Reducing Environmental Triggers of Asthma in Homes of Minnesota Children

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For more information or to obtain additional copies of this report contact:
Laura Oatman, MS
Asthma Program
Minnesota Department of Health
85 East Seventh Place
PO Box 64882
St. Paul, MN 55164-0882
651-201-5914
laura.oatman@health.state.mn.us

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For more information about the Minnesota Department of Health Asthma Program call:
651-201-5909
1-877-925-4189 (toll free)
Website: www.health.state.mn.us/asthma

Table of Contents

List of Tables

Page

List of Figures

Page

EXECUTIVE SUMMARY

Asthma is a common chronic disease in the United States affecting more than 20 million Americans including an estimated 6.3 million children under the age of 18. Environmental exposures to allergens and irritants may cause or exacerbate asthma, and controlling these exposures is an important component in managing asthma.

The Minnesota Department of Health Asthma Program partnered with Pediatric Home Service to conduct a demonstration project Reducing Environmental Triggers of Asthma (RETA) in homes of children with asthma. This study addressed environmental factors in the home using inexpensive, uncomplicated interventions. The most common interventions were HEPA air cleaners, pillow and mattress dust encasements, and HEPA vacuum cleaners.

Sixty four families received both family-specific education and appropriate materials to minimize or eliminate exposures to environmental allergens and irritant triggers of asthma. During the initial home visit, information was collected regarding the number of emergency department visits, hospitalizations, missed school days, and unscheduled clinic visits that occurred in the previous 3 months. Quality of life improvement was measured by responses to a short form completed by the child's parent or guardian regarding how the child's life was affected by asthma by asthma during the past 4 weeks.

RETA KEY FINDINGS

Findings from the RETA data

- At baseline more than three-fourths of the children referred to the EPA asthma housing program were children with moderate persistent or severe asthma.

- The ITG Child Asthma Short-Form results support the finding related to severity in that the mean scores on the Daytime Symptom, Nighttime Symptom and Functional Limitation scales would be considered scores found generally among children with moderate to severe asthma symptom impact.

- Utilization of health care services for children with these severity levels of asthma is substantial.

- On average there was 1 hospital visit, 1 emergency department visit, 2 unscheduled office visits and 1 use of oral prednisone during a 3-month recall period.

- Children with these severity levels of asthma miss an appreciable amount of school. During a 3 month period of time, the average number of days missed is the equivalent of 1 week. Several children missed a considerably greater amount

of school—in 3 cases the equivalent of more than 4 weeks during a 3 month period.

- The most commonly identified asthma trigger was viral infections (98%) followed by weather (80%), exercise (69%), secondhand smoke (67%) and allergies (66%).

- The most common environmental concern was secondhand smoke. Nearly half of the children (48%) were regularly exposed to secondhand smoke.

- The average cost of products provided to families of children with asthma was $204 with a range of $48 to $470. Added to this is the average cost of the initial home assessment of $132 and a product delivery visit in the amount of $132, for an average initial project visit cost of $468.

- Several outcomes demonstrated statistically significant changes over time. At the 12-month follow-up visit there were on average reported declines in unscheduled office visits (approximately 2 office visits) and use of oral prednisone (approximately 1 therapy regimen). These changes were statistically significant ($p \leq 0.05$). Hospital visits also declined by approximately 1 visit, though this difference was not at the significance level designated for significance.

- The number of school days missed significantly declined from 7 days to less than 1 day on average 12 months later. The change was statistically significant ($p \leq 0.05$).

- There were improvements in daytime symptom and functional limitation scores. The resultant scores were dramatically closer to values generally viewed as moderate to no symptom impact on quality of life. These changes were statistically significant ($p \leq 0.050$).

Pediatric Home Service staff observations and actions

- The product interventions were still in homes after 12 months. To date, there have been no products reported missing from the homes.

- The products are still being used.

- The products are “moving” if the family relocates to a different residence.

- The focus has been on the child’s bedroom to provide at least one location were asthma triggers are minimized.

- Home visits helped the families “work the system” by empowering people to tell their landlord about problems.

- Many children were on the wrong medication. For example, one child was using a reliever medication 6 times a day; the child needed a daily controller medication.

- Asthma Action Plans are a powerful tool but often were not prominently displayed in the home. Pediatric Home Service developed a refrigerator magnet for staff to write child-specific information on asthma management.

- PHS also developed colorful “tip cards” for low literacy families. The tip cards include information on asthma medications, steps to take when asthma symptoms occur and triggers of asthma.

- PHS purchased plastic boxes with covers to store the children’s asthma medications and materials.

Cost Savings of RETA Intervention

- The average cost of the initial visit and product interventions was $468.

- Unscheduled office visits (urgent care) costs per pediatric asthma visit is $84 (average).

- Hospitalization costs per pediatric asthma visit is $2,260 (average).

- At the 12-month follow-up visit there were on average reported declines in hospital visits (approximately 1 visit), and unscheduled office visits (approximately 2 office visits).

- Assuming the costs of health service utilization are $2,428 (1 hospital visit and 2 unscheduled office visits) and the average cost of an intervention was $468, the costs saved by implementing these interventions are estimated to be approximately $1,960 per child.

