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Easy Breathing for Schools: A Promising School – Based Asthma Program

Jing Marrero

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A Thesis

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Easy Breathing for Schools: A Promising School – Based Asthma Program

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Background and Significance

Asthma is a chronic disease of the respiratory tract characterized by airway inflammation, reversible airway obstruction, and airway hyperresponsiveness.[1-3] The inflamed airways are hyper reactive to certain stimuli (known as triggers), and in response to these triggers, the muscles around the airways narrow in association with increased mucus production, decreasing airway caliber and air flow through to the lungs.[1,2] Patients often describe this airway obstruction as "breathing through a straw."[3] Acute exacerbations, commonly known as asthma attacks, result in symptoms of wheezing, shortness of breath, coughing, and chest tightness.[1-3]

As one of the most common chronic diseases, the Centers for Disease Control and Prevention (CDC) estimated in 2015 approximately 24.6 million people in the United States have asthma, and of these, approximately 6.2 million are children. Asthma is more prevalent among urban and lower socioeconomic populations and underrepresented minority groups.[4] Black populations have the highest prevalence with 11.2% compared to Asian (5.2%) and Hispanic (6.5%) populations.[3,4] However, within the Hispanic ethnic group, Puerto Rican populations are disproportionately affected by asthma with a prevalence of 16.1% compared to Mexican populations of 5.4%, as well as with more severe asthma and more health care service utilization due to asthma.[4] In the state of Connecticut, asthma prevalence is higher than the national percentages with the Connecticut Department of Public Health reporting approximately 9.2% of adults and 9.6% of children in 2014 having asthma.[5] Asthma continues to disproportionately affect the urban communities in Connecticut with its five largest cities (Bridgeport, Hartford, New Haven, Stamford, and Waterbury) constituting 17.9% of the total Connecticut population but reporting 37.2% of all asthma hospitalizations

(42.1% for children), 37.9% of all asthma emergency department visits (41.7% for children), and 30.1% of all asthma deaths (52.6% for children).[6] In Connecticut, asthma also intemperately affects minorities with 17.2% of Hispanic students and 16.7% of non-Hispanic black students having asthma compared to 11.2% of non–Hispanic white students and 11.5% of other non–Hispanic students.[7]

Due to its high prevalence, asthma has a significant negative public health impact. Asthma resulted in approximately $50.1 billion per year in direct medical costs in 2007 in the United States, required 439,000 hospitalizations, 1.8 million emergency department visits, and 14.2 million physician office visits in 2010, and has been attributed to 3,615 deaths in 2015, of whom 218 were children.[8,9] Aside from these direct effects, its associated morbidity resulted in adults missing 14.2 million days of work and children missing 13.8 million days of school in 2013.[10] This lost productivity from missed work and school contributed to asthma's $81.9 billion total cost to society in 2013,[14] an increase from a total cost of $56 billion in 2007.[2]

Students with asthma miss more days of school compared to students without asthma. Moonie et al. found a difference in school absences of 1.5 days in Missouri, and Mizan et al. found that students with asthma missed approximately 1.7 more days of school in their study in Georgia.[10,11] In their nationwide survey from 2002 – 2007, Barnett et al. found students with asthma were absent 0.92 more days, and Nurmagambetov et al. noted an increase in absences to 2.3 days in their study from 2008 – 2013.[14,15] School absences are even greater for students with poorly controlled asthma.[15,16] Hsu et al. found students who were absent due to asthma were more likely to have poorly controlled asthma as indicated by daytime symptoms, night time symptoms and use of short – acting beta agonists (SABA) in the

previous three months.[15] Similarly, Sullivan et al. found students with indicators of poorly controlled asthma, such as an asthma exacerbation in the past year, using more than three canisters of SABA in the past three months, or an asthma specific emergency department visit or hospitalization, were absent more than students with asthma but without these indicators of poor control and were absent even more days than students without asthma.[16] Consequently, school absences are often used as a marker of asthma control.[15,16]

Perhaps more importantly for children and their families, missing school has been associated with poor academic achievement.[11,17-19] Moonie et al. found children with persistent asthma performed worse on standardized testing and hypothesized the recurring school absences may have contributed to the poorer test scores.[11] Kim et al., Tsakiris et al., and Nilsson et al. also found students with asthma performed poorer academically compared to students without asthma in Korea, Greece, and Sweden, respectively, and similarly hypothesized that the increased missed days of school were a contributing factor.[17-19] This suggests that school absenteeism may have a more extensive impact than simply missing a day of classroom instruction. In addition, asthma has been associated with impaired quantity and quality of sleep due to nighttime asthma symptoms[20-22] resulting in daytime sleepiness, and therefore, daytime dysfunction and a decreased ability to learn.[21] Also, children with asthma have an increased prevalence of difficulty with emotions, behavior, and getting along,[24] which Basch hypothesizes may exacerbate any challenges with school engagement and consequently school attendance and school performance.[23]

As a compelling public health concern, especially for school aged children in urban communities, it is important to consider the school setting as an alternative area for intervention when addressing asthma.[25-29] In Connecticut public schools, the Department of

Public Health reports asthma prevalence has increased from 13.2% of students in 2006 to 14.2% in 2011 with the highest prevalence in elementary school students at a rate of 14.6%.[7] In the Hartford Public School District specifically, the overall prevalence of asthma is even higher at 24%.[7] The school setting provides an opportunity to reach a large population of children with asthma as well as an environment conducive to intervention through screening for, monitoring of, and managing asthma.[25-27] While there are many challenges to implementing school based programs, including a lack of health care personnel and resources, poor communication between students, families, school staff, and health care providers, and competing priorities for school staff,[25-27] the literature also includes many studies showing promising outcomes.[25,28-31] These school based asthma programs often show decreases in school absences, suggesting improvement in asthma control. In their randomized controlled trial of a school nurse case management program Levy et al. noted an almost 50% decrease in absences.[29] Cicutto et al. evaluated the efficacy of their multifaceted Public Health School Asthma Project and found a 10% absolute reduction in the proportion of children missing school due to asthma in the intervention group compared to the control group.[30] Liptzin et al. similarly showed that student participants in their Step Up Asthma Program missed less school days during the program compared to the prior school year.[31] Hollenbach et al., through their school-based Building Bridges for Asthma Care program piloted in two different school districts in two different states, were likewise able to decrease the rate of school absenteeism for the students enrolled in the program.[32]

While the results of these interventions are promising, it is also important to understand the feasibility of these programs in a real-world setting, without the additional resources and support a rigorous research study brings. This reflects the importance of

implementation research. Implementation science is a growing field that addresses the gap between health intervention research and evidence-based practice, translating knowledge into effective programs, policies, and practice.[27,33-35] It is broadly defined as the "scientific study of methods to promote systematic uptake of research findings … into routine practice to improve the quality and effectiveness of health services and care."[34] Implementation studies focus on the context in which the research occurs and the users of this research, including those benefiting from the intervention as well as those implementing it.[33] As the public health field increasingly incorporates evidence-based strategies to further improve population health and achieve state and national health objectives,[35,36] the need for implementation studies to help guide programs, policies, and practice will continue to expand. Therefore, while the literature contained many asthma interventions showing compelling outcomes, we were interested in evaluating their real-world application.

Due to the encouraging results of the Building Bridges for Asthma program, we were interested in its implementation and practicality in a real-world setting. Therefore, we conducted a pilot study to examine the implementation of Easy Breathing for Schools, a modified version of Building Bridges for Asthma Care.[32] The primary outcome was school absences as measured by percentage of days absent during the 2015 – 2016 school year compared to the previous 2014 – 2015 school year. We compared absenteeism for student participants and students with asthma not participating in the program. Secondary outcomes were process measures that examined the implementation of the program using the RE – AIM[36-38] framework as an evaluation guide. We evaluated program enrollment, program utilization, and feasibility in a real – world setting. We hypothesized this program would be effective in reducing school absenteeism for participating students compared to non-

participating students. We also hypothesized this program would be well accepted by school nurses as evidenced by program enrollment, with at least 25% of interested school nurses and at least 25% of eligible students participating in the Easy Breathing for Schools program, which is similar to the approximately 37% of students enrolled in the Building Bridges for Asthma Care program.[32] We also hypothesized the program elements would be well utilized as demonstrated by each element being completed with at least 75% of student participants and repeated with these students as appropriate. Lastly, we hypothesized this program would be well accepted and school nurses would find it feasible to incorporate into a typical day with minimum time of less than 30 minutes required to do so and a high satisfaction rating.

Methods

Participants

Easy Breathing for Schools was a school – nurse driven asthma intervention program that was offered to the 50 school nurses and school – based health center (SBHC) practitioners who worked in the 70 schools in the Hartford Public School District during the 2015 – 2016 school year. The program was introduced at a mandatory professional development day. Of these 50 school nurses and SBHC practitioners, 26 were initially interested in the program and 19 completed training; ten school nurses from ten schools participated in the program by implementing at least one program element. One of these schools used a unique attendance system and we were unable to obtain absenteeism data for the students attending this school. There were 4,365 total students in the nine participating schools, of whom 1,654 had an asthma diagnosis in the school records. Participating school

nurses enrolled 114 students from these participating schools in the program. The Institutional Review Board at Connecticut Children's Medical Center approved this study.

