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Integrating Asthma Education and Smoking Cessation for Parents: Financial Return on Investment

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Summary

Background—Caregivers who smoke and have children with asthma are an important group for intervention. Home-based interventions successfully reduce asthma morbidity, yet are costly. This study evaluated the financial return on investment (ROI) of the Parents of Asthmatics Quit Smoking (PAQS) program, a combined asthma education and smoking cessation intervention.

Methods—Participants included caregivers (n = 224) that smoked, had a child with asthma, and were enrolled in a Medicaid managed care plan. Participants received nurse-delivered asthma education and smoking counseling in three home visits. Program implementation costs were estimated, and health care expenses were obtained from insurance claims data 12 months pre- and 12 months post intervention. ROI was calculated for all participants, children < 6 years, children 6–18 years, and children with moderate/severe persistent asthma.

Results—Total program implementation cost was \$34,481. After intervention, there was increased mean annual refills of beta-agonist (0.51 pre, 1.64 post; p<0.001), and controller medications (0.65 pre, 2.44 post; p<0.001). Reductions were found in mean annual emergency department visits (0.33 pre, 0.14 post; p<0.001), hospitalizations (0.23 pre, 0.08 post; p<0.001), and outpatient visits (2.33 pre, 1.45 post, p<0.001). The program had negative ROI (–21.8%) for the entire sample. The ROI was positive (+106.9) for children < six years, negative (–150.3) for children 6–18, and negligible for moderate/severe persistent asthma (+6.9%).

Conclusion—PAQS was associated with increased medication use and decreased health care utilization. While the overall ROI for PAQS was negative, PAQS had a positive ROI for caregivers of young children with asthma.

Keywords

Asthma; Pediatrics; Smoking Cessation; Education

INTRODUCTION

Asthma is one of the most common pediatric diseases ¹ and results in significant morbidity and health care costs. Home-based educational interventions for asthma are successful at reducing asthma-related morbidity, and cost effective for some subgroups, such as children with moderate/severe persistent illness. ²⁻⁷ Children with asthma exposed to second-hand smoke (SHS) are an important clinical population. They have higher morbidity, including impaired recovery after hospitalization ⁸, greater need for asthma medications ⁹, and greater asthma severity. ¹⁰ Parents who smoke and have children with asthma therefore are an important target group for home-based educational interventions.

Parents of Asthmatics Quit Smoking (PAQS) is an intervention targeted to caregivers who smoke and have a child with asthma. ¹¹ Other asthma education programs typically address smoking in the broader context of reducing environmental triggers, or refer caregivers to smoking cessation programs. ^{2-7; 12} The PAQS program is distinct because in addition to providing asthma education, it aims to motivate smoking cessation in caregivers who are not necessarily motivated to quit, but who are interested in receiving asthma education.

In this study, we evaluated the financial return on investment (ROI) of the PAQS program for a Medicaid sample, utilizing the payer perspective. We hypothesized that the PAQS program would increase asthma controller medications refills, decrease short-acting beta-agonists refills, and decrease health care use (outpatient visits for asthma, emergency department (ED) visits, and hospitalizations). We expected the PAQS intervention would yield a positive ROI over a one year period post-intervention, and the ROI would be greater for 1) children with moderate to severe persistent asthma, and 2) young children, given the potential impact of asthma education for caregivers of children with newer diagnoses, who spend more time with their caregivers.

METHODS

Participants

Caregivers who were smokers and had a child with asthma were recruited from outpatient clinics, inpatient units, and a pediatric ED. Inclusion criteria were being a parent or primary caregiver of a child with physician-diagnosed asthma, being over the age of 18, currently smoking at least 3 cigarettes per day, and having smoked more than 100 cigarettes in their lifetime. Additionally, caregivers could not be pregnant or have medical conditions that precluded Transdermal Nicotine Patch (TNP) use. Participants who did not speak English or who had received smoking cessation treatment within three months were excluded. Participants were told they would receive home-based asthma education from a nurse, who would also discuss their smoking. Participants did not have to want to quit smoking to enroll. The study was approved by the Institutional Review Board (Committee # 0268-01) at the home institution of the first author.

Data presented here include 224 children with asthma in a Medicaid managed care plan and their caregivers who were smokers. To qualify for the plan, family income had to be less than 175% of the federal poverty line. The sample of caregivers was 88% female, with an average age of 32.8 years. Forty percent of caregivers were married or partnered. Ethnic background included 53% White, 20% Black, 19% Latino, and 8% other. Caregivers smoked an average of 14.8 cigarettes per day.