INTRODUCTION

Asthma is a common chronic disease in the United States affecting more than 20 million Americans including an estimated 6.3 million children under the age of 18 (ALA 2003). Environmental exposures to allergens and irritants may cause or exacerbate asthma (IOM 2000), and controlling these exposures is an important component in managing asthma (Crain et al. 2002, Morgan et al. 2004, Takaro et al. 2004). The Minnesota Department of Health Asthma Program (MDH) conducted a demonstration project Reducing Environmental Triggers of Asthma (RETA) in homes of children with asthma. The MDH environmental intervention program used a Certified Asthma Educator / respiratory therapist to teach the family about specific environmental triggers of asthma. This study explored the hypothesis that by addressing environmental factors at home through inexpensive, uncomplicated interventions, the quality of children's lives - through fewer hospitalizations, fewer emergency department visits, and fewer missed school days - can be enhanced. MDH also sought to demonstrate potential cost savings to health plans by providing these in-home environmental interventions.

RESEARCH METHODS

The Minnesota Department of Health (MDH) Asthma Program partnered with Pediatric Home Service (PHS), a durable medical equipment and supply company. Since 1995, PHS has provided over 1,900 pediatric asthma home visits to educate family members regarding medical and environmental management of asthma. A Certified Asthma Educator / respiratory therapist provides this in-home asthma education. The clientele of PHS is almost exclusively disproportionately impacted children. Over 90 percent of their clients reside in the inner cities of Minneapolis or St. Paul, and 80 percent come from minority populations. Approximately 85 percent of their clients live in rental housing. Client referrals come from Hennepin County Medical Center, Partners in Pediatrics, and Children's Respiratory and Critical Care, and Children's Hospitals and Clinics. PHS also has an ongoing working relationship with the Minneapolis Public School District (kindergarten through grade 12).

RETA explored the hypothesis that if environmental asthma triggers in the home can be eliminated or reduced, the quality of children's lives is enhanced. Criteria for a family's inclusion included the child being 18 years of age or younger, a physician diagnosis of persistent asthma, under a physician's care, and on daily preventative medications. In most cases the child also had documented allergies (RAST or skin tested). The results of the first home visit, along with the child's allergies, determined the recommended interventions. Sixty seven children were enrolled in the study; three dropped out before the initial visit. Sixty four families received both the family-specific education and appropriate materials to minimize or eliminate exposures to environmental allergens and irritant triggers of asthma. Families also received an asthma brochure developed by the Hennepin County Medical Center (2004).

During the initial home visit, information was collected regarding the number of emergency department visits, hospitalizations, missed school days, and unscheduled

clinic visits that occurred in the previous 3 months (Appendix A). The Quality of Life improvement was measured by responses to a short form completed by the parent or guardian regarding how the child's life was affected by asthma during the past 4 weeks (Bukstein et al. 2000). Table 1 lists the Quality of Life questions asked during the study. After the intervention, this same information was collected at intervals of 3 months (telephone interview), 6 months (home visit), 9 months (telephone interview), and 12 months (home visit). The total cost of the intervention, including the cost of the home visit by the certified asthma educator, was recorded. The sustainability of the interventions was evaluated for the 3, 6, 9 and 12-month intervals.

Table 1: "Quality of Life" Questions

Has your child complained of being short of breath?
Has exertion, such as running, made your child breathless?
Has your child coughed at night?
Has your child been woken up by wheezing or coughing?
Has your child stayed indoors because of wheeze/cough?
Has your child's education suffered due to asthma?
Has your child's asthma interfered with his/her life?
Has asthma limited your child's activities?
Has taking his/her inhaler or other treatments interrupted your child's life?
Have you had to make adjustments to family life because of your child's asthma?

Enrollment in RETA began in December 2004 and ended about one year later. Table 2 lists the most common environmental interventions used during this study. The most common interventions used were HEPA air cleaners, pillow and bed dust encasements, and HEPA vacuum cleaners.

Table 2: Environmental Interventions Available

Mattress and pillow encasements
HEPA filters for gas forced air furnace
HEPA room air cleaners
HEPA vacuum cleaners and bags
Dehumidifiers
Integrated pest management tools
Education regarding environmental asthma triggers

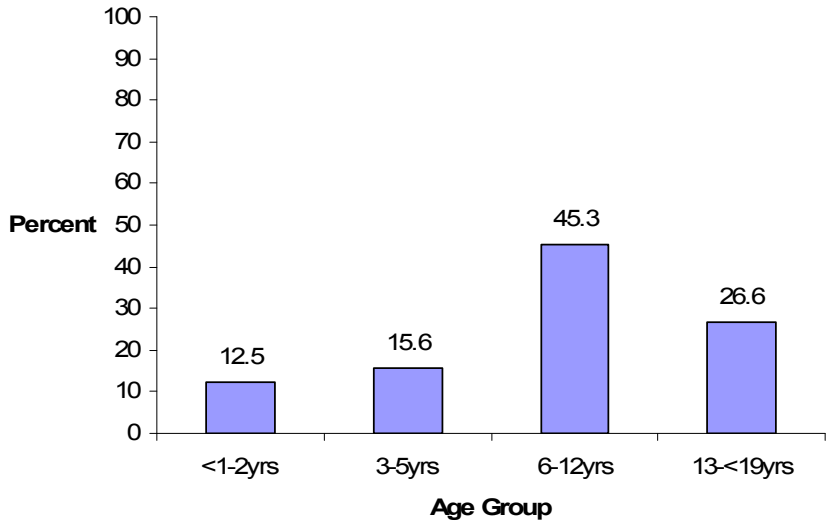
RESULTS

RETA Baseline Descriptive Results

Age and Gender
A total of 67 data records were identified from the data file, of which 64 were valid. Among the 64 enrolled children 43 (67%) were boys and 21 (33%) girls.

