Improved asthma outcomes among at-risk children in a pharmacist-led, interdisciplinary school-based health clinic: a pilot study of the CAReS program

Jennifer Padden Elliott, PharmD, Tricia Morphew, MS, Deborah Gentile, MD, Paige Williams, MPH, Christine Barrett, PharmD, Nicole Sossong, MPH

PII: S1544-3191(21)00469-6
DOI: https://doi.org/10.1016/j.japh.2021.11.008
Reference: JAPH 1437

To appear in: Journal of the American Pharmacists Association

Received Date: 11 May 2020
Revised Date: 1 November 2021
Accepted Date: 4 November 2021


This is a PDF file of an article that has undergone enhancements after acceptance, such as the addition of a cover page and metadata, and formatting for readability, but it is not yet the definitive version of record. This version will undergo additional copyediting, typesetting and review before it is published in its final form, but we are providing this version to give early visibility of the article. Please note that, during the production process, errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

© 2021 Published by Elsevier Inc. on behalf of the American Pharmacists Association.
CRediT author statement:

Jennifer Padden Elliott: conceptualization, methodology, investigation, resources, data curation, writing-original draft, writing-review & editing, supervision, funding acquisition

Tricia Morpew: methodology, validation, formal analysis, writing-original draft Deborah Gentile: methodology, investigation, writing-review & editing Paige Williams: investigation, writing-review & editing Christine Barrett: investigation, data curation, writing-original draft, Nicole Sossong: methodology, investigation, data curation, writing-review & editing, project administration.

Corresponding Author Information:

Jennifer Padden Elliott, PharmD
Director, Center for Integrative Health
Ed and Karen Fritzky Family Chair in Integrative Medicine and Wellbeing
Associate Professor of Medicine and Pharmacy
Duquesne University
308 Bayer Learning Center
600 Forbes Avenue
Pittsburgh, PA 15282
(412) 396-4990
Email: elliott3@duq.edu
Title Page

Title:

Improved asthma outcomes among at-risk children in a pharmacist-led, interdisciplinary school-based health clinic: a pilot study of the CAReS program

Authors:

Jennifer Padden Elliott, PharmD, Director, Center for Integrative Health, Ed and Karen Fritzky Family Chair in Integrative Medicine and Wellbeing, Associate Professor of Medicine and Pharmacy, Duquesne University, Pittsburgh PA

Tricia Morphew, MS, Morphew Consulting, LLC, Bothell WA

Deborah Gentile, MD, Allergy and Asthma Wellness Centers, Butler, PA

Paige Williams, MPH, Community Health Initiatives Manager, Center for Integrative Health, Duquesne University, Pittsburgh, PA

Christine Barrett, PharmD, Hematology/Oncology Pharmacy Specialist, Allegheny Health Network, Pittsburgh, PA

Nicole Sossong, MPH, Senior Manager of Professional Engagement, American Diabetes Association, Pittsburgh, PA

Disclosure:

At the time the research was conducted, Deborah Gentile and Nicole Sossong were at Allegheny Health Network, Paige Williams was at the American Lung Association, and Christine Barrett was at Duquesne University.
CRediT author statement:

Jennifer Padden Elliott: conceptualization, methodology, investigation, resources, data curation, writing-original draft, writing-review & editing, supervision, funding acquisition

Tricia Morphew: methodology, validation, formal analysis, writing-original draft Deborah Gentile: methodology, investigation, writing-review & editing Paige Williams: investigation, writing-review & editing

Deborah Gentile: methodology, investigation, writing-review & editing Paige Williams: investigation, writing-review & editing

Christine Barrett: investigation, data curation, writing-original draft, Nicole Sossong: methodology, investigation, data curation, writing-review & editing, project administration.

Corresponding Author Information:

Jennifer Padden Elliott, PharmD
Director, Center for Integrative Health
Ed and Karen Fritzky Family Chair in Integrative Medicine and Wellbeing
Associate Professor of Medicine and Pharmacy
Duquesne University
308 Bayer Learning Center
600 Forbes Avenue
Pittsburgh, PA 15282
(412) 396-4990
Email: elliott3@duq.edu

Conflicts of Interest: None

Funding Source: Support for this worked was provided by The Heinz Endowments and the Jefferson Regional Foundation.

Acknowledgements: The authors would like to thank the school nurses and administrators at Clairton City School District and Woodland Hills School District for their partnership in this project.

Abstract word count: 318
Table 1. Baseline demographic and clinical characteristics.

<table>
<thead>
<tr>
<th>Valid% or mean (SD)</th>
<th>N=50</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demographics:</strong></td>
<td></td>
</tr>
<tr>
<td>Age (range: 6-11 years)</td>
<td>8.9 years (1.7)</td>
</tr>
<tr>
<td>Male</td>
<td>52%</td>
</tr>
<tr>
<td>Race:</td>
<td></td>
</tr>
<tr>
<td>African-American</td>
<td>56%</td>
</tr>
<tr>
<td>Caucasian</td>
<td>34%</td>
</tr>
<tr>
<td>Other</td>
<td>6%</td>
</tr>
<tr>
<td>BMI:</td>
<td></td>
</tr>
<tr>
<td>Healthy (5th percentile to &lt; 85th percentile)</td>
<td>46.9%</td>
</tr>
<tr>
<td>Overweight (85th to &lt;95th percentile)</td>
<td>14.3%</td>
</tr>
<tr>
<td>Obese (95th percentile or greater)</td>
<td>38.8%</td>
</tr>
<tr>
<td><strong>ETS exposure:</strong></td>
<td></td>
</tr>
<tr>
<td>Current ETS exposure</td>
<td>42%</td>
</tr>
<tr>
<td>Lifetime ETS exposure</td>
<td>56%</td>
</tr>
<tr>
<td>Mother smoked while pregnant</td>
<td>20%</td>
</tr>
<tr>
<td><strong>Co-morbidities:</strong></td>
<td></td>
</tr>
<tr>
<td>Allergic Rhinitis</td>
<td>56%</td>
</tr>
<tr>
<td>Atopic Dermatitis</td>
<td>46%</td>
</tr>
<tr>
<td>Food Allergies</td>
<td>10%</td>
</tr>
<tr>
<td><strong>Clinical status at baseline:</strong></td>
<td></td>
</tr>
<tr>
<td>Underlying disease severity:</td>
<td></td>
</tr>
<tr>
<td>Intermittent</td>
<td>42.9%</td>
</tr>
<tr>
<td>Mild persistent</td>
<td>30.6%</td>
</tr>
<tr>
<td>Moderate persistent</td>
<td>20.4%</td>
</tr>
<tr>
<td>Severe persistent</td>
<td>6.1%</td>
</tr>
<tr>
<td>On controller therapy prior to entry</td>
<td>12% (21.4% of persistent patients)</td>
</tr>
<tr>
<td>Rx controller therapy at baseline visit</td>
<td>44% (78.5% of persistent patients)</td>
</tr>
<tr>
<td>Used reliever in last 12 months</td>
<td>92%</td>
</tr>
<tr>
<td>OCS use in last 12 months (&gt;=2/year)</td>
<td>26.5%</td>
</tr>
<tr>
<td>FEV1 predicted &lt;=80%, [mean (SD)]</td>
<td>18.8%, [90.7 (16.4)]</td>
</tr>
<tr>
<td>FEV1/FVC% &lt;=80%, [mean (SD)]</td>
<td>0.0%, [100 (7.7)]</td>
</tr>
</tbody>
</table>