The average age of the children with asthma was 5.8 years (range 0–17 years). Forty-four percent of the children were female. Asthma severity was 23% Intermittent, 29% Mild Persistent, 34% Moderate Persistent, 14% Severe Persistent.

Study Design

This study used a pretest- posttest design. Participants received nurse-delivered asthma education and smoking cessation counseling in three home visits. The educational components are described in detail elsewhere,¹¹ but are described here in brief. All participants received general asthma education in visits 1 and 2. The first visit included education about asthma management, with learning objectives derived from NHLBI guidelines.^{13, 14} Educational goals included knowledge of asthma and medications, use of spacer devices with metered-dose inhalers, symptom assessment, and symptom management. Trigger identification and strategies for avoidance were introduced in the second session and provided a transition to address the caregiver's cigarette smoking during visits 2 and 3. Smoking cessation counseling (participants were randomized to one of two different types) was delivered in visits 2 and 3. Nurses involved in the research were not responsible for telephone triage of acute asthma symptoms. If they were contacted by participants for this purpose, the family was referred to the primary doctor for exacerbation management. The smoking cessation outcomes of the full trial are the topic of another report¹⁵ and are not reviewed here.

Research assistants collected demographic and clinical data prior to the intervention, immediately after the intervention, 2 months post-intervention, and 6 months post-intervention. Participants were compensated for research visits.

Measures

Asthma severity—Asthma severity was rated at study enrollment according to NHLBI guidelines^{13,14} by a study physician who reviewed current medications, history of healthcare utilization, symptom frequency, and activity limitation.¹⁶

Smoking status—Caregiver smoking was assessed at the two and six month follow-ups. Seven day point prevalence abstinence (no smoking in the 7 days prior to the assessment) was determined by self-report. Carbon monoxide testing was used to verify seven day abstinence, with < 10 parts per million supporting reported abstinence.¹⁷

Total Billable Costs—Claims data frequency and cost of medication refills, health care visits, and hospitalizations, were provided by the Medicaid managed care company (Neighborhood Health Plan of RI). Total billable costs were defined as actual costs paid for these services. Reference periods of 12 months before study enrollment, and 12 months post intervention completion were defined to identify claims for each participant. When continuous claims data across a 12-month period were not available (n = 103), data were annualized to estimate 12-month data for these time periods.⁴

Total billable costs were determined by summing the costs of five components: short-acting β -agonists, controller medications, ED visits, hospitalizations, and outpatient visits for asthma. Controller medications included fluticasone propionate, budesonide, fluticasone/salmeterol combination, and montelukast. Costs for ED visits, hospitalizations, and outpatient visits were only included if there was a primary or secondary diagnosis of asthma (ICD code 493.xx).

Intervention Cost Calculation—The costs of delivering the PAQS intervention were estimated based on the recommendations of Balas et al.¹⁸, accounting for direct expenditures (e.g., staff wages, materials), and for start-up costs and elements of overhead. Training costs included 40 training hours for the asthma education nurse multiplied by a) the hourly wage of professional trainers (\$48 + fringe), and b) the hourly wage of the asthma education nurses (\$25 + fringe). The direct costs for home nursing visits included the asthma

education nurse hourly wage multiplied by total hours spent on visits. Nurse administrative time (e.g. visit scheduling and documentation) was estimated at 0.5 hours per study participant. Travel costs estimated 6 miles traveled per visit (average) multiplied by the federal reimbursement rate for mileage at the time of study (\$0.365 per mile). Finally, the cost of providing TNP to caregivers expressing a readiness to quit smoking was \$40 per prescription.

Intervention costs were \$34,481 for the aggregate sample using these methods. For the subgroup analyses, intervention costs were \$15,851 for children with moderate/severe persistent asthma, and \$17,240 for each of the age group analyses.

Data Analysis

All pre-post comparisons of cost were analyzed using nonparametric methods to account for violations of sample normality. Direct multivariate regression, controlling for baseline costs, was used to evaluate whether smoking cessation was associated with increased cost reductions.

The ROI for the PAQS program was calculated as: ¹⁹

$$\frac{(\text{Total Billable Costs}^{\text{pre-PAQS}} - \text{Total Billable Costs}^{\text{post-PAQS}}) - \text{Intervention Costs}}{\text{Intervention Costs}}$$

ROI was calculated for the aggregate sample, and for moderate or severe persistent asthma, children < 6 years old, and children between 6 and 18 years old.