By age group: 8 children (12.5%) were infants or toddlers (ages <1yr-2yrs); 10 (15.6%) were preschool (ages 3-5yrs); 29 (45.3%) were grade school (ages 6-12yrs); and 17 (26.6%) were middle/high school (ages 13-19yrs). The mean age was 8.8 ± 4.8 years with a range of 0 years (i.e. infants <1 yr) to 19 years (i.e.18 yrs + months). Girls were generally older than boys (mean age for girls was 11.6 ± 4.2 years and for boys was 7.4 ± 4.5 yrs).

Figure 1: Age Distribution of Enrolled Children



Asthma hospitalizations are an indicator of both the severity of the disease and barriers to regular care. Minnesota data show asthma hospitalizations are highest among children under the age of 5. The rates are higher for boys than girls until the late teenage years at which point the rates become higher for girls (MDH 2005). The age distribution and larger percentage of boys enrolled reflects this statewide pattern.

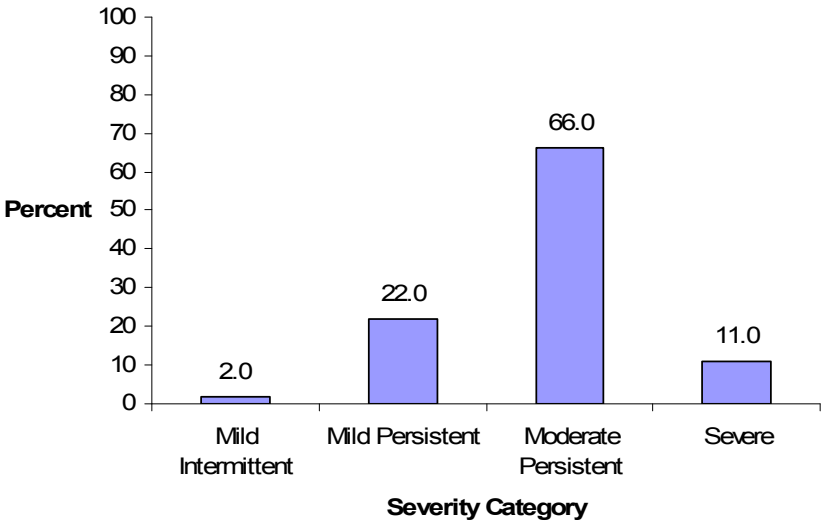
Asthma Severity
Asthma severity was determined for each child using the National Heart, Lung, and Blood Institute (NHLBI) severity classifications (NHLBI, 1997) as described in Table 3. Only one child was identified with mild intermittent asthma; 14 children (22%) were classified with mild persistent asthma, 42 children (66%) with moderate persistent asthma and 7 children (11%) with severe asthma (Figure 2).

Table 3: NHLBI Classification of Asthma Severity

Classification	Description		
	Symptoms	Nighttime Symptoms	Lung Function
Step 4 Severe Persistent	• Continual symptoms • Limited physical activity • Frequent exacerbations	Frequent	• FEV_1 or PEF ≤60% predicted • PEF variability >30%
Step 3 Moderate Persistent	• Daily symptoms • Daily use inhaled short-acting beta2-agonist • Exacerbations after activity • Exacerbations ≥2 times a week; may last days	>1 time a week	• FEV_1 or PEF >60%≤80% predicted • PEF variability >30%
Step 2 Mild Persistent	• Symptoms > 2 times a week but <1 time a day • Exacerbations may affect activity	>2 times a month	• FEV_1 or PEF ≥80% predicted • PEF variability 20-30%
Step 1 Mild Intermittent	• Symptoms ≤2 times a week • Asymptomatic and normal PEF between exacerbations • Exacerbations brief (from a few hours to a few days); intensity may vary	≤2 times a month	• FEV_1 or PEF ≥80% predicted • PEF variability ,>30%

From NHLBI. Expert Panel Report 2. Guidelines for the Diagnosis and Management of Asthma. NIH. Publication No. 97-4051,1997, page 20.

Figure 2: Severity Classification



Family History of Asthma

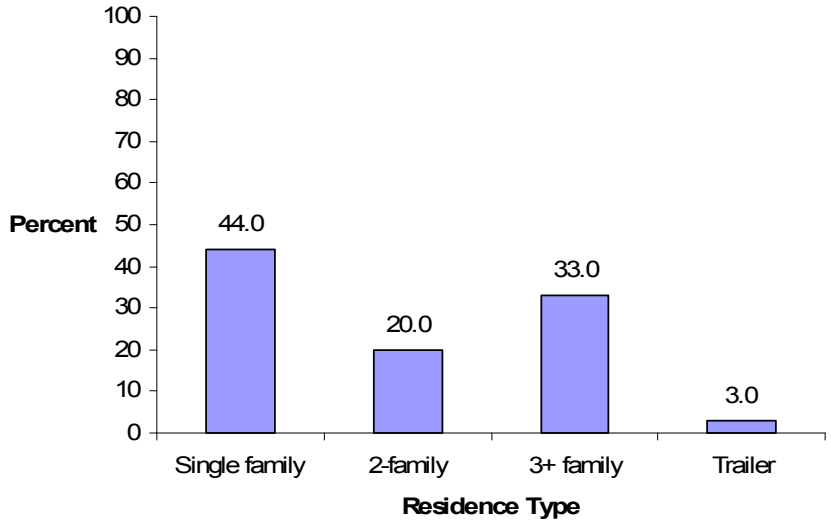
Responses from the baseline visit indicated that 95% of the referred children had a family history of asthma or allergy.

Asthma Action Plan
Responses for 49 of the referred children (76%) indicated that the child had a written asthma action plan.