Easy Breathing for Schools Program

The Easy Breathing for Schools program was a school nurse driven program that was designed to identify students with asthma at risk for adverse outcomes and assist school nurses in managing these students with the goal of improving asthma control and reducing asthma related school absences.[39] This program provided a systematic method and tools to help manage students with asthma at school. Easy Breathing for Schools consists of five components: 1) identifying students with asthma who are at risk for adverse asthma outcomes using the Student Asthma Survey, 2) assessing asthma control using the Asthma Control Test (ACT) or Childhood Asthma Control Test (cACT) and Inhaler Technique (IT) checklist score, 3) reviewing medications with the students and/or parents, 4) communicating issues with clinicians using the Referral Checklist, and 5) providing asthma education.

The Asthma Survey assesses asthma risk and control to determine if a student with asthma is at risk for adverse asthma outcomes including emergency department (ED) visits, hospitalizations, or missing school.[39] The Asthma Survey consists of five questions (Table 1) with the responses indicating the student was at risk for adverse asthma outcomes bolded in the table.

Table 1. Asthma Survey questions and response choices

Asthma Survey question	Response choices
1. In the last 12 months, how many times has your child visited the emergency room/urgent care or had an urgent doctor's office visit for asthma?	0 times 1 times **2 times** **3 times** **4 times** **5 or more times**
2. In the last 12 months, how many times has your child been hospitalized overnight for asthma?	0 times **1 times** **2 times** **3 times** **4 times** **5 or more times**
3. How many days of school did your child miss last school year because of asthma?	0 – 5 days 6 – 9 days **10 – 17 days** **18 or more days**
4. In the last 4 weeks, how often has your child had coughing, trouble breathing, or wheezing in the morning or during the day?	Never 1 – 2 days/week **3 or more days/week but not every day** **Every day**
5. In the last 4 weeks, how often has your child used a rescue or reliever medicine (a pump, inhaler, nebulizer or breathing machine) to relieve coughing, trouble breathing, or wheezing?	Never 1 – 2 days/week **3 or more days/week but not every day** **Every day**

If a student's response to any of the five questions fell into the at risk category, this student was considered at risk for adverse asthma outcomes and was considered a good candidate for Easy Breathing for Schools. School nurses were encouraged to use their own discretion in identifying students for the program whose parents did not complete the Asthma Survey or who did identify as at-risk. In addition to these five questions, the Asthma Survey contained minimal demographic information and family contact information.

The ACT and cACT are validated instruments to assess asthma control.[40,41] The ACT is for children age 12 years or older and consists of five questions resulting in a score range from 0 to 25 with a score of 20 or greater indicating asthma is well controlled.[40] The cACT is for children age four through 11 years and consists of seven questions to be completed by the child and his/her parent. Scores range from 0 to 27 with a score of 20 or greater also indicating well controlled asthma.[41] The minimum important difference, or the smallest change in score for these instruments that represent a clinically significant difference, for the ACT is three points and for the cACT is two points.[42,42]

The IT checklist is an assessment tool developed by the Nursing Best Practice Research Unit (NBPRU), a partnership between the University of Ottawa School of Nursing and the Registered Nurses' Association of Ontario, to evaluate the implementation of clinical nursing best practice guidelines.[44] Proper inhaler technique is an important skill to successfully manage asthma.[30,44-46] The NBPRU adapted their inhaler device assessment tool from a generic tool developed by Dr. Lisa Cicutto and pilot tested in two hospitals in Ontario, Canada.[30,44,45] The IT checklist consists of five steps with specific instructions for both use of metered-dose inhaler (MDI) and metered – dose inhaler plus spacer with or without mask (Table 2).

Table 2. Inhaler Technique checklist

Inhaler Technique step	Proper technique
1. Remove cap	MDI: Removes cap from mouthpiece MDI plus spacer without/with mask: Removes cap(s), AND inserts canister into spacer correctly
2. Shake inhaler	MDI/MDI plus spacer: Shakes inhaler AND inhaler is upright
3. Breathe out	Breathes out fully before putting device to mouth MDI plus spacer with mask: Good fit of mask; nose and mouth covered
4. Breathing in	MDI: Position in mouth or two to three fingers widths away from mouth, breathe in slowly and depress inhaler to release 1 puff. Continues breathing in slowly for about 5 seconds. Position with chin up MDI plus spacer: Place mouthpiece of spacer in mouth, close lips around I and press down on inhaler to get 1 puff into spacer. Breathe in slowly and deeply for about 5 seconds MDI plus spacer with mask: Good seal over nose and mouth, press inhaler to get 1 puff into spacer, slow regular breathing in and out
5. Hold breath	Hold breath and count to 10 with lips kept closed MDI plus spacer with mask: No breath hold, regular breathing in and out 5 – 6 times Repeat steps 4 & 5 without any additional medication to be sure all medication has been inhaled Wait 60 seconds to take next puff and repeat process

Each step of the checklist is scored as one point if the student completed that step or zero points if not for a total score of five. A score of five is considered proper technique.

Medication review consisted of several options for the school nurse to review the asthma medications with the student and/or the parent. The ideal approach for reviewing medication is to have a copy of the student's Asthma Treatment Plan (ATP) and to assess the student and/or parents' knowledge of their asthma and medications as indicated on the ATP. When the ATP was not available, the Medication Review Flowchart was available to ascertain the severity of the students' asthma and their medication regimen. Students and/or parents should be able to identify their medications and whether they use a daily controller medication or rescue medication only. A colored Asthma Medication poster including pictures of the different categories of asthma medications was also provided to help students and/or parents identify their medication.[47]

Communicating issues with clinicians was an important component of Easy Breathing for Schools,[37] and the Referral Checklist was developed to assist with improving the well described barriers in communication between the primary care provider, the parents, and the school nurses caring for the student with asthma.[25-27] The Referral Checklist was formatted as a standardized letter to the primary care provider with copies organized into tear away pads. The letter included a checklist of common issues developed from the experiences in Building Bridges for Asthma Care, such as the child was sent home for an acute asthma attack, the family cannot properly verbalize the Asthma Treatment Plan, the child demonstrates poor inhaler technique despite education, or student has missed 10 days of school due to asthma, as well as space for the school nurse to fill in their own concerns or provide further details. School nurses were instructed to check off their concerns and fax this

letter to the primary care provider. To assist with this, an updated list of fax numbers for local providers was provided.[39]

Asthma education was an optional component that was tailored to the needs of the student and/or parents.[37] School nurses were instructed to use their own experiences and abilities to provide asthma education but several informational handouts on inhaler use and asthma triggers in both English and Spanish were provided.

Training for interested school nurses and SBHC practitioners was scheduled individually based on their availability and occurred from September 2015 to March 2016, resulting in different program time lengths. After completing the approximately 45-minute training that reviewed the purpose of the program, the different components, and the materials provided, school nurses and SBHC practitioners were asked to implement as many components of Easy Breathing for Schools as feasible. We periodically checked in to inquire about progress, elicit feedback, and collect de – identified data with school nurses receiving a range of one to six check – ins, with an average of four (SD = 1) follow – ups over the course of their program time.

The trained school nurses and SBHC practitioners were surveyed at the end of the school year to collect data on their progress in reviewing medications and providing asthma education components of Easy Breathing for Schools, as well for overall feedback regarding the program. To estimate the time to implement this intervention, nurses were asked how much additional time they spent per student in using the program (0 minutes, 5 – 15 minutes, 16 – 30 minutes, 31 – 60 minutes, or more than 1 hour). To quantify medication review and asthma education, two questions were asked regarding how many students or how often,

respectively, they did each component. Response choices included: “all of the students” or “all of the time;” “most of the students” or “most of the time;” “some of the students” or “some of the time;” or “none of the students” or “did not provide additional education.” The survey asked the school nurses or SBHC practitioners to indicate the program element they liked the most as well as the element they liked the least. To attempt to address the fidelity in which Easy Breathing was implemented, one question asked which program element or elements the questionnaire responders changed and to explain what they did differently. There were two questions assessing satisfaction. One asked if they would continue the program the following year with responses of no asked to explain why. The other asked the school nurse or SBHC staff to rate their satisfaction on a four – point Likert scale ranging from “not at all satisfied” to “extremely satisfied.” The final question was an open – ended response asking for any other feedback about the Easy Breathing for Schools program.