P-value <.01 comparing percentage of 28 patients with persistent baseline severity who were on controllers 78.5% (Rx at baseline) to 21.4% (prior to baseline) based on McNemer’s Test.
Table 2. Improvement in outcomes from baseline thru 3 months of intervention, N=50.

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>1 Month of Intervention</th>
<th>2 Months of Intervention</th>
<th>3 Months of Intervention</th>
<th>P-value a</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dichotomous Outcomes, %</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asthma Knowledge (7 items)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child - 100% on knowledge test</td>
<td>6.1%</td>
<td>31.3% **</td>
<td>43.2% **</td>
<td>60% **</td>
<td>P&lt;0.001</td>
</tr>
<tr>
<td>Caregiver - 100% on knowledge test</td>
<td>37.8%</td>
<td>66.7% **</td>
<td>62.5% *</td>
<td>65.7% *</td>
<td>P=0.010</td>
</tr>
<tr>
<td>Asthma Control Test &gt;=20 (Controlled)</td>
<td>52.1%</td>
<td>76.9% **</td>
<td>77.1% *</td>
<td>89.7% **</td>
<td>P=0.003</td>
</tr>
<tr>
<td><strong>Continuous Outcomes, Mean Score (SD):</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asthma Control Test, mean score (SD)</td>
<td>20 (3.6)</td>
<td>21.6 (3.5) **</td>
<td>21.4 (3.4) *</td>
<td>22.9 (3.4) **</td>
<td>P=0.001</td>
</tr>
<tr>
<td>PAQLQ, mean score (SD)</td>
<td>5 (1.2)</td>
<td>----</td>
<td>----</td>
<td>5.7 (1.3) **</td>
<td>P&lt;0.001</td>
</tr>
</tbody>
</table>

a GEE analyses were used to determine p-values. Models accounted for repeat measures within subjects, specified AR(1) correlation structure, and applied binomial logistic for dichotomous and linear regression for continuous outcomes. P-value indicates significance of improvement across time. Percentages based on those who had outcome data at respective time point with means (SD) estimated from GEE model. * p<.05 comparison to baseline ** p<.01 comparison to baseline
Figure 1. Reduction in percentage of patients who required an ED visit or OCS burst pre- to post- intervention was significant, p=0.029, (McNemar test with exact one-tailed significance reported).
Title: Improved asthma outcomes among at-risk children in a pharmacist-led, interdisciplinary school-based health clinic: a pilot study of the CAReS program

Authors:

Jennifer Padden Elliott, PharmD, Director, Center for Integrative Health, Ed and Karen Fritzky Family Chair in Integrative Medicine and Wellbeing, Associate Professor of Medicine and Pharmacy, Duquesne University, Pittsburgh PA

Tricia Morphew, MS, Morphew Consulting, LLC, Bothell WA

Deborah Gentile, MD, Allergy and Asthma Wellness Centers, Butler, PA

Paige Williams, MPH, Community Health Initiatives Manager, Center for Integrative Health, Duquesne University, Pittsburgh, PA

Christine Barrett, PharmD, Hematology/Oncology Pharmacy Specialist, Allegheny Health Network, Pittsburgh, PA

Nicole Sossong, MPH, Senior Manager of Professional Engagement, American Diabetes Association, Pittsburgh, PA

Disclosure:

At the time the research was conducted, Deborah Gentile and Nicole Sossong were at Allegheny Health Network, Paige Williams was at the American Lung Association, and Christine Barrett was at Duquesne University.
CRediT author statement:

Jennifer Padden Elliott: conceptualization, methodology, investigation, resources, data curation, writing-original draft, writing-review & editing, supervision, funding acquisition

Tricia Morphew: methodology, validation, formal analysis, writing-original draft Deborah Gentile: methodology, investigation, writing-review & editing Paige Williams: investigation, writing-review & editing Christine Barrett: investigation, data curation, writing-original draft, Nicole Sossong: methodology, investigation, data curation, writing-review & editing, project administration.

Corresponding Author Information:

Jennifer Padden Elliott, PharmD
Director, Center for Integrative Health
Ed and Karen Fritzky Family Chair in Integrative Medicine and Wellbeing
Associate Professor of Medicine and Pharmacy
Duquesne University
308 Bayer Learning Center
600 Forbes Avenue
Pittsburgh, PA 15282
(412) 396-4990
Email: elliott3@duq.edu

Conflicts of Interest: None

Funding Source: Support for this worked was provided by The Heinz Endowments and the Jefferson Regional Foundation.

Acknowledgements: The authors would like to thank the school nurses and administrators at Clairton City School District and Woodland Hills School District for their partnership in this project.

Abstract word count: 318
Manuscript word count: 2880
Tables: 2
Figures: 1
Supplemental online files: 1
ABSTRACT

Background
Disparities in access to care and outcomes have been identified among children with asthma living in underserved communities. The CAReS program was established to reduce disparities by providing school-based, comprehensive asthma care by a pharmacist-led, interdisciplinary team to high-risk pediatric populations in the Greater Pittsburgh area.

Objective
To investigate program impact on follow-up appointment attendance, the delivery of guideline-based care, asthma control, asthma morbidity (ED visits, OCS requirement), and asthma-related knowledge and quality of life.