Use of Peak Flow Meter
The use of a peak flow meter was considered age appropriate for 42 of the referred children. Among these only 3 (7%) were reported to use one.

Ownership and Residence Type
Information regarding the residences in which children referred to the EPA asthma intervention project were living was obtained for all 64 children. The properties were owned 36% of the time and rented 64% of the time. Single family dwellings (single unit or townhome) comprised 44% of homes; 20% were 2-family units and 33% were multifamily residences (3 or more units). Trailer homes were reported for 3% of families.

Figure 3: Residence Classification



All of the 64 children lived in the Greater Twin Cities metropolitan area. Eighty percent of the residences were located one-half mile or less from a major roadway. Another 17% were located ½-1 mile from a major roadway. Only 3% were located one or more miles from a major roadway.

Pets
The presence of pets was reported for 33% (N=21) of the children. Specifically cats for 14% (N=9), dogs for 16% (N=10) and birds for 5% (N=3).

Other Environmental Concerns
The presence of rodents, cockroaches was reported for a small number of residences. Detection of rodents was noted in the residence of one child and cockroaches in the residences of 3 children. Mold was noted in the residences of 9 children (14%).

The most frequent environmental concern, however, was exposure to secondhand smoke, which was noted for 31 children (48%). Twenty-six of the children had parents who smoked. For five of these children both parents smoked. Smoking was reported for 1 of the referred children. There were six reports of homes were visitors were also allowed to smoke.

When asked about where smoking took place, 28 respondents indicated that smoking was allowed outside of the house, 9 indicated that smoking was allowed in the house and 8 indicated that smoking was allowed in a car.

The large percentage of children exposed to secondhand smoke (48%) is similar to other Minnesota studies. A survey of 13,564 9th to 11th grade students found that students diagnosed with asthma where more likely to live in a household where someone smokes (37.2%) than those without asthma (31.0%) (Brunner et al. 2005). A survey of 3,420 7th and 8th grade students showed kids with asthma were more likely to live in a household where someone smokes (44%) than kids without asthma (31%) (MDH 2006a).

Allergies
Allergy to 16 common allergens was noted for each child. Allergies to cats, dogs, mites, mold, weeds, trees and grasses were all reported for one-third or more of children. The most frequently reported allergy was to mites (83%).

Table 4: Allergies

Allergen	**Number**	**Percent**
Cat	25	39.1
Dog	21	32.8
Mites	53	82.8
Mold	31	48.4
Mice	3	4.7
Roach	2	3.1
Weed	24	37.5
Tree	23	35.9
Grass	24	37.5
Peanut	1	1.6
Milk	4	6.2
Bees	1	1.6
Soy	1	1.6
Egg	4	6.2
Nut	2	3.1
Wheat	3	4.7

Asthma Triggers

Respondents were asked to identify asthma triggers from a list of 8 triggers presented orally. The most commonly identified trigger was viral infections (98%) followed by weather (80%), exercise (69%), smoke (67%) and allergies (66%).

Table 5: Asthma Triggers

Asthma Trigger	Number	Percent
Viral	63	98.4
Allergy	42	65.6
Weather	51	79.7
Smoke	43	67.2
Exercise	44	68.8
NSAIDs	1	1.6
Emotions	13	20.3
Irritants	22	34.4

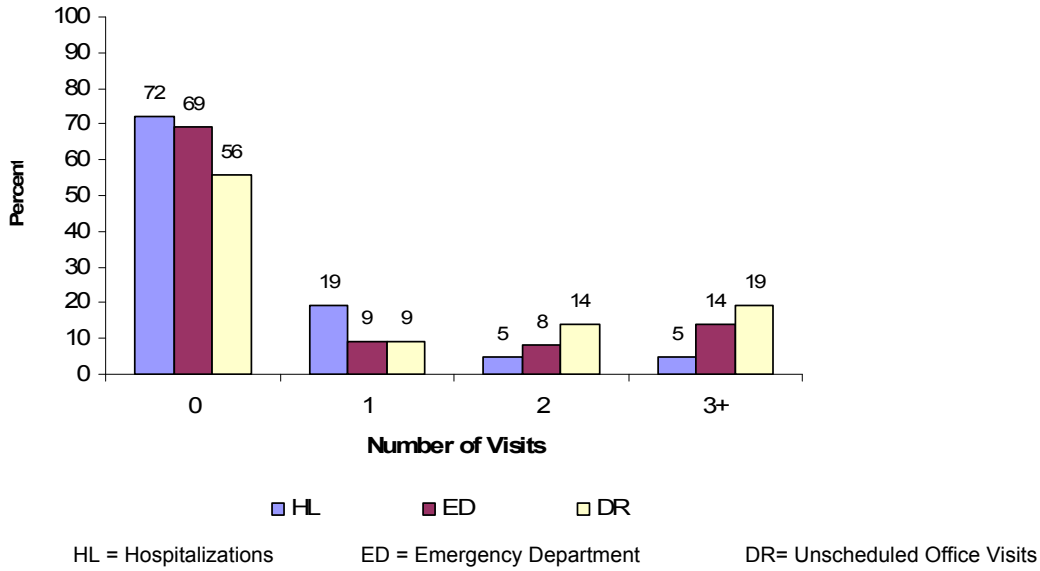
Health Service Utilization

Health service utilization related to asthma in the 3 months prior to the baseline visit was requested for all children. Hospitalization and emergency department information was obtained from parents or guardians for all 64 children while unscheduled office visit use was obtained from parents or guardians for 63 of the 64 children.