Data Collection

In this study we collected demographic characteristics of the 18 trained schools in the Hartford Public School District from EdSight,[48] a public portal for education data in the state of Connecticut, as well as the Hartford Public School District website.[49] Enrollment counts by grade and ethnicity for these 18 different schools for the 2015 – 2016 school year were available on the EdSight website. Specific information regarding these school’s types (e.g., neighborhood school, magnet school, etc.) and grade ranges were available on the Harford Public School District website. The Hartford Public School District contains schools with the unique classification of District Open Choice. This program offers the opportunity for students from Hartford to attend a non – magnet, public school in a suburban town as well as offer students from a suburban district to attend a public school in Hartford.[50] School types

included in the other category included private schools, vocational schools, and alternative schools.[49] The schools in Hartford Public School District contained a variety of grade permutations. Elementary schools ranged from the standardized first grade to fourth through seventh grade[51] as well as a subset of these grades (e.g., kindergarten to third grade, fourth to fifth grade, etc.). Similarly, middle school and high school grade ranges contained the commonly seen sixth to eighth grade and ninth to 12th grade, respectively[51] but also contained variations such as fourth to eighth grade, sixth to 12th grade, ninth to 10th grade, or 11th to 12th grade.[44,45] In this study, we broadly classified the school grade ranges by the highest grade included in that particular school. Therefore, elementary schools were schools that included grades pre – kindergarten to fifth grade but also grades such as pre – kindergarten to third grade or fourth to fifth grade. Middle schools were schools not classified as elementary schools that contained up to eighth grade students, so schools with fourth to eighth grade students or pre – kindergarten to eighth grade students as well as sixth to eighth grade students were considered middle schools in this study. High schools were other schools that contained up to 12th grade students, and therefore included the schools with sixth to 12th grade ranges or ninth to 10th grade grades.

Data regarding the characteristics of the trained school nurses and SBHC practitioners were collected from the end of the year survey. This questionnaire also contained four questions regarding the school nurse or SBHC staff's background and experience as baseline characteristics: how long they have been a nurse, how long they have been working at their current school, their credentials and/or degrees, and their confidence level managing asthma in a school setting. Their credentials were later dichotomized into Registered Nurse (RN) and midlevel providers. The RN credential included those school nurses who also obtained

the Bachelor's degree in nursing (BSN) and Master's degree in nursing (MSN). The midlevel providers included Advanced Practice Registered Nurse (APRN), Nurse Practitioners (NP), and Physician Assistants (PA – C) credentials. School nurses were also asked about their confidence in managing asthma rated by a four – point Likert scale with response options of not at all confident to extremely confident.

In this study we collected demographic information (sex, age, and race and/or ethnicity) on 114 student participants from the Asthma Survey and from the absenteeism data provided by the Hartford Public School District at the end of the 2015 - 2016 school year. This absenteeism data also contained demographic and attendance data for the other students in the participating schools, including the students with asthma not participating in our program. Exclusion criteria were applied to the raw data from Hartford Power School: 1) total enrollment at all attended schools during the school year was less than 25 days total, 2) attendance of zero days total or missing attendance record, 3) duplicate or overlapping school enrollment dates for one student during the school year of which the lower enrollment value was excluded, 4) enrollment at one school was greater than the district total of 182 days, 5) enrollment at multiple schools during the school year was greater than 182 days for all schools except for one school where 187 days was used instead, and 6) absences at one school were greater than 182 days. The percentage of school absences was calculated for each individual student. The total number of school days each student was in attendance and the total number of school days each student was enrolled were summed, and the difference resulted in the total number of days absent per student. The percentage of school absences per student was then derived from this total number of days absent over the total number of days enrolled.

Data on the use of the program components Asthma Survey, ACT/cACT, IT Checklist, and Referral Checklist were kept by the school nurses and periodically collected during check – ins throughout the school year. Data on the other program components of asthma education and medication review were collected in aggregate on the end of year survey.

Statistical Analysis.

The primary outcome for this study was school absenteeism. The percentage of days absent among study participants during the 2015 – 2016 school year was compared to absences for students in the participating schools with asthma but not enrolled in Easy Breathing for Schools. The mean absenteeism for these groups was analyzed using two – sample t tests. Secondary outcomes for this study were process measures to evaluate the implementation of Easy Breathing for Schools. The enrollment of schools, school nurses and SBHC practitioners, and students were studied, and the percentage of these groups compared to the target population of all the schools in the Hartford Public School District. The interested school nurses and SBHC practitioners, and the students with asthma from the participating schools, respectively, were also examined. The distribution of the characteristics of these groups to determine the representativeness of our sample was also analyzed using χ^2 test. The program elements utilized were evaluated using descriptive statistics and expressed as means and standard deviations. The relationship between elements were evaluated using χ^2 test and a comparison of mean score change over the school year was examined using paired t tests. The feasibility of this program in a real – world setting was measured by time and satisfaction. A p value < 0.05 was considered

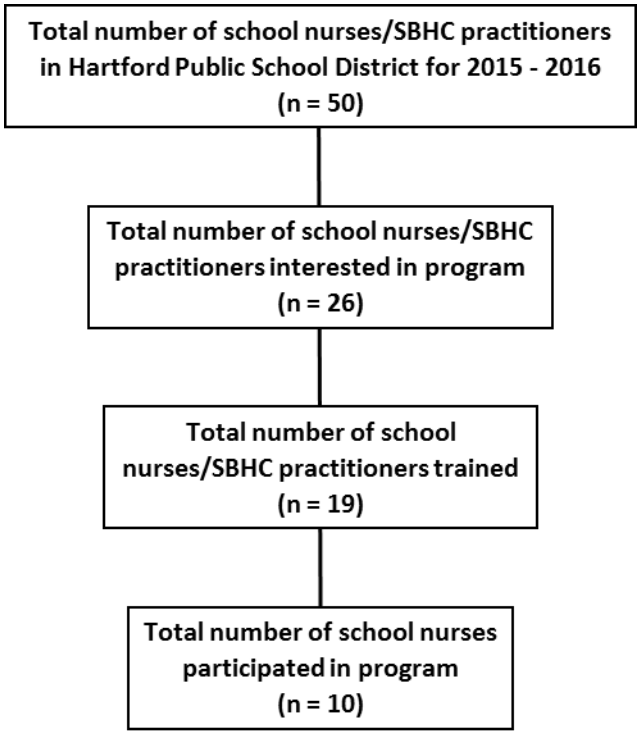
significant. Analysis was done using SPSS version 25 (IBM Corp., Chicago, IL) and using the program editor in SAS Enterprise Guide 9.4 (SAS Institute).

Results

Study population

Easy Breathing for Schools was introduced to 50 school nurses from the 70 schools in the Hartford Public School District at a mandatory professional development day for school nurses prior to the start of the 2015 – 2016 school year (Figure 1).

Figure 1. CONSORT flow diagram of participating school nurses and SBHC practitioners



Of these schools, 18 completed training for Easy Breathing for Schools and ten participated in the program by implementing at least one program element (Table 3).

Table 3. Characteristics of participating schools

	Participating Schools	
	n	%
School Type		
Neighborhood	7	70.0
Magnet	2	20.0
District open choice	0	0.0
Other	1	10.0
Grade Range		
Elementary school	1	10.0
Middle school	9	90.0
High school	0	0.0

The 19 school nurses and SBHC practitioners who completed training for Easy Breathing for Schools were asked to complete the end of year survey. However, one of these school nurses took an extended leave of absence through the end of the school year and was unable to be reached for feedback (Table 4).

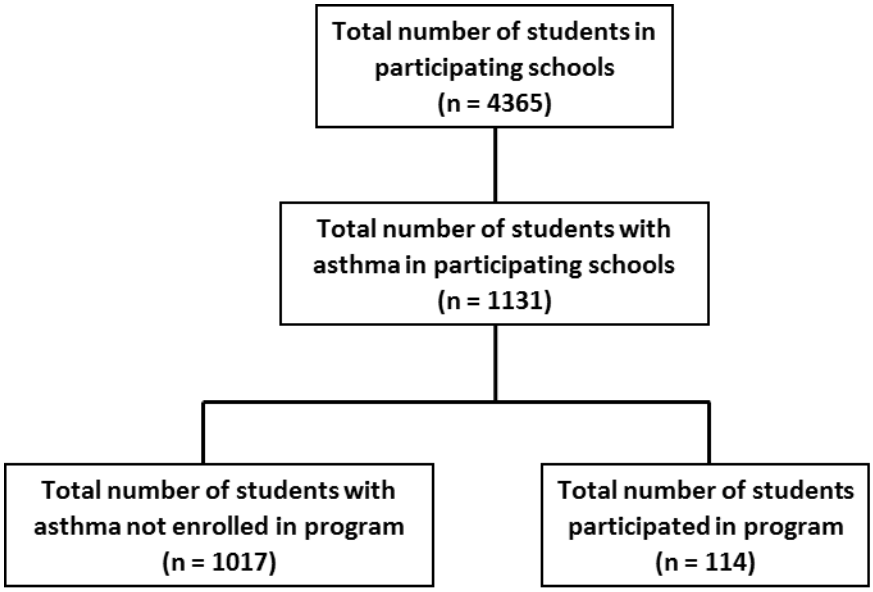
Table 4. Characteristics of participating school nurses

	Participating School Nurses	
	n	%
Years as school nurse/SBHC practitioner		
1 – 4 years	4	22.2
5 – 9 years	5	27.8
10 – 15 years	5	27.8
16 or more years	4	22.2
Years at current school		
1 – 4 years	9	50
5 – 9 years	6	33.3
10 – 15 years	2	11.1
16 or more years	1	5.6
Credentials		
RN	13	72.2
APRN	1	5.6
PA - C	1	5.6
Other	3	16.7
Confident in ability to manage asthma in school setting		
Not at all confident	0	0.0
Somewhat confident	0	0.0
Moderately confident	7	38.9
Extremely confident	11	61.1

There were 4,365 total students in nine of the ten participating schools, of whom 1,131 had an asthma diagnosis in the school records (Figure 2). This data does not include students from one participating school, which uses a unique attendance system that we were

unable to receive absenteeism data from, and therefore data for students from only nine participating schools are represented.