Methods
The study enrolled 50 children with asthma from six elementary schools from September 2014 to December 2017. Children completed five visits over a three-month period. McNemar’s test assessed improvement in guideline-based controller therapy usage and reduced morbidity (ED visits or OCS requirement). GEE analyses determined significance of monthly improvements in asthma control, asthma knowledge, and quality of life.

Results
A 100% show rate was achieved in nearly all participants (92.0%). The majority of patients were African-American (56%), reported lifetime exposure to ETS (56%), and had elevated BMI (53.1%). In children with persistent disease, only 21.4% were prescribed controller therapy at baseline which improved to 78.5% upon enrollment (p<0.05). Asthma control significantly improved (p<0.05), and reduction in percentage of patients who required an ED visit or OCS burst pre- to post- intervention was also significant (31.3% vs. 14.6%, p<0.05). The goal of
100% treatment plan knowledge was achieved in 67% of caregivers within one month and steadily increased from 6% to 60% in children over three months (p<0.05). Asthma-related quality of life also significantly improved pre- to post- intervention (p<0.05).

**Conclusions**

Disparities in asthma outcomes due to inadequate access to healthcare can be addressed. Improved asthma control, asthma medication knowledge, quality of life, and reduced morbidity in high-risk pediatric patients is achievable as demonstrated by our study. Our findings support the feasibility and value of a pharmacist-led, interdisciplinary school-based health care delivery model in providing comprehensive asthma care to at-risk pediatric populations.

**Keywords:** asthma; ambulatory; collaborative care; evidence-based medicine; pediatrics; pharmacy practice; quality of life; scope of practice

**Abbreviations:** CARES= Caring for Asthma in our Region’s Schoolchildren; ETS= environmental tobacco smoke; ACT=Asthma Control Test; PAQLQ= Pediatric Asthma Quality of Life Questionnaire; GEE = Generalized Estimating Equations; OCS=oral corticosteroid.

**Key Points:**

**Background:**

- Asthma disparities among non-Hispanic black children and those from lower income families have been attributed, in part, to a lack of access to preventative care, underdiagnosis of asthma, and underutilization of controller medications.
- Mobile, school-based asthma clinics that provide care to underserved children have resulted in improved symptom-free days and achieved direct medical cost savings by decreasing hospitalizations and emergency department visits.
- There is a paucity of literature on the pharmacist’s role in addressing pediatric asthma disparities as well as the role of pharmacists in school-based chronic disease management.
Findings:

- This study showed that a pharmacist-led, school-based asthma clinic resulted in compliance with chronic disease management appointments, significant improvements in asthma treatment plan knowledge, asthma-related quality of life, and asthma control, as well as decreased morbidity post-intervention.

- Our findings support the feasibility and value of a pharmacist-led, interdisciplinary school-based health care delivery model in providing comprehensive asthma care to at-risk pediatric populations.

- Future studies are needed to explore the cost-effectiveness of pharmacist management of asthma and other chronic diseases in the school setting.
Improved asthma outcomes among at-risk children in a pharmacist-led, interdisciplinary school-based health clinic: a pilot study of the CAReS program

Background

Asthma is one of the most common chronic diseases, affecting nearly six million American children annually. Asthma is a complex condition involving chronic inflammation, and recurrent episodes of airway obstruction and bronchial hyperresponsiveness. Research suggests that the cause of asthma is a combination of genetic and environmental factors, including exposure to airborne allergens, environmental tobacco smoke (ETS), and air pollution. Increased exposure to environmental factors among inner-city pediatric populations may increase the prevalence and severity of asthma-like symptoms. Disparities in asthma control, as well as asthma-related morbidity and mortality have been identified among children of non-Hispanic black descent and from lower income families. Previous studies suggest that increased incidence of asthma-related emergency department visits, hospitalization, and mortality is in part due to a lack of access to ambulatory care, underdiagnosis of asthma, and underutilization of anti-inflammatory, controller medications.

Mobile, school-based clinics have been proposed as a solution to the lack of access to quality medical care among at-risk pediatric populations. Established in Los Angeles, California in 1995, the Breathmobile was the first comprehensive mobile pediatric asthma management program in the nation. Studies demonstrated that this mobile, school-based asthma clinic providing care to underserved children improved symptom-free days and achieved direct medical cost savings by decreasing hospitalizations and emergency department (ED) visits. Additionally, asthma education and management facilitated by a multidisciplinary healthcare
team, including pharmacists, can increase medication compliance and self-management. Improving compliance to asthma medications has also been shown to improve asthma control, and decrease the prevalence of asthma-related morbidity and mortality. The Caring for Asthma in our Region’s Schoolchildren (CAReS) program was modeled after the Breathmobile to address barriers contributing to disparities in asthma care among children in Pittsburgh, Pennsylvania. The mission of the CAReS program was to provide school-based, comprehensive asthma care facilitated by a multidisciplinary healthcare team to high-risk pediatric populations in the Greater Pittsburgh area. A key differentiator from previously published models is that the CAReS program was a pharmacist-led clinic and care transitioned from a mobile unit to shared space within each school during the study period.

Objective(s)

The goal of this study was to evaluate if a pharmacist-led, multidisciplinary school-based health care delivery model would impact follow-up appointment attendance, the delivery of guideline-based care, asthma control, asthma morbidity (ED visits, OCS requirement), and asthma-related knowledge and quality of life.

Methods

Prior to implementation, the Institutional Review Board at Duquesne University approved this longitudinal cohort study. The study enrolled 50 children, ages 6-11 years, from six elementary schools located in the Greater Pittsburgh area from September 2014 to December 2017. All children with known asthma were referred by the school nurse and asthma diagnosis was confirmed by the study physician at the baseline visit. For this pilot project, care was initially
delivered at the school site using a mobile clinic modelled after the Breathmobile Program\textsuperscript{10-14}, but then transitioned to shared space within each school. The care delivery team was comprised of a pharmacist, student-pharmacists, a physician who was a board-certified allergist, and school nurses at each site who provided continuity of care across visits for the patients and their families. Children and their caregivers were informed of the nature of the study, as well as the potential risks and benefits; informed consent and assent were obtained from each child and caregiver who voluntarily participated in the study. Caregivers were encouraged but not required to attend appointments with their child.