Hospitalizations for asthma were reported for 28% (N=18) of enrolled children. Among these children 6 had two or more hospitalizations. Thirty-two percent of children (N= 20) were reported to have one or more emergency department visits related to asthma. Unscheduled office visits related to asthma were reported for 42% (N=27) of children.

Five children had more than 1 of each type of service. The most frequent use was by an infant (i.e. <1 year of age) with a reported 20 hospitalizations, 10 emergency department visits and 10 unscheduled office visits in the 3 months prior to the baseline visit.

Figure 4: Health Service Utilization—Baseline



HL = Hospitalizations ED = Emergency Department DR= Unscheduled Office Visits

Oral prednisone use in the 3 months prior to the baseline visit was also identified. Thirty-seven children (58%) had required this treatment. Of these, 15 children (40%) were identified with a single treatment regimen; 12 (32%) with 2 treatment regimens and 10 (27%) with 3 or more treatment regimens.

Table 6: Mean Health Service Utilization—Baseline

	Hospital Visit	ED Visit	Office Visit	Oral Pred
Baseline	.70	0.97	1.82	1.28

Asthma Medications

The use of asthma medications was determined for each child. Medications were classified into 6 categories. Individual children could be listed under more than one category

Table 7: Asthma Medication Use--Baseline

Medication Type	Number	Percent
Short Acting Bronchodilator	62	96.9
Inhaled Corticosteroid	26	40.6
Inhaled Corticosteroid w/ Long Acting Bronchodilator	33	51.6
Long Acting Bronchodilator	0	--
Leuokotriene Inhibitor	33	51.6
Nasal Spray	14	21.9

Fifty-nine children (92%) were reported to be using a medication containing a control agent (an inhaled corticosteroid, a combination product containing an inhaled corticosteroid or a leukotriene). A short acting bronchodilator (a reliever medication) was used by 97% of children. One child used no medications, 4 relied on short acting bronchodilators only. Only one child who used asthma medications did not also have a short-acting bronchodilator for rescue purposes. Eleven children used 4 different categories of medications—all used short acting bronchodilators, inhaled corticosteroids (either alone or in combination with a long acting bronchodilator), a leukotriene, and nasal spray.

Of the 63 children using medications for asthma, 44 (70%) were determined to be compliant with them.

School Absences

Data regarding school absences was used only for visits where the recall period included time when school was in session (i.e., visits from December 1st through June 10th) and for children 6 years of age or older. At the baseline visit this included responses for 33 children. The mean number of days absent for these children was 7.3 days (range 0-30 days) during the prior 3 months.

Asthma Symptoms (ITG Child Asthma Short-Form)

The ITG Child Asthma Short Form is a 10-question, validated instrument measuring the impact of asthma symptoms on a child's life (Bukstein et al. 2000). Scoring of the instrument results in 3 scale scores (Daytime Symptoms, Nighttime Symptoms and Functional Limitations). Two single question items may also be reported, although most commonly only the 3 scales are discussed. The instrument is scored so that higher scores indicate less symptom burden, while low scores indicate more severe symptom burden.

The baseline results for children referred to the housing project are found in Table 8. There were 61 children with responses to score the Daytime Symptom scale, 62 with responses to score the Nighttime Symptom scale and 62 with responses to score the Functional Limitations scale. The EPA results are compared with the results of the published literature, which, at the time of its publication, were judged to be moderately impacted by asthma symptoms (Bukstein et al. 2000).

Table 8: ITG Child Asthma Short Form—Baseline Scores

Mean Score
Standard Deviation

	Daytime Symptoms (N=61)	**Nighttime Symptoms N=62**	**Functional Limitations (N=62)**
EPA	51.8	57.7	50.2
Bukstein sample	62.2	60.5	75.7

These baseline results indicate a group of children more impacted by asthma symptoms than the validation sample. Daytime Symptoms and Functional Limitations scores are both more than 10 percentage points lower than those reported by Bukstein et al.

ITG scores were also categorized into 3 categories—scores ≤25 (severe impact), scores 26-74 and scores ≥ 75 (low to no impact). Nineteen children (30%) had daytime symptom scores ≤25; 13 (20%) had nighttime symptom scores ≤25; and 15 (23%) had functional limitation scores ≤25. Table 9 summarizes the information for the three scales.

Table 9: ITG Child Asthma Short Form—Baseline Scores by Asthma Severity

	Mild Intermittent (N=1)	**Mild Persistent (N=14)**	**Moderate Persistent (N=42)**	**Severe (N=7)**
Daytime Symptoms				
Missing	0	0	2	1
≤25	0	3	12	4
26-74	1	4	15	2
≥75	0	7	13	0
Nighttime Symptoms				
Missing	0	0	1	1
≤25	0	4	6	3
26-74	0	4	21	1
≥75	1	6	14	2
Functional Limitations				
Missing	0	0	1	1
≤25	0	0	11	4
26-74	1	9	21	2
≥75	0	5	9	0

The ITG scoring results generally support the severity assignments previously reported. Children identified with severe asthma also generally had lower scores. For daytime symptoms, 4 of the 7 had scores ≤25. For nighttime symptoms, 3 of 7 had scores ≤25, although 2 of the 7 had scores ≥75. For functional limitations, 4 of the 7 had scores ≤25.

In contrast children identified with mild intermittent or mild persistent asthma generally scored higher on the symptom scales. For daytime symptoms, 7 of 15 scored ≥75; for nighttime symptoms, 7 of 15 scored ≥75; and for functional limitations, 5 of 15 scored ≥75.