RESULTS

Medication and Health Care Use Costs

Mean annual β -agonist fills increased from 0.51 fills to 1.64 fills ($p < 0.001$), and costs increased from \$7.24 to \$25.19 per participant ($p < 0.001$). Mean annual controller medication fills increased from 0.65 fills to 2.44 fills ($p < 0.001$), and controller medication costs increased from \$53.74 to \$212.41 ($p < 0.001$). Data are presented in Figure 1.

Mean annual ED visits decreased from 0.33 visits to 0.14 visits ($p < 0.001$), and costs also decreased from \$80.19 to \$36.13 ($p < 0.01$). Mean annual hospital days due to asthma decreased from 0.23 to 0.08 ($p < 0.05$), and costs decreased from \$253.29 to \$98.70 ($p < 0.05$). Mean outpatient visits decreased from 2.33 per year to 1.45 per year ($p < .0001$), and costs decreased from \$193.45 to \$93.02 ($p < .0001$). Total annual billable costs per child for asthma decreased from \$587.81 to \$255.48 ($p < 0.001$). Data are presented in Figure 2.

Smoking outcomes

At two month follow-up, 19.2% of caregivers had quit smoking for at least 7 days; and at six months 9.1% of caregivers had quit smoking for at least 7 days. Multiple regression analyses, controlling for baseline costs, indicated that having achieved 7 day abstinence at two months was modestly associated with increased total annual billable costs (R^2 change = .03, $\beta = .16$, $p = .014$). Achievement of 7 day abstinence at the six month follow-up was not associated with total annual billable costs (R^2 change = .001, $\beta = -.03$, $p = .69$).

ROI Analysis

Cost data for the aggregate population as well as for subgroup analyses are presented in Table 1. The ROI for the aggregate population was -21.8%. The ROI for the 103 children with moderate or severe persistent asthma was +6.9%. The ROI for children less than 6 years old (n=112) was +106.9%, and the ROI in children 6 years and older (n=112) was -150.3%.

DISCUSSION

The PAQS program was associated with increased medication use and cost, and decreased urgent health care use and costs among children. Examination of cost patterns indicates that increases in controller medication use and decreased hospitalizations, both suggestive of more effective management, were key factors in cost change post-intervention.

β -agonist refills increased after the PAQS intervention in the aggregate sample and all sub-groups. The PAQS asthma education curriculum stresses early warning signs of an asthma exacerbation, prompt initiation of quick-relief medication, and use of an asthma action plan. Therefore, caregivers may have been more likely to appropriately administer β -agonists with increased frequency. Other studies have demonstrated that educational interventions result in more appropriate use of β -agonists.²⁰

There was also an increase in asthma-controller medication fills after the PAQS intervention in all sub-groups, suggesting either increased prescribing of controller medications, or increased use with subsequent refills of controller medications. Since prescription of controller medications was not an intervention component, caregivers may have initiated discussions with their physicians after learning about asthma medications, or may have developed increased medication adherence following the intervention. Previous studies have demonstrated that controller medication use increases after educational interventions.^{3, 20}

The PAQS intervention was associated with decreased urgent health care use for asthma. ED visits and outpatient visits were halved, and hospitalizations reduced to one third after the intervention. This resulted in average annual cost savings of \$44.06 per patient for ED visits, \$154.59 per patient for hospitalization, and \$98.33 per patient for outpatient visits for asthma. Other home-based asthma education programs have found that improving asthma-management skills translates into decreased urgent health care use.^{4, 5} Asthma-related education may also have decreased caregivers' propensity to visit EDs for asthma exacerbations, by educating them about the role of primary care provider consultation with or without an office visit, and home management using an asthma action plan.

