. (%)‡	32 (14.4)	520 (72.1)
Mother's race, no. (%)‡		
White	62 (27.8)	561 (77.6)
African American	152 (68.2)	138 (19.1)
Other race	9 (4.0)	24 (3.3)
Hispanic	5 (2.2)	13 (1.8)
Family income (annual), no. (%)‡		
<$10,000	71 (33.2)	7 (1.0)
$10,000 to $24,999	65 (30.4)	19 (2.7)
$25,000 to $49,999	69 (32.2)	97 (13.8)
$50,000 to $74,999	7 (3.3)	146 (20.8)
$75,000 to $99,999	1 (0.5)	128 (18.3)
>$100,000	1 (0.5)	304 (43.4)
Parent has asthma, no. (%)*	72 (32.4)	176 (24.4)
Someone else at home with asthma, no. (%)	88 (39.5)	258 (35.8)
Patient characteristics		
Male sex, no. (%)	135 (60.5)	458 (63.4)
Age (y), mean (SD)*	6.5 (2.7)	7.0 (2.7)
Years with PCP, mean (SD)	5.7 (2.8)	5.7 (2.9)
Asthma history		
Years with asthma	3.9 (2.5)	3.9 (2.6)
Asthma specialist in past year ‡	42 (19.1%)	241 (33.6%)
Controller medication use, no. (%)		
ICS only	58 (26.0)	218 (30.2)
LTRA only	33 (14.8)	116 (16.0)
ICS and LTRA	38 (17.0)	119 (16.5)
None	94 (42.2)	270 (37.3)
Baseline outcome measures		
Parental QOL, mean (SD) PACQLQ score‡	6.03 (1.1)	6.5 (0.8)
SFDs, mean (SD)‡	233.3 (125.3)	275.3 (103.5)
ED visit in past year, mean (SD)‡	1.34 (2.1)	0.49 (1.0)
Hospitalizations in past year, mean (SD)†	0.16 (0.5)	0.07 (0.3)
Intervention group assignment, no. (%)	124 (55.6)	338 (46.8)
Completed 12-mo follow-up, no. (%)‡	189 (84.8)	692 (95.7)
Completed 24-mo follow-up, no. (%)‡	187 (83.9)	680 (94.1)

ICS, Inhaled corticosteroid; *LTRA*, leukotriene receptor antagonist.
*$P < .5$.
†$P < .01$.
‡$P < .001$.