Figure 2. CONSORT flow diagram for participating students



During the 2015 – 2016 school year, 114 students from the participating schools were enrolled in Easy Breathing for Schools and completed at least one component of the program (Table 5).

Table 5. Characteristics of participating students

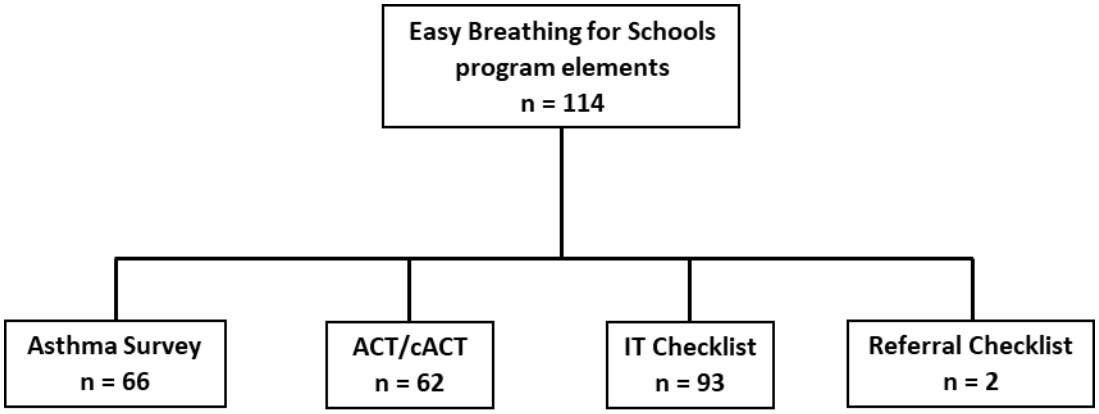
	Participating Students	
	n	%
Sex		
Male	56	49.1
Female	58	50.9
Age		
4 – 9 years	66	57.9
10 – 14 years	48	42.1
Race/ethnicity		
Black, non – Hispanic	30	26.3
White, non – Hispanic	6	5.3
Hispanic	76	66.7
Asian/Pacific Islander	1	0.9
American Indian/Alaskan Native	0	0.0
2 or more races	1	0.9

Easy Breathing for Schools Program Components

The implementation of the Easy Breathing for Schools program components was examined to better characterize their utilization for the student participants. The components of identifying students with asthma at risk for adverse asthma outcomes using the Asthma Survey, assessing asthma control using the ACT/cACT and IT checklist score, and communicating issues with clinicians using the Referral checklist were examined directly. The utilization of these program elements as measured by number of students completing each element are summarized in Figure 3. The remaining components of reviewing medications and providing asthma education were indirectly evaluated in the aggregate using

the end of year survey, and school nurses and SBHC practitioners reported with which percentage of their students they completed these program elements.

Figure 3. Number of participants completing each element of Easy Breathing for Schools



The asthma survey was completed for 57.9% (n = 66) of our student participants, and 52% were at risk for adverse asthma outcomes. For these students, the most common adverse outcome was Question 5 "in the last 4 weeks, how often has your child used a rescue or reliever medicine (a pump, inhaler, nebulizer or breathing machine) to relieve coughing, trouble breathing, or wheezing?" Additionally, using χ^2 test to characterize the relationship between the Asthma Survey and other program elements, there was a significant association between the Asthma Survey and the ACT/cACT scores indicating students at risk for adverse asthma outcomes were more likely to have lower ACT/cACT scores ($p < 0.001$). There was also a significant relationship between the Asthma Survey and mean school absenteeism ($p < 0.05$), and student participants at risk for adverse asthma outcomes were more likely to have above average school absence rates. There was no statistically significant relationship

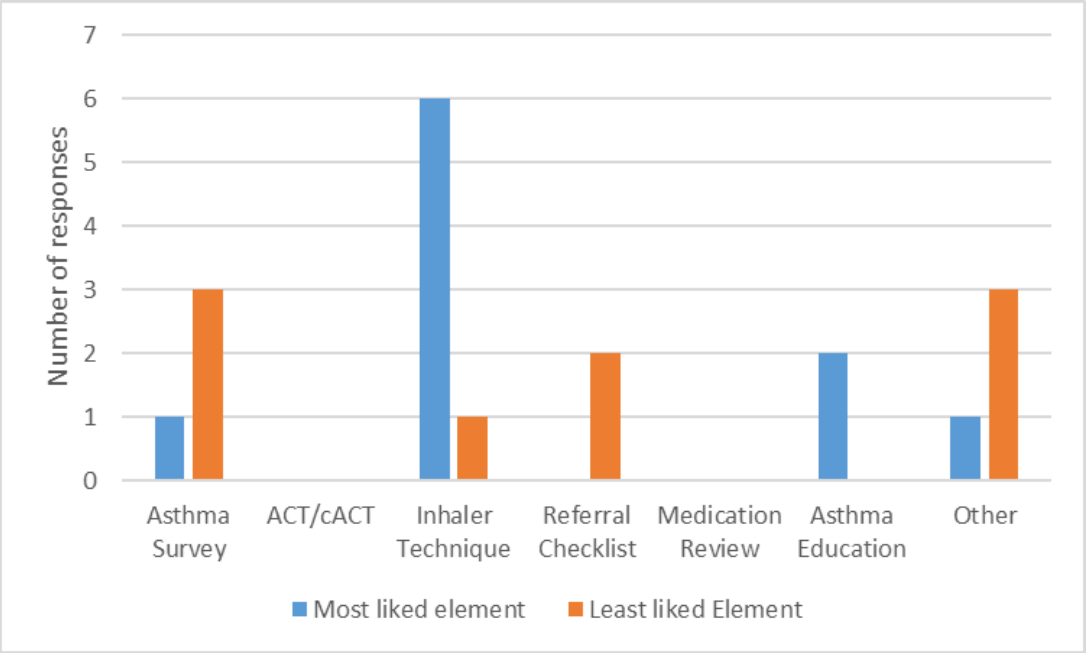
between the Asthma Survey and either the initial or final Inhaler Technique checklist scores ($p = 0.30$ and $p = 0.71$, respectively).

The ACT/cACT was completed for 54.4% (n = 62) of our student participants, and 56.5% (n = 35) of these students had well controlled asthma. Of those students who completed an initial ACT/cACTs, only five repeated the ACT/cACT. Due to the small sample size of ACT/cACTs administered, further analysis of this element was not done. There were a few additional ACT/cACTs collected but were incomplete as responses were missing from the portion that required parental input.

The IT checklist was completed for 81.6% (n = 93) of our student participants. Of the students who completed an initial IT, 49 students repeated the IT checklist. For those student participants with repeated Inhaler Technique checklist scores, an initial and final mean IT score was calculated, similar to a pre and post test score. The mean initial IT checklist score was 4.0 (SD = 1.27), and the mean final score was 4.5 (SD = 0.79). A paired t test used to compare these mean initial and final scores showed a statistically significant change in score ($p < 0.001$). Additionally, 57.0% of students scored five points out of the total five points and had proper technique on the initial IT administered. For the students with a repeat IT administered, 65.3% of the 49 student participants had proper technique, and 32.7% had an improved score. However, 65.3% of repeat students maintained the same IT checklist score and 2.0% of repeat students had a worse IT checklist score. For 15 students, it was completed five times, the maximum allotted independent administrations on the single copy of the checklist. When examining the different steps of proper inhaler technique, no single step was consistently difficult for the student participants. Additionally, 60% of school

nurses (n = 6) reported the Inhaler Technique checklist was their most liked program element (Figure 4).

Figure 4. School Nurse responses regarding the most liked and least liked program element



The Referral Checklist to communicate issues with clinicians was administered for 1.75% of student participants (n = 2). For both students the concern was the first issue "Child sent home [DATE] for an acute asthma attack and was instructed to call your office and schedule an appointment."

