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# Analysis of an Evidence-based Pediatric Asthma Management Tool for Providers Confirms Linkages between Asthma and Known Risk Factors in a Vermont Practice

Julie Marie Desrochers  
*University of Vermont*

Jane Wolforth MPH  
*Vermont Department of Health*

Thomas V. Delaney PhD

Maria Roemhildt PhD  
*Vermont Department of Health*

Lynn Zanardi Blevins MD, MPH  
*University of Vermont College of Medicine*

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**Title:** Analysis of an Evidence-based Pediatric Asthma Management Tool for Providers Confirms Linkages between Asthma and Known Risk Factors in a Vermont Practice

**Authors:** Julie Desrochers, Jane Wolforth, Thomas Delaney, Maria Roemhildt, Lynn Blevins

**Keywords:** asthma, chronic disease management, pediatric

**Abstract:**

**Introduction:** Pediatric asthma is one of the largest targets for innovative programs in chronic care management due to its extensive and expanding health burden. A physician-directed asthma management, diagnostic and data tracking tool was implemented in a Vermont pediatric practice. Data were analyzed after one year to enable the Vermont Department of Health (VDH) and practice to describe program participants.

**Methods:** A modified version of a validated pediatric asthma survey, Easy Breathing, was administered during office visits at a pediatric practice located in Burlington, VT. Fisher's exact test was used to assess relationships between those with and without current asthma, and between those with intermittent versus persistent levels of asthma.

**Results:** Of 206 patients, 150 had no asthma, 55 had a current asthma diagnosis and one (1) was listed as 'unable to determine.' Patients with current asthma were significantly more likely to be insured with Medicaid ( $p=.048$ ), have a family history of asthma ( $p=.019$ ) and be exposed to environmental tobacco smoke ( $p=.028$ ). Within the asthma group, persistent asthma was associated with exposure to cat ( $p=.043$ ).

**Conclusion:** Participants in the Easy Breathing Program at this practice with and without current asthma diagnosis showed differences that reflect established asthma risk factors and related asthma triggers. Further efforts are needed to increase the reliability of the data.

**Introduction:**

Pediatric asthma is one of the largest targets for chronic care management due to its extensive and expanding burden. Globally, mean annual asthma prevalence has been increasing by an estimated 0.5% each year.<sup>1</sup> In 2013, the prevalence of current asthma in the United States was 8.3% for children.<sup>2</sup> Geographic variations in pediatric asthma prevalence range from 6.4% in Nevada to 13.9% in the District of Columbia.<sup>3</sup> Prevalence of pediatric asthma varies widely within the state of Vermont with county level prevalence ranging from 6% to 14%, with an overall rate of 10%.<sup>4</sup> Once thought to be primarily an urban disease, rural and suburban areas are catching up with high consequences on both public health and healthcare systems.

For children under age 15, asthma is the third leading cause of hospitalization. Asthma can cause persistent airway deterioration and, on rare occasions, death.<sup>5</sup> According to the Centers for Disease Control and Prevention, children had 14.4 million lost school days in 2008 from asthma attacks.<sup>6</sup> A 2015 update from the 2008-2010 *Medical Expenditure Panel Survey* estimated that individuals with asthma incur on average \$1,095 more in medical costs per year than individuals without asthma.<sup>7</sup> This causes major ramifications for the economic burden on society, individual financial status and quality of life in both individuals and families.

Easy Breathing is an evidence-based program designed to relieve challenges for providers associated with pediatric asthma management. Clinical difficulties in asthma management include lack of accurate diagnostic techniques and underutilized pharmacological therapy. The National Asthma Education and Prevention Program outlines guidelines for medical providers on proper pediatric asthma management with a set of 40 recommendations.<sup>8</sup> Easy Breathing in its original development focused on improvement in just four of these recommendations: proper diagnosis, determination of severity, appropriate pharmacological therapy, and providing the patient with an asthma action plan.<sup>8</sup>

The Easy Breathing questionnaire was validated in Connecticut for use as a screening tool with 94% sensitivity and 55% specificity.<sup>9</sup> The validated questions are highlighted in yellow

**(Figure 1).** The screening tool is a questionnaire administered at office visits to patients or parent/guardians that offers an opportunity for systematic data collection on asthma severity and control, medication use, demographic information and trigger reporting. The program has shown success when implemented independently with physician-champions within Connecticut.<sup>8</sup> Evidence has shown a 61% increase in provider performance on an asthma knowledge test after Easy Breathing training.<sup>10</sup> Evidence has also shown a threefold increase in adherence to national prescribing guidelines post-training<sup>10</sup> and a 35% reduction in hospitalization rates in children receiving primary care at Easy Breathing practices.<sup>11</sup> The specific goal of this project was to generate a descriptive analysis of the data collected during the first year of implementation to support decision-making by practitioners and the Vermont Department of Health (VDH).