Children completed five study visits over a three-month period, during the academic year, and were assessed at baseline, two weeks, four weeks, eight weeks, and 12 weeks. The pharmacist worked with the school nurse to schedule clinic dates within study window. Parent-reported patient characteristics were collected at the initial visit by the pharmacist, and included gender, age, ethnicity, and a comprehensive asthma and allergy history. Confirmation of an asthma diagnosis, and a baseline assessment of asthma severity was documented at the first visit by a licensed medical doctor; asthma control was assessed at each visit by the pharmacist and/or licensed medical doctor via the Asthma Control Test (ACT) and spirometry. An asthma treatment plan knowledge assessment, given to both the patient and caregiver, was administered at each visit. The seven-item pharmacotherapy knowledge survey (see online supplement 1) had good internal consistency at baseline as measured by Cronbach’s alpha of 0.87 in assessment of patient identification of their asthma medications by name, ability to differentiate reliever and controller medications by mode of action (reason for use), understanding of how often to take each type of medication, and demonstration of proper use of reliever and controller medications prescribed as part of their treatment plan. Patients not on controller medication were only asked four questions
specific to their reliever medication. Placebo inhalers with spacers were used to evaluate technique and the same pharmacist verbally administered the pharmacotherapy knowledge survey at each appointment. The 23-item Pediatric Asthma Quality of Life Questionnaire (PAQLQ) was administered at the first and last visit by the pharmacist. The PAQLQ was developed to measure the functional problems (physical, emotional and social) that are most troublesome to children with asthma. Children respond to each question on a seven-point scale and the overall PAQLQ score is a mean of all 23 responses. Changes to drug therapy were recommended by a pharmacist and initiated by the study physician, and were based on The National Heart Lung and Blood Institute’s Guidelines for the Diagnosis and Management of Asthma (EPR-3) Stepwise Approach to Managing Asthma. Visit summaries including results of lung function tests and medication changes were faxed to each child’s primary care provider. The pharmacist provided asthma self-management education (ASME) at every visit, emphasizing appropriate inhaler technique and reinforcing the importance of medication compliance in achieving and maintaining asthma control. The pharmacist provided ongoing support to families and school nurses between visits; resolving insurance problems, working with pharmacies to get medications delivered to the home, making sure children had an asthma action plan and reliever medication at school, and providing continued education and counseling to improve asthma knowledge and medication compliance. Parent report of their child’s asthma medication prescriptions and compliance were further verified by examination of inhaler dose-counter or pill count if available and verification of pharmacy records.

Statistical Analysis

Demographic and clinical characteristics of patients at baseline were described by percentage with defined trait and by mean (SD) for continuous factors. The binomial test procedure assessed whether the show rate goal of at least four of five visits was achieved in
>=80% of participants. In patients with persistent disease, the increased percentage prescribed controller therapy after enrollment was assessed for significance using McNemar’s test. This test procedure also assessed significance of reduction in percentage of patients who required an ED visit or OCS steroid burst (pre- to post- intervention) with one sided significance reported. The pre- three month period was estimated by dividing the total number ED visits in prior year by 4 then rounding to determine if >=1 (yes). This was replicated for OCS use and the maximum of both variables was used to determine if participants required an ED visit or OCS burst in the pre-intervention three-month period (Y/N). Percentage of children (and caregivers) with complete asthma treatment plan knowledge and whose asthma was well controlled (ACT score >=20) were described at baseline and across the first three months of intervention. Average scores on the ACT and PAQLQ were also described at baseline and across the first three months of intervention. Generalized estimating equations (GEE) analyses were performed to assess significance of monthly improvement. Models accounted for repeat measures within subjects (baseline, month one, month two, and month three) with specification of first-order autoregressive AR(1) correlation structure, and applied binomial logistic for dichotomous and linear regression for continuous outcomes. All analyses were conducted using SPSS software, version 18.0 (IBM Company).

Results

Characteristics of 50 children who enrolled in the CARes program are described in Table 1. Average age of participants was 8.9 years (SD=1.7) and the majority were African-American (56%) or Caucasian (34%). More than half were male (52%), reported lifetime exposure to ETS (56%), and had elevated body mass index (BMI) as indicated by percentage overweight (14.3%)
or obese (38.8%). The expectation of 80% show rate across the five visits was met by 92% of participants (p=0.01). Asthma status at baseline showed 57.1% had persistent disease. Yet, only 21.4% of those with persistent underlying disease severity were prescribed and/or taking controller therapy prior to their baseline visit. This improved to 78.5% upon enrollment in the program (p<0.001).

Parent response to ACT survey items suggested approximately 52.1% of patients had controlled asthma (ACT>=20) at baseline compared to 76.9% after one month, 77.1% after two months, and 89.7% after three months of participation (p=0.003). Average ACT scores improved from 20 (SD=3.6) to 22.9 (SD=3.4) during the three-month period (p=0.001).

Approximately 31.3% of the children had been to the ED or required an OCS burst due to their asthma in the three months prior to program participation, Figure 1. In the post-intervention period, the percentage of children with asthma who experienced a morbidity event was reduced to 14.6% (p=0.029).

The percentage of children with asthma who had complete asthma knowledge on the seven-item survey was 6.1% at baseline, but improved significantly with each subsequent month of program participation to reach 60.6% by the third month (p<0.001), Table 2. In caregivers, the percentage with complete knowledge at baseline was 37.8%, although higher than in children, and improved by the first month to 66.7% without further increase (p=0.01). Pediatric asthma quality of life survey scores also improved significantly from baseline to last visit with an increase of 0.7 points from 5 to 5.7 (95% CI 0.5, 1.0, p<0.001).

Discussion
In this study, we demonstrated a pharmacist-led, interdisciplinary school-based health care delivery model in an at-risk pediatric population was able to achieve visit compliance greater than 80% in nearly all participants (92%). Further, impact of the CAReS program was significant with respect to achieving program goals (p<0.05). The goal of 100% asthma treatment plan knowledge was achieved within one month in 67% of caregivers and steadily increased from 6% to 60% in children over the three-month intervention period. Improvement in average quality of life by 0.7 points was clinically meaningful, defined by Young et al. as a magnitude of change that exceeds 0.5 points on the seven-point PAQLQ scale. Percentage of patients with well controlled asthma (ACT>=20) increased from 52.1% at baseline to 89.7% by the third month of participation. Improved health status was further evidenced by reduction in percentage of patients requiring an ED visit or OCS burst due to their asthma from 31.3% to 14.6%, p<0.05. Improvement in medication compliance was noted by the pharmacist, however, inability to consistently monitor this outcome as intended in our population precluded more formalized evaluation in the pilot study.