The program elements of reviewing medications and providing asthma education were indirectly evaluated on the end of year survey. Of the school nurses who responded to the question "How often did you review and/or educate regarding medication," 54.5% (n = 6) reported reviewing medications all of the time, 18.2% (n = 2) reported most of the time, and

27.3% (n = 3) reported some of the time. Of the school nurses who responded to the question "How often did you provide additional asthma education" 27.3% (n = 3) reported all of the time, 18.2% (n = 2) reported most of the time, and 45.5% (n = 5) reported some of the time.

Outcomes

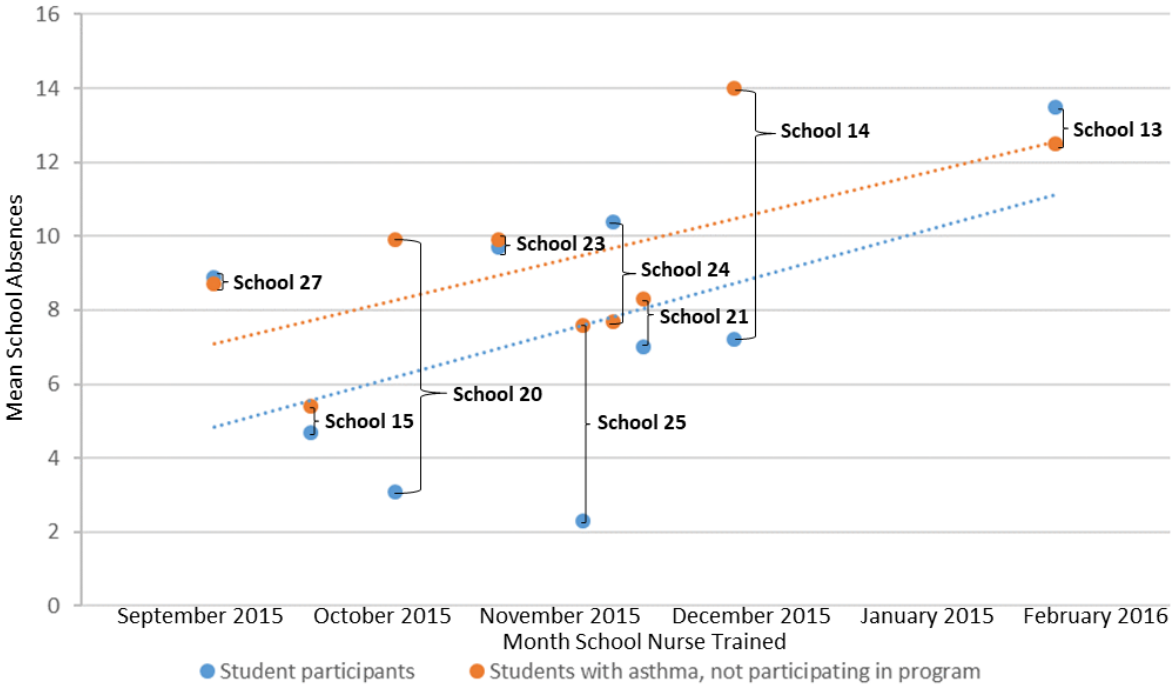
The primary outcome was the percentage of school absences during the 2015 – 2016 school year for student participants and students with asthma not participating in the program compared to their percentage of absences during the prior 2014 – 2015 school year (Table 6). The mean percentage of days absent for student participants decreased from an average of 8.82% (SD 7.20) to 7.46% (SD 6.81). However, the mean percent of days absent for students with asthma not in Easy Breathing for Schools also decreased. The mean difference in percent of days absent was compared using a 2 – sample t test and was not statistically significant ($p = 0.37$). Nonparametric analysis was also done to compare the difference in percentage of school absences for student participants and students with asthma not participating in the program to examine if potential outlying student absenteeism may have skewed our result. The mean difference of percent of days absent using a Mann Whitney U test was also not statistically significant ($p = 0.62$).

Table 6. Percent of school days absent for students, by participation status

Absences	2014 – 2015 School Year			2015 – 2016 School Year			2 sample t test	
	N	Mean	SD	N	Mean	SD	t	p
Students participating in program	89	8.82	7.20	114	7.46	6.81	0.89	0.37 (0.62)*
Students with asthma, not participating in program	1654	9.12	8.14	1643	8.40	8.75		
*Independent Samples Mann Whitney U test								

Length of time students participated in the program varied depending on when school nurses and SBHC practitioners completed training. Thus, we attempted to address this limitation by descriptively examining the mean percentage of days absent for student participants and for students with asthma not participating in Easy Breathing for Schools compared to the month the school nurse was trained (Figure 5).

Figure 5. Mean school absences for participating students and non-participating students by month school nurse was trained



The null hypothesis for this is that there would be no association of mean school absences with month of training (i.e. a flat line with slope = 0). The graph shows positive associations for students participating in the program and a slightly greater positive association for students with asthma not participating in the program. This is suggestive that for participating students, the month of training may be a critical factor in the success of the program. No formal statistical tests were applied to this data.

Secondary outcomes included process measures for the implementation of Easy Breathing for Schools. We examined the enrollment of schools, school nurses/SBHC practitioners, and students in the program, the utilization of program elements, and the feasibility of this program in a real – world setting.

Of the 70 schools in the Hartford Public School District, 14.3% (n = 10) participated in Easy Breathing for Schools. The characteristics of these schools were not statistically different compared to other schools in the district not participating in the program in terms of school type (Table 7). However, regarding the distribution of grade ranges, our participating schools did not contain any high school grade ranges or other grade ranges.

Table 7. Characteristics of schools in the Hartford Public School District, by participation status

	Schools participating in program		Schools not participating in program		
	n	%	n	%	p values
School Type					
Neighborhood	6	60	16	26.7	0.18
Magnet	2	20	16	26.7	
District open choice	1	10	7	11.7	
Other	1	10	21	35.0	
Grade Range					
Elementary school	1	10.0	4	6.7	<0.001
Middle school	9	90.0	13	21.7	
High school	0	0.0	17	28.3	
Other/unknown	0	0.0	26	43.3	
Fisher's exact test comparing schools participating in program vs. schools not participating in program					

Of the 50 school nurses and SBHC practitioners, 52% (n=26) were interested in the program and initially signed up to be trained. Of the 26 interested school nurses and SBHC practitioners, 73.1% (n = 18) completed training and 38.5% (n = 10) participated in Easy

Breathing for Schools. We were unable to collect data on the characteristics of all the school nurses and SBHC practitioners in the Hartford Public School District but were able to collect information regarding the characteristics of the school nurses trained in the program. The participating school nurses were not statistically different in their years of experience as a school nurse, their years of experience at their current school, their credentials, and their confidence in their ability to manage asthma in a school setting compared to the trained school nurses (Table 8).

Table 8. School nurse/SBHC practitioners' characteristics for trained staff, by participation status

	School nurses participating in program		School nurses/SBHC staff not participating in program		
	n	%	n	%	p values
Sex					
Male	0	0.0	0	0.0	N/A
Female	10	100	8	100	
Years as school nurse/SBHC practitioner					
1 – 9 years	6	60.0	3	37.5	0.64
10 or more years	4	40.0	5	62.5	
Years at current school					
1 – 9 years	9	90.0	6	75.0	0.56
10 or more years	1	10.0	2	25.0	
Credentials					
RN	10	100	5	62.5	0.069
Midlevel Provider	0	0.0	3	37.5	
Confident in ability to manage asthma in school setting					
Moderately confident	3	30.0	4	50.0	0.63
Extremely confident	7	70.0	4	50.0	
Fisher's Exact Test					

There were 1131 students with an indication of a diagnosis of asthma in PowerSchool from the nine participating schools with absenteeism data, and 10.1% (n = 114) of these students participated in the program. The distribution of sex, age, and race/ethnicity were not

statistically different for the student participants compared to the students with asthma not participating in the program (Table 9).