#### **Methods:**

Easy Breathing, described extensively in other literature,<sup>8, 9, 10, 11</sup> was initiated in Vermont by physician request in a pediatric practice in Burlington, VT. Through collaboration with VDH, the physician-champion administered the Easy Breathing Survey (**Figure1**) in March 2014 through February 2015 that was modified to be region-specific (e.g. list of insurers was changed to display locally used insurance providers). One of three physicians at the practice elected to administer the survey and undergo Easy Breathing training delivered by the founder of the program in Connecticut. VDH connected the physician-champion with the program's leaders, agreed to be available for program support and assumed responsibility for data entry.

The patients (or a parent or guardian) presenting to the physician filled out the survey regardless of reason for the visit or insurance type. The physician-champion completed the bottom portion of the survey with information on diagnosis, severity and control. There were no exclusion criteria. A child was "enrolled" as a participant in the study if a survey was completed and the parents signed the release to for use of the data by VDH.

The first four survey questions completed by the patient or parent/guardian were the validated diagnostic questions. Based on answers to the validated questions, and combined with patient history and clinical practices, the physician assigned a diagnosis to the patient on the Easy Breathing survey. The physician also categorized the severity of the asthma (intermittent, mild persistent, moderate persistent, or severe persistent) and the control of the asthma (good, marginal or inadequate). The survey asked respondents to document an exposure to a trigger if the child was exposed two or more times per week; this was considered an exposure.

Data from the surveys were obtained in de-identified form from VDH. The analysis was divided into three parts: general description of the survey population, comparison of the asthma and non-asthma groups and within asthma comparisons between patients with intermittent and those with persistent asthma. "Unable to determine" diagnoses were excluded from the asthma versus no-asthma comparisons, and surveys of patients with asthma missing a designated severity were excluded from the within asthma comparisons. Demographic information included age, sex and insurance payer. Race, ethnicity, town, address and birthdate were asked on the survey but excluded from analysis for reasons of human subjects' protection.

This project was reviewed and accepted by the University of Vermont Research Protections Office under an Instructor's Assurance for the Master of Public Health Culminating Project Experience. All analyses were performed using IBM SPSS 21. For comparison of the asthma and non-asthma groups Fisher's exact tests were calculated for each variable using cross-tabulations. This was repeated for a comparison of the asthma groups, between those with intermittent and those with persistent asthma. For the within asthma comparison, mild, moderate and severe asthma were all grouped together as "persistent." Cross-tabulations were used to generate odds ratios. 95% confidence intervals were obtained by generating frequencies with bootstrapping for each variable.

## Results:

In the first year of project implementation, March 2014 to February 2015, 206 surveys were completed. Reasons for and rates of refusal to complete the survey (by the patient/family) and failure to administer the survey (by the medical staff) were not recorded on an individual basis.

The distribution of responses on the Easy Breathing survey is shown in **Table 1**. The sample (N=206) was predominantly female (68.4%, N=143) and all resided in the state of Vermont. Participants were all 21 years of age or younger. The mean age was 8.8 years. Of the 206 participants 55 (27.2%) had a positive asthma diagnosis. Physician-designated diagnosis included 48(23.3%) for “Yes-previously diagnosed” asthma, six (2.9%) for “Yes- New Diagnosis” and one (0.5%) “No, at first then diagnosed later.” One (0.5%) survey indicated the physician’s diagnosis as “Unable to determine.” 14 of 55 asthma-positive surveys were missing a classification for control and one of 55 was missing a classification for severity. These sections of the survey are completed by the physician.

For all four of the validated asthma questions differences between positive responses in the asthma and no-asthma groups were significant ( $p<.001$ ). Questions one and three of the set of four validated diagnostic questions (wheezing or whistling in the last months and difficulty with exercise) were associated with persistent severity ( $p=0.024$ ,  $p=0.044$ ) as compared with intermittent severity asthma.

Statistically significant results included a difference in insurers between the asthma and non-asthma group, differences in family history and tobacco smoke exposure. 36.4% of asthma patients versus 22.0% of non-asthma patients were insured with Medicaid and 58.2% of asthma patients were insured privately as compared to 74.0% of non-asthma patients. Of the provider’s total patient load, including those who did not complete surveys, 32.2% were insured with Medicaid, 66.4% were insured privately and 1.4% had no insurance. 47.3% of the asthma group reported at least one instance of family history of asthma as compared with 28.7% of the

non-asthma group. 12.7% of asthma respondents reported tobacco smoke exposure while only 3.3% of non-asthma respondents reported exposure. No significant differences were found between groups with regard to pet exposure, history of eczema or exposure to wood smoke.