Products and Project Costs
Products to address environmental concerns noted in the home were provided as needed. The most frequently identified were mattress and pillow encasements and HEPA air cleaners, provided for 62 of the 64 residences.

Table 10: Products

Product	Number	Percent
Mattress and pillow encasements	62	96.9
HEPA vacuum	39	60.9
HEPA Vacuum Bags	1	1.6
Furnace Filters	0	--
Removal of Bedroom Clutter	2	3.1
HEPA Air Cleaner	62	96.9
Dehumidifier	1	1.6
Dresser for clothes	6	9.4
Boric Acid	1	1.6

The average cost of the products provided was $204 with a range of $48 to $470. The median cost was $202. Added to this is the average cost of the initial home assessment $132 and product delivery visit in the amount of $132, for an average initial project cost per enrollee of $468.

3-, 6-, 9-, and 12-month Follow-up Results

Statistical Analysis and Limitations
Children enrolled in the EPA asthma housing project were followed for 12 months. The number of children lost to follow-up was large, resulting in a small number of children available at any follow-up period.

Table 11: Follow-up Visits

Visit	Number
Baseline	64
3-month follow-up	29
6-month follow-up	24
9-month follow-up	28
12-month follow-up	20

For this demonstration project the outcomes of interest (number of hospital visits, number of emergency department visits, number of unscheduled office visits, use of oral prednisone, school absences, daytime symptoms, nighttime symptoms, and functional limitations) were examined using paired Student t-tests with a p-value of 0.05, two tailed

as the level of significance. The use of statistical analyses presents several limitations that must take into account the following considerations:

- The sample size for any comparison will be small
- The number of outcome measures relative to the sample size available is large
- The number of comparisons that are made resulting in the potential for multiple test error.

In no case, should the results be interpreted as causative. While children enrolled in the EPA asthma housing project may demonstrate improvements in the identified outcomes, attribution of improvement to the housing project alone cannot be made.

Health Service Utilization

With the exception of emergency department visits at the 12 month follow-up, health service use declined during the 12 month period following the initial home visit. At the 12-month follow-up visit, reported declines in hospital visits, unscheduled office visits and use of oral prednisone were noted. The number of emergency department visits associated with asthma increased, however.

Table 12 summarizes the information for the 4 health services of interest.

Table 12: Mean Health Service Utilization by Follow-up Visit

Mean
Standard Deviation

	Hospital Visit	**ED Visit**	**Office Visit**	**Oral Pred**
Baseline	.70	0.97	1.82	1.28
3-month follow-up	0.14	--	0.07	0.07
6-month follow-up	0.08	0.21	0.92	1.17
9-month follow-up	0.07	0.18	0.18	0.28
12-month follow-up	0.05	1.8	0.10	0.20

Studies have indicated that there may be seasonal trends in the use of health services for asthma that are generally related to seasonal environmental changes. Given the small sample size and the inability to adjust for this seasonal trend, the best comparator would be the baseline to 12-month follow-up since both of these visits occurred at the same time of year. The results of statistical analysis for children with paired results for these comparisons indicate statistically significant differences in the number of unscheduled office visits related to asthma and the number of times oral prednisone was used ($p < 0.05$). The number of hospital visits related to asthma, while reduced, was not statistically significant.

Table 13: Paired t-tests—Health Service Utilization at 12 months

Baseline → 12 months	Mean change	t-value	Pr > | t |
Hospital visits	- 0.3	1.83	0.08
ED visits	+ 0.8	-0.49	0.63
Office visits	- 1.35	2.55	0.02*
Oral prednisone regimens	- 0.7	3.04	0.01*

*significant at $p \leq 0.05$

School Absences

Children were included in the analysis of school absences if 2 criteria were met:

1) age was ≥ 6 yrs
2) the visit (baseline, 3-, 6-, 9- or 12-month) was between December 1 and June 10th to all for a recall period when school was in session.

Inclusion in paired analysis was dependent on the visit meeting the 2nd criterion specified above.

Thus the baseline visit and any follow-up visit were required to be completed during the period December 1 and June 10.

The number of missed days of school declined during the 12 month period following the initial home visit. The mean differences in the number of school days missed were statistically significant at each of the follow-up periods.

Table 14: School Absences by Follow-up Visit

Mean
Standard Deviation

	Days Missed
Baseline	7.30 ± 8.55
3-month follow-up	0.15 ± 0.55
6-month follow-up	0
9-month follow-up	0.62 ± 1.71
12-month follow-up	0.10 ± 0.32

Table 15: Paired *t*-tests—School Absences

	Mean change (days)	t-value	Pr > | t |
Baseline → 3 months	- 3.6	2.71	0.02*
Baseline → 6 months	- 6.5	4.18	0.02*
Baseline → 9 months	- 6.6	2.86	0.02*
Baseline → 12 months	- 6.7	2.35	0.04*

*significant at $p \leq 0.05$

Asthma Symptoms (ITG Child Asthma Short-Form)
Symptom scores for all 3 scales of the ITG Child Asthma Short-Form improved during the 12 month period following the home visit.