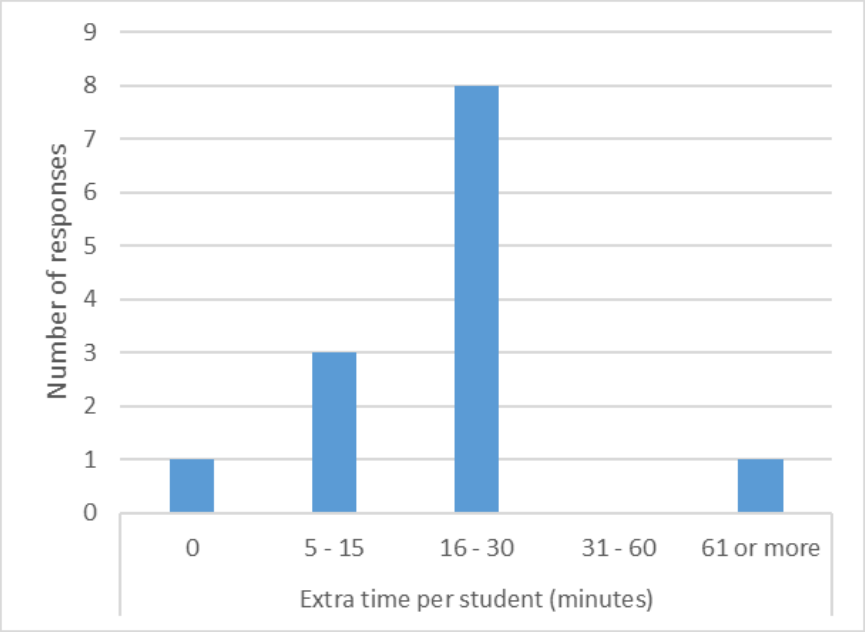
Table 9. Demographic characteristics of students in Hartford Public School District, by participation status

	All students in participating schools			Students participating in program		Students with asthma not participating in program		
	n	%		n	%	n	%	p value
Sex								
Male	2,300	52.7		56	49.1	567	44.2	0.18
Female	2,065	47.3		58	50.9	450	55.8	
Age groups								
Age 3 – 9 years	2433	55.7		66	57.9	507	49.9	0.10
Age 10 - 18 years	1932	44.3		48	42.1	510	50.1	
Race/ethnicity								
Black, non-Hispanic	1,376	31.5		30	26.3	308	30.3	0.65
Hispanic	2,320	53.2		76	66.7	634	62.3	
Other	669	15.3		8	7.0	75	7.4	
χ^2 comparing students participating in program vs. students with asthma not participating in program								

The feasibility of Easy Breathing for Schools in a real – world setting was evaluated in the context of time to implement and satisfaction with the program. With respect to the cost of time to implement Easy Breathing for Schools (Figure 5), the 61.5% (n = 8) of school nurses responding on the end of year survey reported needing 16 – 30 extra minutes per student to implement Easy Breathing for Schools. For the 10 participating school nurses, who on average each worked with 13 student participants, this resulted in a total time of

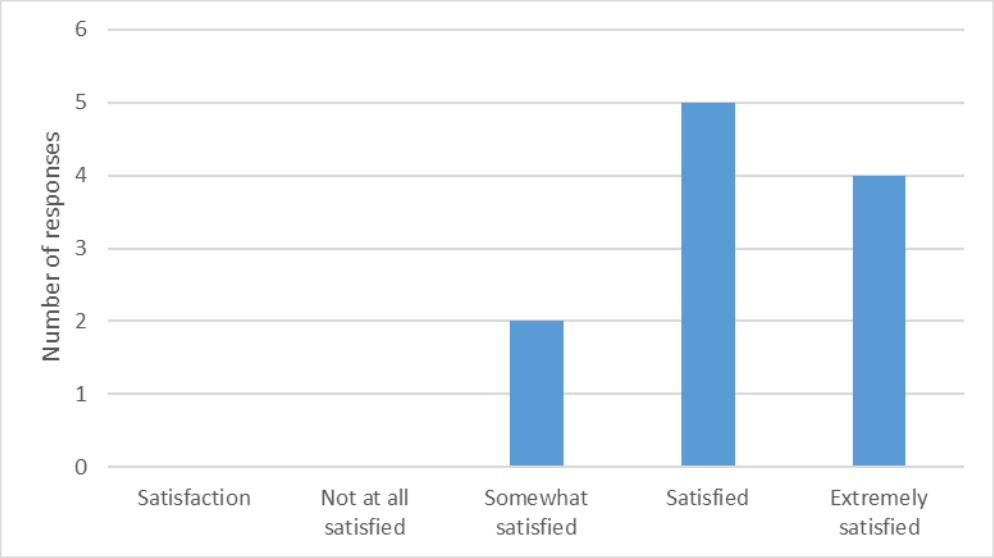
approximately 3.5 hours to 6.5 hours over the course of the school year. While some participating school nurses reported less time was required, one school nurse did report more than one hour per student was needed to implement the program.

Figure 5. Time per student to implement Easy Breathing for Schools



Regarding satisfaction, 81.8% (n = 9) of respondents reported being satisfied or extremely satisfied (Figure 6). When asked if they would continue the program next year all but one school nurse reported "yes". The school nurse who reported "no" wrote in the comments "I am retiring but the next nurse probably will."

Figure 6. Satisfaction with Easy Breathing for Schools



Discussion

This study evaluated the real – world application of the Easy Breathing for Schools asthma intervention program during the 2015 – 2016 school year in the Hartford Public School District. Easy Breathing for Schools is a streamlined version of Building Bridges for Asthma Care, a collaborative asthma intervention.[32] We hoped to translate the successes of Building Bridges into a feasible, day – to – day program for school nurses to help students with asthma. We compared the primary outcome of percent of school days absent for student participants and students with asthma not participating in the program. Secondary outcomes were process measures of the implementation of Easy Breathing for Schools that included program enrollment, program element utilization, and feasibility in a real – world setting.

Outcomes

In this study, the primary outcome of percentage of school absences between student participants and students with asthma not participating in the study was not statistically significant ($p = 0.37$). Absences for participating students improved from a mean of 8.82% during the prior school year to 7.46% during the 2015 – 2016 school year; however, the percentage of days absent for students with asthma not participating in the program also improved over this time. Nonparametric analysis was also done with the Mann Whitney U test to examine if outlying student absenteeism data may have skewed our results. The results of this more conservative test were similarly not statistically significant, which supported our 2 – sample t test results, and the difference between percent of days absent between students by participation status was not statistically significant.

There are several confounding variables that could affect school absences for both participating students and non-participating students, and these variables may have contributed to the improvement in school absences from the prior 2014 – 2015 school to the study 2015 – 2016 year. Our data may have been contaminated by the Building Bridges for Asthma Care program, which concluded its intervention at the end of the 2014 – 2015 school year. It is unknown how many students were in Building Bridges for Asthma Care and not in our program, but the effects of the prior asthma intervention may have improved the percent of days absent for students with asthma not in Easy Breathing for Schools.

The absenteeism results may have also been affected by the many factors that may affect a student's attendance: safety including feeling safe getting to school as well as feeling safe in school; interest in school with challenging but engaging lessons, resources to be academically successful, and meaningful relationship with peers and adults are another factor; and unmet basic needs such as transportation, housing, and clothing can impact a

students' ability to attend school.[52,53] The Connecticut State Department of Education and the Hartford Public School District worked to reduce absences with a new policy on chronic absenteeism enacted in July 2015 targeting several of these barriers.[53] Therefore, this policy and its effects may have contributed to the reduction in school absenteeism.

The seasonal variability of asthma is another potentially important factor affecting attendance for students with asthma. The incidence of asthma exacerbations varies with the seasons, and the fall and spring season are peak times of exacerbations due to increases in asthma triggers.[54-58] Allergens such as house dust mites, mold spores, and pollens are a common trigger for asthma exacerbations.[1,2,58] Respiratory illnesses such as viral upper respiratory infections are another common trigger for exacerbations in the winter, with the highest incidence in January.[1,2,54-58] During the summer and fall of 2014, there was a nationwide outbreak of Enterovirus D68 (EV-D68), a virus that causes mostly respiratory symptoms such as rhinorrhea, cough, and sneeze with severe symptoms including dyspnea and wheezing.[58-60] The CDC confirmed 1153 cases across 49 states and the District of Columbia from August 2014 to January 2015.[59] The majority of cases were among children, of whom many had a history of asthma.[59,60] Children with asthma are at increased risk for severe respiratory illness due to EV – D68, and this outbreak may have affected the students of the Hartford Public School District, both those participating in the program and those not participating in the program resulting in their absence from school. This outbreak of EV – D68 may have contributed to the higher absenteeism in the 2014 – 2015 school year.

Due to this seasonal variability, an important limitation of our study is the time frame in which Easy Breathing for Schools was implemented. As Cohen et al. noted in their study, clinic visits for asthma peaked during the end of September and this increased incidence of

asthma – related clinic visits continued throughout the fall and winter.[61] Silverman et al. similarly noted an increase in asthma – related emergency department visits in New York City that began in late August and peaked in early October for children aged five to 13 years.[62] This timing most likely represented a confluence of asthma triggers, from the environmental allergens to viral infections, resulting in an increase in asthma symptoms.[59,60] Therefore, the fall is an important time for students with asthma regarding their symptom management. However, the first nurse trained in Easy Breathing for Schools was not trained until the end of September 2015, and the majority of trained school nurses and SBHC practitioners were trained in November 2015 and February 2016, after this peak incidence of asthma exacerbations was seen in the fall. Therefore, our program missed this important window of time for students with asthma and we may have missed an opportunity to improve symptom management and asthma control.