To achieve improvement in clinical outcomes through a school-based health care delivery model requires care coordination and participant engagement. Coordination with the school nurse and pharmacy, parent reminder phone calls for upcoming appointments, and continuity of care by the same caring staff are effective tools to achieve good retention. The high retention rate in our patient population was expected based on findings from other asthma programs that utilized similar coordination and care delivery strategies. Bollinger et al reported those lost to follow-up in their study of inner-city, high risk children were more likely to have less severe asthma which would have lowered retention expectations in our study where 42.9% had intermittent disease. However, Goldman’s study of recruitment and retention in a community-based asthma intervention in 311 children found those with more severe asthma were more likely
to be the “hardest-to-reach”, where the families required many contact attempts to complete at least one follow-up.\textsuperscript{25} Difficulty often occurs at the stage of recruitment requiring rescheduling of appointments for the enrollment visit as noted by Goldman et al, but once enrolled high retention is feasible as achieved in their study (96\%) and our pilot study (92\%). Additional influencing factors for consideration when going to scale include caseloads and number of calls to families required by care coordinators.\textsuperscript{26} Findley et al reported a wide range in retention, from 43\% to 93\% at 6 months, for their community-based asthma intervention.\textsuperscript{26}

Patient and caregiver knowledge of pharmacotherapy are also essential to achieving asthma control and reduced morbidity in patients with persistent disease. A paucity of literature exists on children’s ability to differentiate their reliever and controller medications, identify reason for use of both types of medication, know how often to use, and demonstrate proper technique. Medication use in pediatric patients is generally supervised by a caregiver or school nurse; however, acquiring knowledge regarding asthma medications will contribute to their ability to properly self-manage in the future. Franks et al found in a pilot study of 83 adults with asthma that patient understanding of the mode of action for medication translated to increased ability for them to distinguish controller and reliever medication.\textsuperscript{27} In patients using controller medication, they found optimal administration technique ranged from 34-75\% with most common reasons for sub-optimal technique (errors) described as “Did not inspire slowly” and “Did not inspire deeply”.\textsuperscript{27} Over 60\% of children in our pilot study and their caregivers achieved 100\% knowledge with respect to identification of their asthma medications, and to distinguish, demonstrate proper technique, and correctly state frequency of use for their reliever and controller medication per their treatment plan. Still, approximately one third of children/caregivers had not yet achieved full knowledge regarding their/their child’s asthma treatment plan after three months of participation.
Although beyond the scope of this study, further investigation to identify specific pharmacological knowledge items that present difficulty for the child/caregiver and how this impacts asthma control and morbidity outcomes is recommended for future study.

Achievement of asthma control in 88% of our patients by the third month of participation was on par with estimate of 80% of patients who achieved well controlled asthma by their third visit in a large study that involved 7,822 patients across 34,339 visits. Post intervention morbidity in our pilot study trended down as expected based on post year reductions reported in the Scott et al study. The cohort of patients in their study who were similar in demographic and clinical composition to our pilot study resided in Chicago, IL and Baltimore, MD. The Chicago cohort comprised 2384 patients of whom 44% reported an ED visit in the year prior to intervention which was similar to the 48% found in our study prior to converting to quarterly (three month) average. The cohort of patients in their study who resided in Baltimore, Maryland were more likely to have persistent disease than in our cohort (67% vs. 57%), which was reflected by the higher percentage who required an ED visit pre year (68%). Morbidity reductions after a complete year of follow-up in the Chicago and Baltimore cohorts ranged from 56-74% for ED visits.

Although the maximum post exposure follow-up time in our study was limited to three months, the 53.3% reduction from 31.3% to 14.6% aligned with expectations based on the Scott et al study.

There were limitations to our study. Although intent-to-treat approach was utilized in the analyses, it is important to note that approximately 10% of children/caregivers did not complete the treatment plan knowledge nor ACT survey at one or more follow-up visits. We were unable to demonstrate improved medication compliance in our study population due to child/caregiver inconsistency in bringing medications to visits which as a result informed our decision to
investigate including pharmacy claims data in future studies. Achieving a higher ratio of controllers to total asthma medication (controllers and relievers) defined by the asthma medication ratio is feasible with this health care delivery model\textsuperscript{28}, but requires consideration of mitigating factors to improve adherence such as caregiver worry about medication side effects.\textsuperscript{29} In the morbidity reduction analyses, maximum exposure time in the post period per patient was three months; however, ‘at risk’ patients generally require an average of three visits to first achieve asthma control based on the Scott et al study\textsuperscript{13}, which would suggest potential bias towards more conservative rate reduction estimates. Further, reductions in hospitalizations were not analyzed due to limited data (only one patient required hospitalization in the post period). Generalizability of our findings is limited to high-risk pediatric patients, predominately representative of African-American children, living in underserved areas, and with exposure to second hand smoke higher than the national average. Study enrollment was limited to 50 children given the frequency of visits and the availability of the study physician and pharmacist. Replication of this study in a larger population of at-risk children and in other settings with other providers (pediatricians, physician extenders) would further substantiate and increase generalizability of the study findings. Future studies are also needed to explore the cost-effectiveness of pharmacist management of asthma in the school setting through Collaborative Practice Agreements.

**Conclusion**

Asthma is one of the most common chronic diseases that affects children. Disparities in asthma control due to inadequate access to healthcare increase the incidence of asthma-related morbidity. Asthma control and reduced morbidity in high-risk pediatric patients is achievable as demonstrated by our study. Our findings support the feasibility and value of a pharmacist-led,
interdisciplinary school-based health care delivery model in providing comprehensive asthma care
to at-risk pediatric populations.

References

1. Expert Panel Report 3 (EPR-3): Guidelines for the Diagnosis and Management of Asthma-
2. Milligan KL, Matsui E, Sharma H. Asthma in Urban Children: Epidemiology,
   2016;16(4):33.
   July 9, 2020.
4. Zahran HS, Bailey C, Garbe P. Vital Signs: asthma prevalence, disease characteristics,
   and self-management education-United States, 2001-2009. MMWR. 2011; 60(17): 547-
   552.
5. Akinbami LJ, Schoendorf KC. Trends in childhood asthma: prevalence, health care
7. Akinbami LJ, Rhodes JC, Lara M. Racial and ethnic differences in asthma diagnosis among


ABSTRACT

Background
Disparities in access to care and outcomes have been identified among children with asthma living in underserved communities. The CAReS program was established to reduce disparities by providing school-based, comprehensive asthma care by a pharmacist-led, interdisciplinary team to high-risk pediatric populations in the Greater Pittsburgh area.