Table 16: Mean ITG Child Asthma Short-Form Scores

Mean
Standard Deviation

	Daytime Symptoms	**Nighttime Symptoms**	**Functional Limitations**
Baseline	51.8 ± 31.4	57.7 ± 30.7	50.2 ± 28.2
3-month follow-up	82.3 ± 19.0	92.7 ± 14.4	85.0 ± 13.7
6-month follow-up	74.5 ± 32.4	74.0 ± 34.0	78.9 ± 26.0
9-month follow-up	75.0 ± 24.3	77.7 ± 24.1	76.5 ± 24.0
12-month follow-up	70.1 ± 34.9	64.6 ± 33.3	72.9 ± 31.9

As with health service utilization, there may be seasonal trends in the impact that symptoms have on a child's life that may be related to environment and activity changes. Given the small sample size and the inability to adjust for this seasonal trend, the best comparator would be the baseline to 12-month follow-up since both of these visits occurred at the same time of year. The results of analysis for children with paired results for these comparisons indicate statistically significant differences in scores for daytime symptoms and functional limitations ($p < 0.05$). While nighttime symptoms scores showed improvement, the difference was not statistically significant.

Table 17: Paired t-tests

Baseline → 12 months	**Mean change (scale points)**	**t-value**	**Pr > | t |**
Daytime Symptoms	22.2	2.87	0.01*
Nighttime Symptoms	14.6	1.86	0.08
Functional Limitations	19.8	3.06	0.01*

*significant at $p \leq 0.05$

DISCUSSION

RETA Findings of Note

Several findings from the RETA data are noteworthy:

- At baseline more than three-fourths of the children referred to the RETA Project were children with moderate persistent or severe asthma.

- The ITG Child Asthma Short-Form results support the finding related to severity in that the mean scores on the Daytime Symptom, Nighttime Symptom and Functional Limitation scales would be considered scores found generally among children with moderate to severe asthma symptom impact.

- Utilization of health care services for children with these severity levels of asthma is substantial.

- On average there was 1 hospital visit, 1 emergency department visit, 2 unscheduled office visits and 1 use of oral prednisone during a 3-month recall period.

- Children with these severity levels of asthma miss an appreciable amount of school. During a 3 month period of time, the average number of days missed is the equivalent of 1 week. Several children missed a considerably greater amount of school—in 3 cases the equivalent of more than 4 weeks during a 3 month period.

- The most commonly identified asthma trigger was viral infections (98%) followed by weather (80%), exercise (69%), secondhand smoke (67%) and allergies (66%).

- The most common environmental concern was secondhand smoke. Nearly half of the children (48%) were regularly exposed to secondhand smoke.

- The average cost of products provided to families of children with asthma was $204 ± $78 with a range of $48 to $470. Added to this is the average cost of the initial home assessment of $132 and a product delivery visit in the amount of $132, for an average initial project visit cost of $468, a dollar figure offset by improvements in asthma outcomes; most notable health service utilization related to asthma.

- Several outcomes demonstrated statistically significant changes over time. At the 12-month follow-up visit there were on average reported declines in unscheduled office visits (approximately 2 office visits) and use of oral prednisone (approximately 1 therapy regimen). These changes were statistically significant ($p \leq 0.05$). Hospital visits also declined by approximately 1 visit, though this difference was not at the significance level designated for significance.

- The number of school days missed significantly declined from 7 days to less than 1 day on average 12 months later. The change was statistically significant ($p \leq 0.05$).
- There were improvements in daytime symptom and functional limitation scores. The resultant scores were dramatically closer to values generally viewed as moderate to no symptom impact on quality of life. These changes were statistically significant ($p \leq 0.050$).

Pediatric Home Service staff observations and actions included:

- The product interventions were still in homes after 12 months. To date, there have been no products reported missing from the homes.
- The products are still being used.
- The products are "moving" if the family relocates to a different residence.
- The focus has been on the child's bedroom to provide at least one location were asthma triggers are minimized.
- Home visits helped the families "work the system" by empowering people to tell their landlord about problems.
- Many children were on the wrong medication. For example, one child was using a reliever medication 6 times a day; the child needed a daily controller medication.
- Asthma Action Plans are a powerful tool but often were not prominently displayed in the home. Pediatric Home Service developed a refrigerator magnet for staff to write child-specific information on asthma management.
- PHS also developed colorful "tip cards" for low literacy families. The tip cards include information on asthma medications, steps to take when asthma symptoms occur and triggers of asthma.
- PHS purchased plastic boxes with covers to store the children's asthma medications and materials.

Cost Savings of RETA Interventions

The main purpose of this demonstration project was to address environmental factors in the home through inexpensive, uncomplicated interventions and to improve the quality of children's lives through fewer hospitalizations, fewer emergency department visits, and fewer missed school days. Health plans in Minnesota do not reimburse families for the expenses associated with eliminating or reducing environmental triggers of asthma. One intended outcome of this study was to demonstrate that the benefits of reimbursement for environmental interventions, such as a decrease in emergency department visits, are greater than the costs of the family-specific interventions.

Minnesota hospitals report information to the Minnesota Hospital Association (MHA) on a voluntary basis. Currently, 95% of all hospitalizations in the state are reported to MHA using the standardized billing form (UB-92). Through an agreement with the MHA, the MDH Center for Data Initiatives receives selected elements, including charges per claim, from the claims data records for inpatient, ambulatory surgery, and emergency department discharge data from participating hospitals.

Using the charge data from 2004, along with Medicare cost-to-charge ratios, the MDH Asthma Program has estimated the actual costs of an average pediatric asthma unscheduled office visit (urgent care) and hospitalization in the Twin Cities metropolitan area (MDH 2006b).

- Average cost per pediatric unscheduled office visit (urgent care) for asthma is $84
- Average cost per pediatric asthma hospitalization is $2,260

At the 12-month follow-up visit there were on average reported declines in hospital visits (approximately 1 visit), and unscheduled office visits (approximately 2 office visits). The average cost of the initial visit and product interventions was $468, a dollar figure offset by improvements in asthma outcomes; most notably unscheduled office visits (urgent care) and hospitalizations. Assuming the costs of health service utilization are $2,428 (1 hospital visit and 2 unscheduled office visits (urgent care)) and the average cost of an intervention was $468, the costs saved by implementing these interventions are estimated to be approximately $1,960 per child.