Another important factor that may have affected our absenteeism results and limited the conclusions we can infer is the small sample size of our student participants, which represented approximately 10% of students with asthma in our participating schools and an even smaller percentage of students with asthma in the entire district. This study may have been under powered, which potentially could have limited our ability to identify changes in absenteeism given the many confounding variables noted above. Additional implementation cycles in the future may increase the enrollment of participants and our sample size to address this concern.

An important limitation affecting our results was the different program lengths for each participating school nurse and the students participating in the program. School nurses completed training between September and March of the 2015 – 2016 school year.

Therefore, school nurses who were trained later in the school year, especially those trained in February and March of 2016, would not have as much time to implement the program and help their students improve their asthma management and therefore improve their school absences compared to school nurses who were trained earlier in the school year. Additionally, our school absenteeism data for participating students from the Hartford Public School District was provided as a single value for the entire school year, and we were unable to analyze the absences for a portion of the school year to only include the absences after the start of the program. Therefore, for students working with school nurses who were trained in February or March, the absenteeism data we received reflects the majority of the school year when they were not participating in Easy Breathing for Schools. Therefore, for these student participants, the changes in percentage of days absent does not necessarily reflect the activities done in the Easy Breathing for Schools program. This is an important limitation of our analysis and may have skewed our data as well as altered our results. While we are unable to address this important limitation with this data, we attempted to descriptively address this issue by plotting the mean percentage of days absent for students participating in the program and for students with asthma not participating in the program by the month the school nurse was trained. There appeared to be a difference in the relationship of mean absences by the month the school nurse was trained for both participating and non-participating students. For students participating in the program, as the school nurse was trained later in the school year, those schools reported yearly mean absences that were higher. This relationship was also noted for students with asthma not participating in the program, but the association may be less pronounced. While this is a descriptive result and it does not completely address this limitation of program lengths, it potentially indicates a

promising trend. This is an important limitation and future implementation cycles will need to carefully address this issue and better control for this difference in program length and absenteeism data.

Secondary outcomes examined the implementation of Easy Breathing for Schools as measured by participant enrollment, program element utilization, and feasibility as measured by time to implement and satisfaction with the program. The enrollment for schools was low; of the total schools in the Hartford Public School District, 14.3% participated in Easy Breathing for Schools. These participating schools had a similar distribution of school type and our sample of participating schools appears to be comparable to schools not participating in program. However, the distribution of grade ranges was statistically different, and the participating schools did not contain high school grade ranges. Several of the school nurses at these high schools anecdotally mentioned it was difficult to regularly follow up with their students with asthma because they self – carry their rescue inhalers and therefore do not come into the office as frequently. There were also several unique barriers noted between schools that were interested in implementing the program when it was initially introduced and those that completed training. When training for the program was being scheduled, one interested school was closing mid – way through the school year and could not adopt Easy Breathing for Schools. Another school was utilizing temporary school nurses while their regular school nurse was recovering from surgery. Several schools were unable to be reached after multiple attempts, and we were unable to collect data regarding additional barriers to adoption.

The adoption of the program by trained school nurses and SBHC practitioners compared to those initially interested in the program was higher than expected. We

hypothesized at least 25% of interested school nurses would participate in Easy Breathing for Schools. However, we did not initially differentiate between trained school nurses and SBHC practitioners and participating school nurses, but as Easy Breathing for Schools was implemented, these two different groups emerged. Both groups of trained school nurses and SBHC practitioners and participating school nurses enrolled more participants than the 25% hypothesized. Of the 26 interested nursing staff, 73.1% completed training, and 38.5% participated in the program by implementing at least one component. A commonly noted barrier to adoption for the interested school nurses who were unable to complete training for Easy Breathing for Schools was the ability to fit in another program. While they were still interested in the program, they felt they were already too busy and unable to dedicate time to another program for the 2015 – 2016 school year. Several school nurses noted the beginning of the school year was one of the busiest times and there were many competing priorities. One school nurse mentioned feeling overwhelmed with the amount of work she already had. Another school nurse noted on the end of year survey that if she had more help she may have done more with the program. Competing demands and limited time were some of the most frequently reported barriers to adoption that programs assessing real – world applications need to address.[63] Perhaps completing training prior to the start of the school may help address this barrier and retain some of the interested school nurses. Additionally, as the Connecticut State Department of Education and the Hartford Public School District focus on addressing chronic absenteeism, this program and its similar primary outcome of school absences may become more of a priority as it aligns with newly enacted policy goals. This may provide the motivation necessary to help interested school nurses and SBHC practitioners adopt Easy Breathing for Schools in the future. The 38.5% of participating

school nurses were similar in their distribution of characteristics and representative of the larger population of trained school nurses and SBHC practitioners. However, while the characteristics of credentials was not statistically different between the participating and trained school nurses/SBHC practitioners, the comparison of this characteristic using χ^2 was nearly statistically significant ($p = 0.069$), and our sample of participating school nurses did not include the trained SBHC practitioners. With several schools in the Hartford Public School District containing school – based health centers to help care for the health needs of their students, we thought this would be an additional area to implement our intervention. However, while several SBHC practitioners were interested in the program after initially being introduced to it and three completed training, none were able to implement any component in their typical day. While the engagement and buy in is important to increasing implementation of a new intervention,[64,65] other important factors in adoption include the general and innovation specific capacity of the organization.[65] While SBHC practitioners may be interested in programs that can help their students with asthma improve their symptom management and control, this program may not fit in well with their schedule, role, or other organizational context. One SBHC practitioner noted that it was difficult to adopt the program because it seemed "designed for RN rather than mid – level providers" and therefore was difficult to fit into their clinical encounters with the students.

The enrollment for student participants was lower than our hypothesized 25%; 10.1% of students with asthma attending the participating schools participated in our program. However, these student participants were representative of the larger target population regarding sex, age, and ethnicity/race. There may be many factors affecting student enrollment in the program and some of these variables may overlap with barriers to adoption

noted for the school and for the school nurses, but one potential barrier for student participants may be related to parental involvement. The Asthma Survey to identify students at risk for adverse asthma outcomes who should be enrolled in Easy Breathing for Schools required the parents to complete it and return it. Many school nurses noted difficulty with having Asthma Surveys returned with one school nurse reporting on the end of year survey "wished more surveys came back." Developing strategies to help parents complete this additional paperwork may help ameliorate this barrier in the future.

The implementation of program elements was modest, and this reflects the number of program elements completed as well as the number of program elements repeated, if appropriate, for student participants. We hypothesized these program elements would be implemented with at least 75% of student participants. For the 114 student participants, approximately half completed the Asthma Survey. This element was intended to be the primary method for identifying students at risk for adverse asthma outcomes to be enrolled in the program, and we expected the majority of students enrolled in the program would have completed an Asthma Survey. However, school nurses were also asked to use their clinical judgment to enroll students they felt would benefit from the program. One factor affecting the utilization of the Asthma Survey may have been the need to rely on parental participation. As noted above, it was difficult to get parents to return Asthma Surveys. Another factor could be the competing priorities; in addition to the many other responsibilities and duties for a school nurse, there were competing program components with the different elements in Easy Breathing for Schools. The Asthma Survey was one of the least liked elements for approximately a third of responders, and therefore they may have chosen to use their time to implement a different program element.

For the 114 participating students, 54.4% completed the ACT/cACT. However, only five of these students repeated the ACT/cACT, which was low as this element was intended to be repeated to measure asthma control throughout the program. The ACT/cACT are tools that measure asthma control over the previous four weeks, and due to the seasonal variability of asthma, this can change throughout the year. Therefore, while approximately half of the student participants who completed the ACT/cACT demonstrated asthma that was well controlled at that time point, this may change as the school year progresses, and it is important to assess asthma control frequently. One potential contributing factor could have been that the cACT also includes several questions requiring responses from parents. Several cACTs that were returned were incomplete due to missing information on the parent portion of this instrument. Additionally, another important factor could be the need to provide better education regarding the ACT/cACT during training and its reflection of asthma control over the previous four weeks. Emphasizing the need to repeat these instruments throughout the school year may help in future implementation cycles.

The implementation of the IT checklist was higher than expected, and it was completed for 81.6% of student participants. The IT checklist was also repeated for approximately half of these students. The mean initial IT and mean final IT score for these students improved, which is encouraging, but the mean final IT score was still not a perfect score of five, indicating proper inhaler technique. Additionally, for those students with repeat IT scores 32.7% improved from their initial IT score to their final IT score, but the majority of students had the same score and 2.0% had a worse score. The IT checklist represents a change in behavior for students as they learn to use and consistently practice proper inhaler technique, and therefore more time may be needed to see students improve

their IT scores, obtain perfect IT scores and utilize proper technique. The IT Checklist also reflects a component of the students' inhaler technique at that particular time and if the student was not paying attention, in a hurry, or distracted for a variety of other reasons they may not have devoted their attention to completing all the steps and demonstrated their best technique, resulting in a same or worse score. Additional IT scores may help buffer the variability of scores that may be more pronounced with only a few IT scores over the school year. However, the overall improvement in mean scores of this school year was encouraging. The IT checklist was also one of the most liked program elements, which may have increased its utilization. We hypothesize the formatting of this program element into a checklist made it straightforward and more feasible to incorporate into a busy day. Additionally, students frequently visited the school nurse to take their asthma medication and use their inhaler, making it easier to incorporate this element into a common student interaction.