Objective
To investigate program impact on follow-up appointment attendance, delivery of guideline-based care, asthma control, asthma morbidity (ED visits, OCS requirement), and asthma-related knowledge and quality of life.

Methods
The study enrolled 50 children with asthma from six elementary schools (September 2014-December 2017). Children completed five visits over a three-month period. McNemar’s test assessed improvement in guideline-based controller therapy usage and reduced morbidity (ED visits or OCS requirement). GEE analyses determined significance of monthly improvements in asthma control, asthma knowledge, and quality of life.

Results
A 100% show rate was achieved in nearly all participants (92.0%). The majority of patients were African-American (56%). In children with persistent disease, only 21.4% were prescribed controller therapy at baseline which improved to 78.5% upon enrollment (p<0.05). Asthma control significantly improved (p<0.05), and reduction in percentage of patients who required an ED visit or OCS burst pre- to post- intervention was also significant (31.3% vs. 14.6%, p<0.05). The goal of 100% treatment plan knowledge was achieved in 67% of caregivers within one
month and increased from 6% to 60% in children over three months (p<0.05). Asthma-related quality of life also significantly improved pre- to post-intervention(p<0.05).

Conclusions

Disparities in asthma outcomes due to inadequate access to healthcare can be addressed. Improved asthma control, asthma medication knowledge, quality of life, and reduced morbidity in high-risk pediatric patients is achievable as demonstrated by our study. Our findings support the feasibility and value of a pharmacist-led, interdisciplinary school-based health care delivery model in providing comprehensive asthma care to at-risk pediatric populations.

Keywords: asthma; ambulatory; collaborative care; evidence-based medicine; pediatrics; pharmacy practice; quality of life; scope of practice

Abbreviations: CAReS= Caring for Asthma in our Region’s Schoolchildren; ETS= environmental tobacco smoke; ACT=Asthma Control Test; PAQLQ= Pediatric Asthma Quality of Life Questionnaire; GEE = Generalized Estimating Equations; OCS=oral corticosteroid.

Key Points:

Background:

- Asthma disparities among non-Hispanic black children and those from lower income families have been attributed, in part, to a lack of access to preventative care, underdiagnosis of asthma, and underutilization of controller medications.
- Mobile, school-based asthma clinics that provide care to underserved children have resulted in improved symptom-free days and achieved direct medical cost savings by decreasing hospitalizations and emergency department visits.
- There is a paucity of literature on the pharmacist’s role in addressing pediatric asthma disparities as well as the role of pharmacists in school-based chronic disease management.

Findings:
This study showed that a pharmacist-led, school-based asthma clinic resulted in compliance with chronic disease management appointments, significant improvements in asthma treatment plan knowledge, asthma-related quality of life, and asthma control, as well as decreased morbidity post-intervention.

Our findings support the feasibility and value of a pharmacist-led, interdisciplinary school-based health care delivery model in providing comprehensive asthma care to at-risk pediatric populations.

Future studies are needed to explore the cost-effectiveness of pharmacist management of asthma and other chronic diseases in the school setting.
Improved asthma outcomes among at-risk children in a pharmacist-led, interdisciplinary school-based health clinic: a pilot study of the CARes program

Background

Asthma is one of the most common chronic diseases, affecting nearly six million American children annually.\textsuperscript{1} Asthma is a complex condition involving chronic inflammation, and recurrent episodes of airway obstruction and bronchial hyperresponsiveness.\textsuperscript{1} Research suggests that the cause of asthma is a combination of genetic and environmental factors, including exposure to airborne allergens, environmental tobacco smoke (ETS), and air pollution.\textsuperscript{1} Increased exposure to environmental factors among inner-city pediatric populations may increase the prevalence and severity of asthma-like symptoms.\textsuperscript{2} Disparities in asthma control, as well as asthma-related morbidity and mortality have been identified among children of non-Hispanic black descent and from lower income families.\textsuperscript{1-5} Previous studies suggest that increased incidence of asthma-related emergency department visits, hospitalization, and mortality is in part due to a lack of access to ambulatory care, underdiagnosis of asthma, and underutilization of anti-inflammatory, controller medications.\textsuperscript{6-9}

Mobile, school-based clinics have been proposed as a solution to the lack of access to quality medical care among at-risk pediatric populations. Established in Los Angeles, California in 1995, the Breathmobile was the first comprehensive mobile pediatric asthma management program in the nation. Studies demonstrated that this mobile, school-based asthma clinic providing care to underserved children improved symptom-free days and achieved direct medical cost savings by decreasing hospitalizations and emergency department (ED) visits.\textsuperscript{10-14} Additionally, asthma education and management facilitated by a multidisciplinary healthcare
team, including pharmacists, can increase medication compliance and self-management. Improving compliance to asthma medications has also been shown to improve asthma control, and decrease the prevalence of asthma-related morbidity and mortality.\textsuperscript{15-22} The Caring for Asthma in our Region’s Schoolchildren (CARES) program was modeled after the Breathmobile to address barriers contributing to disparities in asthma care among children in Pittsburgh, Pennsylvania. The mission of the CARES program was to provide school-based, comprehensive asthma care facilitated by a multidisciplinary healthcare team to high-risk pediatric populations in the Greater Pittsburgh area. A key differentiator from previously published models is that the CARES program was a pharmacist-led clinic and care transitioned from a mobile unit to shared space within each school during the study period.

Objective(s)

The goal of this study was to evaluate if a pharmacist-led, multidisciplinary school-based health care delivery model would impact follow-up appointment attendance, the delivery of guideline-based care, asthma control, asthma morbidity (ED visits, OCS requirement), and asthma-related knowledge and quality of life.