Significant differences were not found between the intermittent and persistent severity groups except with regard to cat exposure and asthma control (31.4% intermittent vs. 63.2% persistent). 82.4% of intermittent asthma respondents had adequate physician-designated control while 31.6% of persistent asthma respondents had adequate control.

## **Discussion:**

### Consequences of Findings

The prevalence of asthma in the survey population is higher than the general population. The high rate of asthma in the survey respondents may indicate that the physician-champion sees a high percentage of asthma patients, staff members were less likely to administer the survey to non-asthmatic patients or non-asthmatic patients were more likely to refuse the survey. Furthermore, pediatric asthma patients typically have twice yearly wellness exams compared to non-asthmatic children with yearly asthma exams, increasing the chances that an asthmatic patient would be reached by the survey. Beyond additional wellness exams, the pharmacological management, aggravated viruses and acute exacerbations that often accompany pediatric asthma increase the likelihood of a pediatric patient with asthma interacting with his or her provider over the non-asthmatic pediatric patient.

The family history associated with asthma may encourage the clinician to suspect asthma earlier from respiratory symptoms, leading to better long-term outcomes.<sup>12</sup> This study was consistent with previous studies in showing associations with asthma and family history, particularly maternal and paternal.<sup>13,14</sup> However, other studies have shown much stronger and more significant results in these associations.

In Vermont, adults in the Asthma Callback Survey (part of the larger CDC Behavioral Risk Factor Surveillance Survey) had a prevalence of asthma of 19% in households with income below 125% of the federal poverty level (FPL) and 8% in households 250% above the FPL.<sup>4</sup> Prevalence rates range from 20% current asthma in those without a high school degree to 9% in college graduates.<sup>4</sup> Using Medicaid as an indicator of income, the significant differences seen in this analysis between the asthma and non-asthma groups with regard to having Medicaid insurance is consistent with the BRFSS findings for adults.

Easy Breathing is designed to help reduce healthcare costs by improving asthma management and has been shown to have a return on investment of \$3.58 per child with asthma per year to the insurance payer.<sup>8</sup> The Easy Breathing program attempts to accomplish this by use among patients of the Asthma Action Plan and feedback on risk factors and exposures. Easy Breathing offers provider education on long-term asthma management patient care and national guidelines.

#### Modifiable Risk Factors

The presence of modifiable risk factors in asthma patients is relevant for targeting public health interventions and for clinical management. According to the Asthma Callback Survey, 67% of children with current asthma had been advised to modify a factor in the home.<sup>4</sup> Vermonters of all ages with asthma were more likely to have four or more triggers in the home than adults with current asthma in other U.S. states (43% versus 32%).<sup>4</sup> The triggers included indoor pets, allowing pets in the bedroom, bedroom carpeting, cooking with gas, woodstove or fireplace, evidence of mold in the home, seeing rodents in the home and secondhand smoke exposure.<sup>4</sup> The Vermont version of the Easy Breathing survey could potentially be further modified to include those triggers not already included: cooking with gas, pets in the bedroom, bedroom carpeting and evidence of mold.

The significant difference in environmental smoke exposure between asthma and non-asthma patients reinforce the importance of promoting smoking cessation or smoking behavior activities within the pediatric asthma population of Vermont. Nine (9) percent of the adults with current asthma surveyed by the Asthma Callback Survey reported anyone smoking in the home.<sup>4</sup> These estimates were not reported for children because of insufficient numbers. More information is needed on the differences in rates of smoking in the home between children with and without asthma.

Other results, such as those for cat exposure among those with persistent asthma, confirm known triggers. Cat and rodent exposures are well-established asthma triggers. Studies are inconsistent with regard to dog's status as a trigger. Of the adults in the 2013 Asthma Callback Survey, 82% of those with current asthma reported having an indoor pet.<sup>4</sup> Data for children are last available through this survey from 2010 when 86% of Vermont children with current asthma reported having an indoor pet and 60% of Vermont children with asthma had bedrooms where pets were allowed.<sup>4</sup>

Wood stoves have been implicated as asthma aggravators but were not seen as significant in this study. As heating with wood is common in Vermont and other northern, rural climates, this is an area that merits future study. Due to the small sample size in this study, future analyses on this topic may need to include multiple practices that also include practices located in more rural areas in order to observe enough patients having both current asthma and woodstoves in the home. The medical practice in this study was located in the most populated area of the state where access to natural gas is abundant, thereby reducing reliance on wood heat. Within the Vermont adults with asthma population that were surveyed in the 2013 Asthma Callback Survey, 25% had a woodstove.<sup>4</sup> This was consistent with Vermont children with current asthma in the 2010 Asthma Callback Survey data where 25% had a woodstove or fireplace.<sup>4</sup> Woodstove is a common exposure among Vermont asthmatics and one that needs more study.