The implementation of the Referral Checklist was also lower than expected, and it was completed for only 1.75% of student participants. An important reason for this could be school nurses did not need to communicate with clinicians, and therefore, did not need to use this element. While we do not expect school nurses need to communicate with clinicians for all participants, we did anticipate more than 1.75% would be completed due to the results of other program elements, such as the Asthma Survey which showed 51.5% of student participants were at risk for adverse asthma outcomes and the ACT/cACT which demonstrated 43.5% of student participants had poorly controlled asthma at that time. However, the trained school nurses and SBHC practitioners identified themselves as moderately to extremely confident in their ability to manage asthma in a school setting, and

perhaps the participating school nurses were able to manage their students' asthma concerns and felt they did not need to communicate with clinicians. Another factor that may have contributed to the low utilization of the Referral Checklist was prior experience with difficulty obtaining responses from community providers. One responder noted on the end of year survey "get back nothing from physicians…." Therefore, better reinforcement of the development of this checklist and the buy in from community providers regarding this tool may have helped. Additionally, given the competing priorities of a busy school day as well as the other program elements, this may have been another element that would benefit from additional support to increase its utilization.

Easy Breathing for Schools was well received in the real – world setting as measured by time and satisfaction. We hypothesized most school nurses would report less than 30 minutes to implement the program and most would be highly satisfied with Easy Breathing for Schools overall. Most school nurses reported spending 16 to 30 extra minutes per student to implement the program, and for the average 13 students each participating school nurse enrolled in the program, this results in a total time cost of approximately 3.5 hours to 6.5 hours over the course of the school year. While this time commitment can be modest, in the context of multiple trips to the school nurse for acute asthma symptoms and the time required to administer medications, especially using nebulizer treatments, the time spent implementing Easy Breathing for Schools may be a valuable investment. Additionally, most of the trained school nurses who completed the end of year survey reported being satisfied or extremely satisfied with the program and all would continue the program the following school year, aside from one school nurse who was retiring. Other school nurses were positive in their feedback for the program, noting the "educational information is great,

especially for new school nurses" and another wrote "should have been implemented a long time ago." Indeed, there were no negative comments about Easy Breathing for Schools. A few mentioned ways to improve the program such as simplifying the paperwork further and providing a checklist to help the school nurses keep track of the program elements. Overall, Easy Breathing for Schools was well received.

Limitations

There were some limitations with this study. It was difficult to establish rigorous procedures and balance evaluating the real – world application of Easy Breathing for Schools. One of the goals of this study was to better understand what is feasible for a busy school nurse or SBHC practitioner. There were many program components to keep track of and as more students were screened for the program, the physical amount of paper to collect and organize was overwhelming. The initial plan was to move the data collection to PowerSchool, but this was not able to be implemented during the 2015 – 2016 school year. As one school nurse noted, a checklist to help them keep track of what was done would have been helpful. In the future, moving this data to PowerSchool will help reduce any errors in data collection with the files being imported from the system instead of collected by hand.

Additionally, there were gaps in our data regarding demographic information for the participating school nurses and students. Unfortunately, we were unable to access demographic data for the school nurses and SBHC practitioners working in the Hartford Public School District. Therefore, we were not able to characterize this study population well and the analysis of the representativeness of our participating school nurses was limited. Furthermore, we were not able to ascertain how many students were approached to be

enrolled in the program. School nurses sent home the Asthma Survey as an initial screen, but it was difficult to ascertain how many were not returned, and many school nurses noted the difficulty with receiving Asthma Surveys back. The ideal target population of Easy Breathing for Schools was students at risk for adverse asthma outcomes, but it is difficult to estimate the number of students in the participating schools who were at risk for adverse asthma outcomes without the benefit of the Asthma Survey to quantify. Instead, we modified this target population to students with asthma. Additionally, while the prevalence of asthma in the Hartford Public School District has been studied, the prevalence per school is unknown. Therefore, this population was derived from the number of students who are diagnosed with asthma or have an indication of asthma such as "inhaler" or "MDI" in their school records as our modified target population of students with asthma. Similarly, we did not have a method to keep track of the Medication Review and the Asthma Education components. Therefore, these components were analyzed in the aggregate and we estimated its utilization. Additionally, the utilization of these elements was self-reported by school nurses on the end of year survey, and these results may also be subject to response bias.

Interested school nurses scheduled training based on their availability, which resulted in some school nurses and SBHC practitioners initiating the program in the fall and others starting the program in the winter. While this highlights the busy schedules of these school nurses, the different program lengths made it difficult to compare implementation between schools. Additionally, this made it difficult for the school nurses to complete different components of the program or to repeat program elements multiple times. Most importantly, the delay between when staff were introduced to the program and when they completed training may have resulted in a loss of engagement, decreasing the program enrollment. This

delay may also have decreased program adoption as school nurses became busy and were unable to commit to another intervention program, and similarly may have decreased program implementation as school nurses managed competing demands and chose to utilize certain program elements. As Easy Breathing for Schools continues, we would like to complete the training for interested school nurses and SBHC staff together at one time, preferably during the professional development days prior to the start of the school year.

Lastly, as noted above, Easy Breathing for Schools is a streamlined version of Building Bridges, a rigorous research intervention shown to effectively decrease school absenteeism that was ongoing during the preceding 2014 – 2015 school year. In addition to potentially confounding our primary outcome of school absences, several school nurses who participated in Easy Breathing for Schools had previously participated in Building Bridges. This may have influenced their ability to incorporate this program into their work and therefore the overall implementation of this program. Similarly, students who participated in Easy Breathing for Schools may also have participated in the Building Bridges program which may have biased their understanding of components of the Easy Breathing for Schools program and influenced the component results as well as the overall implementation results.

Future directions

The next steps involve continuing this program into subsequent school years and another implementation cycle to better evaluate our primary outcomes of improved school absences as well as our secondary outcome of the implementation of Easy Breathing for Schools. It would be interesting to examine our primary outcome with larger sample sizes and analyze for statistically significant changes in school absences. Most importantly, it

would be important to analyze this data while controlling for the limitation of program length and obtaining school absenteeism data that accurately reflects the student participants' time enrolled in Easy Breathing for Schools. There were several other confounding variables affecting school absences that can be difficult to control for in an implementation study but more thoughtful planning and procedures may help mitigate some of these variables in future implementation cycles. As we continue this program, it will be important to collect and analyze data regarding the barriers to adoption and better understand how to increase program enrollment and program element utilization. Another possible future direction is to analyze Easy Breathing for Schools' impact chronic absenteeism among students who are chronically absent. It would also be interesting to see how the students, schools, and school nurses/SBHC staff who are continuing the program fare against the new students, schools, and school nurses/SBHC staff.

Conclusion

Overall, asthma is an important public health concern that affects a large proportion of students in Hartford, CT. There are many asthma intervention programs shown to improve asthma control as well as improve school absences. We were interested in evaluating the real – world application of a school nurse – driven program, and therefore examined the implementation of Easy Breathing for Schools in the Hartford Public School District for the 2015 – 2016 school year.

Easy Breathing for Schools demonstrated promising results but was not without its limitations. The primary outcome of percentage of school days absent for student

participants compared to students with asthma not participating in the program was not statistically significant. There were many confounding variables, including our program starting after a peak time for incidence in asthma exacerbations. Additionally, our absenteeism data reflects the entire school year and therefore, may not accurately represent the time many student participants were enrolled in the program which severely limits our ability to interpret these results.

The implementation of the program was overall modestly successful. While enrollment of schools and student participants was low, the percentage of trained school nurses and SBHC practitioners and participating school nurses was higher than hypothesized. There were many barriers to adoption by participants with the most common being the many competing priorities for the school nurses and SBHC practitioners. Providing additional support to help interested nursing staff, especially at the beginning of the school year, may also increase program adoption. The program elements were implemented with a modest proportion of student participants but repeating important elements was lower than expected. Additional education, support for participants, and organizational tools may help address this in the future. Lastly, Easy Breathing for Schools was well received, and the time needed to implement and satisfaction with this program was as hypothesized. In addition, the trained school nurses and SBHC practitioners also provided complimentary and encouraging feedback, indicating their belief in the importance of this program.

Therefore, while the results of this study were not statistically significant and there were many limitations to address, the school nurses and SBHC practitioners found the program to be valuable. We are encouraged that in future implementation cycles, Easy

Breathing for Schools can help address asthma management and improve school absences for students with asthma in Hartford, CT.

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