Methods

Prior to implementation, the Institutional Review Board at Duquesne University approved this longitudinal cohort study. The study enrolled 50 children, ages 6-11 years, from six elementary schools located in the Greater Pittsburgh area from September 2014 to December 2017. All children with known asthma were referred by the school nurse and asthma diagnosis was confirmed by the study physician at the baseline visit. For this pilot project, care was initially
delivered at the school site using a mobile clinic modelled after the Breathmobile Program\textsuperscript{10-14}, but then transitioned to shared space within each school. The care delivery team was comprised of a pharmacist, student-pharmacists, a physician who was a board-certified allergist, and school nurses at each site who provided continuity of care across visits for the patients and their families. Children and their caregivers were informed of the nature of the study, as well as the potential risks and benefits; informed consent and assent were obtained from each child and caregiver who voluntarily participated in the study. Caregivers were encouraged but not required to attend appointments with their child.

Children completed five study visits over a three-month period, during the academic year, and were assessed at baseline, two weeks, four weeks, eight weeks, and 12 weeks. The pharmacist worked with the school nurse to schedule clinic dates within study window. Parent-reported patient characteristics were collected at the initial visit by the pharmacist, and included gender, age, ethnicity, and a comprehensive asthma and allergy history. Confirmation of an asthma diagnosis, and a baseline assessment of asthma severity was documented at the first visit by a licensed medical doctor; asthma control was assessed at each visit by the pharmacist and/or licensed medical doctor via the Asthma Control Test (ACT) and spirometry. An asthma treatment plan knowledge assessment, given to both the patient and caregiver, was administered at each visit. The seven-item pharmacotherapy knowledge survey (see online supplement 1) had good internal consistency at baseline as measured by Cronbach’s alpha of 0.87 in assessment of patient identification of their asthma medications by name, ability to differentiate reliever and controller medications by mode of action (reason for use), understanding of how often to take each type of medication, and demonstration of proper use of reliever and controller medications prescribed as part of their treatment plan. Patients not on controller medication were only asked four questions.
specific to their reliever medication. Placebo inhalers with spacers were used to evaluate technique and the same pharmacist verbally administered the pharmacotherapy knowledge survey at each appointment. The 23-item Pediatric Asthma Quality of Life Questionnaire (PAQLQ) was administered at the first and last visit by the pharmacist. The PAQLQ was developed to measure the functional problems (physical, emotional and social) that are most troublesome to children with asthma. Children respond to each question on a seven-point scale and the overall PAQLQ score is a mean of all 23 responses. Changes to drug therapy were recommended by a pharmacist and initiated by the study physician, and were based on The National Heart Lung and Blood Institute’s Guidelines for the Diagnosis and Management of Asthma (EPR-3) Stepwise Approach to Managing Asthma. Visit summaries including results of lung function tests and medication changes were faxed to each child’s primary care provider. The pharmacist provided asthma self-management education (ASME) at every visit, emphasizing appropriate inhaler technique and reinforcing the importance of medication compliance in achieving and maintaining asthma control. The pharmacist provided ongoing support to families and school nurses between visits; resolving insurance problems, working with pharmacies to get medications delivered to the home, making sure children had an asthma action plan and reliever medication at school, and providing continued education and counseling to improve asthma knowledge and medication compliance. Parent report of their child’s asthma medication prescriptions and compliance were further verified by examination of inhaler dose-counter or pill count if available and verification of pharmacy records.

Statistical Analysis

Demographic and clinical characteristics of patients at baseline were described by percentage with defined trait and by mean (SD) for continuous factors. The binomial test procedure assessed whether the show rate goal of at least four of five visits was achieved in
>=80% of participants. In patients with persistent disease, the increased percentage prescribed controller therapy after enrollment was assessed for significance using McNemar’s test. This test procedure also assessed significance of reduction in percentage of patients who required an ED visit or OCS steroid burst (pre- to post- intervention) with one sided significance reported. The pre- three month period was estimated by dividing the total number ED visits in prior year by 4 then rounding to determine if >=1 (yes). This was replicated for OCS use and the maximum of both variables was used to determine if participants required an ED visit or OCS burst in the pre-intervention three-month period (Y/N). Percentage of children (and caregivers) with complete asthma treatment plan knowledge and whose asthma was well controlled (ACT score >=20) were described at baseline and across the first three months of intervention. Average scores on the ACT and PAQLQ were also described at baseline and across the first three months of intervention. Generalized estimating equations (GEE) analyses were performed to assess significance of monthly improvement. Models accounted for repeat measures within subjects (baseline, month one, month two, and month three) with specification of first-order autoregressive AR(1) correlation structure, and applied binomial logistic for dichotomous and linear regression for continuous outcomes. All analyses were conducted using SPSS software, version 18.0 (IBM Company).

Results

Characteristics of 50 children who enrolled in the CAReS program are described in Table 1. Average age of participants was 8.9 years (SD=1.7) and the majority were African-American (56%) or Caucasian (34%). More than half were male (52%), reported lifetime exposure to ETS (56%), and had elevated body mass index (BMI) as indicated by percentage overweight (14.3%)
or obese (38.8%). The expectation of 80% show rate across the five visits was met by 92% of participants (p=0.011). Asthma status at baseline showed 57.1% had persistent disease. Yet, only 21.4% of those with persistent underlying disease severity were prescribed and/or taking controller therapy prior to their baseline visit. This improved to 78.5% upon enrollment in the program (p<0.001).

Parent response to ACT survey items suggested approximately 52.1% of patients had controlled asthma (ACT>=20) at baseline compared to 76.9% after one month, 77.1% after two months, and 89.7% after three months of participation (p=0.003). Average ACT scores improved from 20 (SD=3.6) to 22.9 (SD=3.4) during the three-month period (p=0.001).

Approximately 31.3% of the children had been to the ED or required an OCS burst due to their asthma in the three months prior to program participation, Figure 1. In the post-intervention period, the percentage of children with asthma who experienced a morbidity event was reduced to 14.6% (p=0.029).

The percentage of children with asthma who had complete asthma knowledge on the seven-item survey was 6.1% at baseline, but improved significantly with each subsequent month of program participation to reach 60.0% by the third month (p<0.001), Table 2. In caregivers, the percentage with complete knowledge at baseline was 37.8%, although higher than in children, and improved by the first month to 66.7% without further increase (p=0.010). Pediatric asthma quality of life survey scores also improved significantly from baseline to last visit with an increase of 0.7 points from 5 to 5.7 (95% CI 0.5, 1.0), p<0.001).