The differences in asthma prevalence with regard to modifiable risk factors seen in this survey may allow the physician-champion to open conversation with patients and families on the home environment. The mere presence of these questions on the survey may provide another route to open conversations while the provider-level data now available can bring research to the local level. This may lead to a measure of relatability unattainable with national level research, allowing the provider to offer local evidence to parents on the risk to children with asthma resulting from presence of modifiable risk factors in the home.

### Limitations

Some limitations arose from conditions surrounding response to the survey. A potential for bias was introduced by asking patients or parents to recall symptoms or events from the past. Because parents of children with asthma may have reason to pay closer attention to their child's health, particularly respiratory symptoms, this may have been a cause for bias. The low numbers of smoke exposure also suggest that parents may not have been entirely truthful on the survey. Parents may have also been more likely to complete the survey if their child was more likely to benefit from the program (i.e. the child had asthma). Office staff may have been more likely to target children for the survey if they had asthma. The office cited time constraints as the greatest reason of failure to administer survey, meaning that not all patients were invited to take the survey.

The sample size was small in comparison to the number of variables analyzed which could have resulted in some tests showing significance by chance. In particular a study with greater power is needed to confirm the differences between persistent and intermittent groups.

Some trigger factors were not asked about on the form. Some of these were not under the control of the patient's family. These include air pollution, cold or viral infections. Another limitation was the lack of information on town, race or ethnicity, information that was included in the survey but not the analysis due to human subjects' protection.

## Adherence to Clinical Guidelines

There are challenges with matching provider behavior to NAEPP guidelines.<sup>10</sup> Providers often forego prescription of daily inhaled corticosteroids when it is indicated. Because the corticosteroids are used prophylactically physicians and patients may not experience the direct benefits despite significant evidence of their utility. Additionally, a definitive test for asthma is lacking as asthma is a clinical syndrome. Traditional diagnoses depend on established history of recurrent respiratory symptoms, exclusion of alternative diagnoses and demonstration of reversible airflow obstruction.<sup>14</sup> Easy Breathing is designed to help providers catch cases that might otherwise go undiagnosed. Proper diagnosis of asthma leads to proper treatment, preventing the progression of scar tissue that can increase asthma severity and decrease control in the future. It is unclear from our findings whether Easy Breathing use contributed to diagnosis of the six new asthma cases identified on the surveys. Further assessment is necessary to make this distinction. For full assessment of adherence to treatment recommendation, VDH must work with the physician-champion to give and receive regular feedback on Easy Breathing through the feedback system embedded in the data entry component of the Easy Breathing database as well as regular evaluation

Implemented more broadly across geographic locations and populations, the Easy Breathing Program may yield data sufficient for public health practice when targeting management programs (e.g. home visiting programs to reduce triggers in the home) or examining adherence to clinical guidelines. Analyses of data for Asthma Action Plan use and corticosteroid prescribing practices were ultimately omitted in this study due to missing or limited data. Earlier Easy Breathing literature suggested that this was a common problem of implementation and survey completeness increased with feedback from program coaches.<sup>8</sup> This information, combined with feedback from the practice staff on time constraints, suggests that missing data can be attributed to hurried form completion and inexperience with the form.

Because this learning curve was seen in earlier studies it is expected that missing data issues will resolve with time, provided VDH can provide sustained feedback on data omissions. This feedback should mirror that seen in earlier program implementations which included written feedback from data entry staff and regularly scheduled in-person meetings between program administrators, physician-champions and practice staff.

## Conclusion

The significant findings of increased asthma prevalence with smoke exposure as well as increased asthma prevalence with Medicaid insurance confirm national studies, reflect proportions seen in adult Vermonters in the Asthma Callback Survey<sup>4</sup> and provide evidence for similar trends in children, a group with limited data in Vermont.

The baseline measures will allow further comparisons to the first year of the program's measurements by tracking changes in the provider's asthma patient population over time. This will include on a patient level and across the provider's patient load. In order to accomplish this, the data quality issues will need resolution. The addition of other providers will expand the generalizability and quality of the data. According to VDH, opportunities still exist to implement the program free of charge in interested medical practices across the state. This program is provided at no cost to the practice through a grant facilitated by VDH. The grant-funded nature raises concerns that funds may be unavailable in the future to provide support for program administration, data entry or to incentivize practices to implement the program.

Asthma is considered by some to be the most "short-term" route for delivering measurable reduction of healthcare utilization in pediatric practice. Other conditions, such as obesity, often take years to manifest in the form of high healthcare utilization rates for complications like diabetes. Asthma yields the most "immediate" results (e.g. removing smoke exposure in the home will likely show improvement in asthma control levels in the child in a few days). By continuing to monitor Easy Breathing data, both the provider and VDH can make a

coordinated effort to maintain program fidelity, track changes in asthma management over time and increase appeal to expand the Easy Breathing Program.

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