NEXT STEPS / SUSTAINABILITY

Several Minnesota organizations had concurrent grants that included an environmental component. The MDH Asthma Program received an EPA grant (RETA Project), the City of Minneapolis Regulatory Services and the St. Paul Ramsey County Health Department received a US Department of Housing and Urban Development (HUD) Healthy Homes Grant, and the American Lung Association of Minnesota (ALAMNN) received a US Centers for Disease Control and Prevention (CDC) Controlling Asthma in American Cities Grant. These organizations decided to combine our intervention data. The pooled analysis of the EPA and HUD data increased the total number of families who received environmental interventions. To ensure consistency of data, Pediatric Home Service conducted the initial home visit for both the MDH RETA Project and the HUD grant. The same demographic data collection tool was used (Appendix A). ALAMN paid for the pooled analysis of data using their CDC asthma grant. The goal of the pooled analysis was to demonstrate there is a cost savings to health plans if they fund similar education and environmental interventions.

Preliminary analysis of the pooled data has shown a decline in hospitalizations and an improvement in Quality of Life indicators. As of November 2006, these preliminary data have been presented to 2 of Minnesota's 6 health plans. One of these health plans has

awarded a modest grant to ALAMN to offer environmental interventions for low income pediatric members.

Washington County is located in the eastern part of the Twin Cities metropolitan area. The Washington County Public Health and Environment Department recognized that asthma is a growing public health concern in their community. An interdisciplinary department work group met to determine what should be done locally to address gaps in asthma awareness, understanding, and prevention. The result of the assessment and planning process was a commitment to implement activities to improve the lives of people with asthma in Washington County. One of these activities was to use the MDH/EPA model to provide educational and environmental interventions to children with poorly managed asthma. As of December 1, the county has provided interventions for 15 children referred by either a county public health nurse or a school nurse.

Other Washington County activities include:

- Conducting a multi-dimensional public awareness campaign about asthma targeted to the general public, coaches, health care providers, and people with asthma;
- Improving the department's internal capacity to assist the public in recognizing asthma symptoms and environmental triggers;
- Recruiting members and supporting efforts of a county-based asthma coalition;
- Providing resources to families and providers to help raise awareness and improve asthma management; and,
- Working with the Minnesota Environmental Initiative on their Clean Air Minnesota project to retrofit Washington County's school buses.

Washington County, in collaboration with the MDH Asthma Program, will develop a guide that local public health agencies can use to initiate asthma activities in their communities.

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Pediatric Home Service Data Collection Form
Minnesota Department of Health Asthma Program Intervention Grant
January 2005

General Information
Date of Initial Visit
Zip Code
Proximity to Busy Road
Age in Years/Months
Male
Female
Type of Housing
Own
Rent
Single Family
Duplex
4-plex
Multi Large
Trailer
Townhouse
Utilizations 3 months before intervention
of Hospitalizations
of ER Visits
School Days Missed
Prednisone Use
Unscheduled Clinic Visits
None
Pets in Home
Cat
Dog
Other
Visible Problems
Rodents
Cockroaches
Visibly Seen Mold

Smoke in Home
None
Parent
Parent(s)
Visitor
Child
Smoking Where
Outside
Inside
Car
Allergies
Cat
Dog
Dust mites
Mold
Cockroaches
Weeds
Trees
Grass
Peanuts
Cow's Milk
Stinging Insects
Soy
Eggs
Tree Nuts
Wheat
General
Family History
AAP in Home
Using Peak Flow Meter
Personal Best #

Triggers
Viral Infections
Allergies
Weather
Tobacco Smoke
Exercise
Aspirins, NSAIS
Emotions
Irritants
Severity
Mild Intermittent
Mild Persistent
Moderate Persistent
Severe Persistent
Medications
Short Aching Bronchodilators
I.C.S.
I.C.S. + L.A.B.
L.A.B.
Anti Leutrotriene
Nasal Spray
Compliance with Meds
Rescue Medication Use in Past 2 Weeks
≤ 1 x/wk
≥ 2 x/wk
Daily

Environmental Interventions
Bed & Pillow Encasements/Size
HEPA Vacuum
HEPA Vacuum Cleaner Bags
HEPA Furnace Filters
Changed Window Treatments
Removal of Bedroom Clutter
Cleaning Supplies Provided
Removed Carpet
Fixed Plumbing Problem
Air Cleaner
Dehumidifier
Other
Quality of Life in last 4 weeks
SCALE: 1 = All; 2 = Most; 3 = Some; 4 = A Little; 5 = None; n/a = Not Applicable.
Your child complained of being short of breath
Exertion (such as running) made your child breathless
Your child coughed at night
Your child been woken up by wheezing or coughing
Your child stayed indoors because of wheeze/cough
Your child's education suffered due to asthma
Your child's asthma interfered with his/her life
Asthma limited your child's activities

Taking his/her inhaler or other treatments interrupted your child's life
You had to make adjustments to family life because of your child's asthma
Spirometry
Not Age Appropriate
FEVI: ≤ 60%
> 60 — < 80%
> 80 %
FEVI/FVC: ≤ 60%
> 60 — < 80%
> 80 %
Peak Flow:≤ 60%
> 60 — < 80%
> 80 %
Costs
Visit paid by Insurance
Visit paid by Grant
Cost of Supplies
Cost of Handyman