**Discussion**
In this study, we demonstrated a pharmacist-led, interdisciplinary school-based health care delivery model in an at-risk pediatric population was able to achieve visit compliance greater than 80% in nearly all participants (92%). Further, impact of the CARes program was significant with respect to achieving program goals (p<0.05). The goal of 100% asthma treatment plan knowledge was achieved within one month in 67% of caregivers and steadily increased from 6% to 60% in children over the three-month intervention period. Improvement in average quality of life by 0.7 points was clinically meaningful, defined by Young et al. as a magnitude of change that exceeds 0.5 points on the seven-point PAQLQ scale. Percentage of patients with well controlled asthma (ACT>=20) increased from 52.1% at baseline to 89.7% by the third month of participation. Improved health status was further evidenced by reduction in percentage of patients requiring an ED visit or OCS burst due to their asthma from 31.3% to 14.6%, p<0.05. Improvement in medication compliance was noted by the pharmacist, however, inability to consistently monitor this outcome as intended in our population precluded more formalized evaluation in the pilot study.

To achieve improvement in clinical outcomes through a school-based health care delivery model requires care coordination and participant engagement. Coordination with the school nurse and pharmacy, parent reminder phone calls for upcoming appointments, and continuity of care by the same caring staff are effective tools to achieve good retention. The high retention rate in our patient population was expected based on findings from other asthma programs that utilized similar coordination and care delivery strategies. Bollinger et al reported those lost to follow-up in their study of inner-city, high risk children were more likely to have less severe asthma which would have lowered retention expectations in our study where 42.9% had intermittent disease. However, Goldman’s study of recruitment and retention in a community-based asthma intervention in 311 children found those with more severe asthma were more likely
to be the “hardest-to-reach”, where the families required many contact attempts to complete at least one follow-up.\textsuperscript{25} Difficulty often occurs at the stage of recruitment requiring rescheduling of appointments for the enrollment visit as noted by Goldman et al, but once enrolled high retention is feasible as achieved in their study (96%) and our pilot study (92%). Additional influencing factors for consideration when going to scale include caseloads and number of calls to families required by care coordinators.\textsuperscript{26} Findley et al reported a wide range in retention, from 43% to 93% at 6 months, for their community-based asthma intervention.\textsuperscript{26}

Patient and caregiver knowledge of pharmacotherapy are also essential to achieving asthma control and reduced morbidity in patients with persistent disease. A paucity of literature exists on children’s ability to differentiate their reliever and controller medications, identify reason for use of both types of medication, know how often to use, and demonstrate proper technique. Medication use in pediatric patients is generally supervised by a caregiver or school nurse; however, acquiring knowledge regarding asthma medications will contribute to their ability to properly self-manage in the future. Franks et al found in a pilot study of 83 adults with asthma that patient understanding of the mode of action for medication translated to increased ability for them to distinguish controller and reliever medication.\textsuperscript{27} In patients using controller medication, they found optimal administration technique ranged from 34-75% with most common reasons for sub-optimal technique (errors) described as “Did not inspire slowly” and “Did not inspire deeply”.\textsuperscript{27} Over 60% of children in our pilot study and their caregivers achieved 100% knowledge with respect to identification of their asthma medications, and to distinguish, demonstrate proper technique, and correctly state frequency of use for their reliever and controller medication per their treatment plan. Still, approximately one third of children/caregivers had not yet achieved full knowledge regarding their/their child’s asthma treatment plan after three months of participation.
Although beyond the scope of this study, further investigation to identify specific pharmacological knowledge items that present difficulty for the child/caregiver and how this impacts asthma control and morbidity outcomes is recommended for future study.

Achievement of asthma control in 88% of our patients by the third month of participation was on par with estimate of 80% of patients who achieved well controlled asthma by their third visit in a large study that involved 7,822 patients across 34,339 visits. Post intervention morbidity in our pilot study trended down as expected based on post year reductions reported in the Scott et al study. The cohort of patients in their study who were similar in demographic and clinical composition to our pilot study resided in Chicago, IL and Baltimore, MD. The Chicago cohort comprised 2384 patients of whom 44% reported an ED visit in the year prior to intervention which was similar to the 48% found in our study prior to converting to quarterly (three month) average. The cohort of patients in their study who resided in Baltimore, Maryland were more likely to have persistent disease than in our cohort (67% vs. 57%), which was reflected by the higher percentage who required an ED visit pre year (68%). Morbidity reductions after a complete year of follow-up in the Chicago and Baltimore cohorts ranged from 56-74% for ED visits. Although the maximum post exposure follow-up time in our study was limited to three months, the 53.3% reduction from 31.3% to 14.6% aligned with expectations based on the Scott et al study.

There were limitations to our study. Although intent-to-treat approach was utilized in the analyses, it is important to note that approximately 10% of children/caregivers did not complete the treatment plan knowledge nor ACT survey at one or more follow-up visits. We were unable to demonstrate improved medication compliance in our study population due to child/caregiver inconsistency in bringing medications to visits which as a result informed our decision to
investigate including pharmacy claims data in future studies. Achieving a higher ratio of controllers to total asthma medication (controllers and relievers) defined by the asthma medication ratio is feasible with this health care delivery model\textsuperscript{28}, but requires consideration of mitigating factors to improve adherence such as caregiver worry about medication side effects.\textsuperscript{29} In the morbidity reduction analyses, maximum exposure time in the post period per patient was three months; however, ‘at risk’ patients generally require an average of three visits to first achieve asthma control based on the Scott et al study\textsuperscript{13}, which would suggest potential bias towards more conservative rate reduction estimates. Further, reductions in hospitalizations were not analyzed due to limited data (only one patient required hospitalization in the post period). Generalizability of our findings is limited to high-risk pediatric patients, predominately representative of African-American children, living in underserved areas, and with exposure to second hand smoke higher than the national average. Study enrollment was limited to 50 children given the frequency of visits and the availability of the study physician and pharmacist. Replication of this study in a larger population of at-risk children and in other settings with other providers (pediatricians, physician extenders) would further substantiate and increase generalizability of the study findings. Future studies are also needed to explore the cost-effectiveness of pharmacist management of asthma in the school setting through Collaborative Practice Agreements.

Conclusion

Asthma is one of the most common chronic diseases that affects children. Disparities in asthma control due to inadequate access to healthcare increase the incidence of asthma-related morbidity. Asthma control and reduced morbidity in high-risk pediatric patients is achievable as demonstrated by our study. Our findings support the feasibility and value of a pharmacist-led,
interdisciplinary school-based health care delivery model in providing comprehensive asthma care to at-risk pediatric populations.

References