Smoking cessation rates were greater than expected, given that this was a population that was not necessarily motivated to quit. Meta-analyses have shown that quit rates for smokers who receive smoking counseling but are unmotivated to quit are 3–5%²¹; our study produced quit rates of 9–19%. Paradoxically, caregiver smoking cessation at the two month follow-up was associated with *increased* health care use and costs in the follow-up period. Our data do not allow an analysis of the timing of health care use during follow-up, and some of these health care costs may have occurred prior to actual cessation of smoking, and may even have motivated cessation. Alternatively, parents of children with more severe asthma may have been more likely to quit smoking. Importantly, smoking cessation was defined as having at least 7 days of abstinence at the time of the assessment; it is not known whether these caregivers could have relapsed after 7 days. Therefore, our results regarding smoking should be interpreted with caution, particularly in light of recent reports indicating that reductions in SHS exposure typically do result in reduced health care utilization for asthma.^{22, 23}

Although there was a negative ROI across the entire study group, the PAQS program resulted in a positive ROI in certain populations of children with asthma. Most notably, the ROI for children less than 6 years old was +106.9%, demonstrating a high rate of return for each dollar spent in this age group. One reason that younger children had a higher ROI than older children may have been that these children had higher baseline rates of health care use, especially hospitalization. Therefore, reductions in health care use produced bigger changes in cost savings in younger children. In older children, the largest contributor to costs was increased controller medication use after the PAQS intervention. In this age group, baseline rates of hospitalization and ED use were not as high as in younger children, and therefore the increased costs associated with controller medications resulted in a negative return on investment. We were unable to measure the impact of individual changes in asthma management, for example smoking cessation versus medication use. In this study, we also noted that targeting children with moderate/severe asthma did not yield a large ROI.

There are several limitations to this study. Since we did not include a control group, some of the observed changes over the study period may have been due to natural improvement in asthma management skills, or changes in health care delivery. It is important to note though that in Rhode Island, ED use and hospitalization rates have increased over the last decade.²⁴ Second, we used a “payer” perspective, which does not include “spillover effects” for family members other than the child with asthma. Potential spillover effects include, for example, decreased healthcare use for other family members, or missed work/school days for caregivers. These effects may be particularly relevant for our group of older children, who had increased controller medication use. Although this use was associated with increased medication cost, it may have been associated with improvements in asthma control, not measured in the “payer” framework of the current ROI. As a result, our conservative ROIs may have actually underestimated the true returns that could be achieved with the PAQS project. A third limitation is that the study population was predominantly female with relatively low numbers of cigarettes smoked per day, both factors which may have contributed to the relatively high smoking cessation rates.

The PAQS intervention, with dual goals of asthma education and smoking cessation in caregivers of children with asthma, decreased health care utilization and costs, and increased asthma medication fills. When viewed strictly from a cost savings perspective, the program yielded the highest ROI in children under 6 years old. The program had a small positive return in children with moderate/severe persistent asthma, and had a negative return in children 6 years and older. These interventions should be included in comprehensive disease management strategies, especially for young children with asthma.

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Abbreviations

ED	Emergency Department
PAQS	Parents of Asthmatics Quit Smoking
ROI	Return on Investment
SHS	Second Hand Smoke
TNP	Transdermal Nicotine Patch

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Figure 1. Costs of Beta agonists and Controller medications (U.S. Dollars) per participant in a 12 month period before and after the PAQS intervention.

Figure 2.
Mean costs of asthma-related ED visits, hospitalizations, and outpatient visits (U.S. Dollars) per participant in a 12 month period before and after the PAQS intervention.

Table 1

Return on investment for PAQS Program

Total Billable Costs for Medical Services (rounded to nearest US dollar)													
	Aggregate Population			Children with moderate / severe persistent asthma			Children less than 6 years old			Children 6 to 18 years old			
	Pre- PAQS	Post- PAQS	Δ	Pre- PAQS	Post- PAQS	Δ	Pre- PAQS	Post- PAQS	Δ	Pre- PAQS	Post- PAQS	Δ	
Beta-Agonists	1,622	5,643	4,021	918	3,323	2,405		802	2,603	1,801	819	3,039	2,220
Controller Medication	12,038	47,580	35,542	7,166	24,322	17,156		4,706	17,960	13,254	7,333	29,620	22,287
ED Visits	17,963	8,093	-9,870	10,489	3,824	-6,665		12,431	5,776	-6,655	5,531	2,317	-3,214
Hospital	56,737	22,109	-34,628	35,557	17,379	-18,178		47,384	17,076	-30,308	9,332	5,033	-4,299
Outpatient	42,862	20,837	-22,025	22,573	10,913	-11,660		26,299	12,534	-13,765	16,633	8,303	-8,330
TOTAL	131,222	104,262	-26,960	76,703	59,761	-16,942		91,622	55,949	-35,673	39,648	48,312	8,664
Return on Investment	-21.8%			+6.9%				+106.9%			-150.3%		