

Asthma: School-based Self-Management Interventions for Children and Adolescents with Asthma, Updated 2026

Community Preventive Services Task Force Finding and Rationale Statement Ratified July 2019

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CPSTF Finding and Rationale Statement

Context

Asthma is the most common chronic lung disease among children in the United States, affecting approximately 6 million children, or one out of every 12 (Zahran et al. 2018). The burden of childhood asthma in the United States is disproportionate, with higher rates in urban settings and low-income and minority communities (Woods et al. 2016; Sullivan et al. 2019).

Children with asthma may experience limitations in daily activities, missed school days, hospitalizations, or urgent primary care and emergency department visits.

Schools provide a unique opportunity for asthma control activities. Students, parents, and staff can be educated about asthma prevention and control, steps can be taken to remove or reduce asthma triggers, and healthcare services can be offered to students. School-based interventions are an important component of a comprehensive community and health system approach to asthma control.

Intervention Definition

School-based self-management interventions for asthma control provide education or counseling to help children and adolescents with asthma learn to do one or more of the following:

- Recognize and manage asthma symptoms
- Use medications and inhalers properly
- Avoid asthma triggers

Interventions may also provide instruction on the following:

- Monitoring asthma signs and symptoms
- Stress management
- Implementing an asthma action plan

Interventions may be delivered to students with asthma in group or individual sessions. Trained facilitators may include nurses, teachers, health educators, or peers, and sessions may be provided at school during or outside of regular school hours. Self-management interventions may be combined with additional asthma control activities directed at school staff, parents, or healthcare providers.

CPSTF Finding (July 2019)

The Community Preventive Services Task Force (CPSTF) recommends school-based self-management interventions for asthma control based on strong evidence of effectiveness in reducing hospitalizations and emergency room visits among children and adolescents with asthma. Interventions were effective when delivered by trained school staff, nurses, and health educators in elementary, middle, and high schools serving diverse populations.

When implemented in schools in low-income or minority communities, interventions are likely to reduce asthma morbidity, improve asthma-related quality of life, and promote health equity.

Rationale

Basis of Finding

The Community Preventive Services Task Force (CPSTF) uses recently published systematic reviews to conduct accelerated assessments of interventions that could provide program planners and decision makers with effective options for improving the health of their communities. The following published review was selected and evaluated by a team of specialists in systematic review methods, and in research, practice, and policy related to asthma prevention and control:

Harris KM, Kneale D, Lasserson TJ, McDonald VM, Grigg J, Thomas J. School-based self-management interventions for asthma in children and adolescents: a mixed methods systematic review. *Cochrane Database of Systematic Reviews* 2019, Issue 1. Art. No.: CD011651. DOI: 10.1002/14651858.CD011651.pub2

The team reviewed the evidence summarized in the publication and examined the included studies to obtain additional data on study, intervention, and population characteristics. The CPSTF assessment considered the findings of the published review, the additional data from the included studies, and expert input from team members and the CPSTF.

The published systematic review included 33 randomized controlled trials (search period through August 28, 2017).

The CPSTF considered outcomes from the 30 studies that examined effectiveness for one or more outcomes related to morbidity, quality of life, or asthma control. Three of these studies did not measure any of the outcomes of interest to the CPSTF and were excluded from this analysis. Included studies compared effectiveness of asthma self-management interventions with no intervention or self-management interventions targeting health issues other than asthma. Nineteen of the 30 studies provided measures that were included in the published meta-analysis. Estimates of change for asthma-related outcomes are summarized in the table below.

Findings on Asthma-related Outcomes

Body of Evidence	Studies and Participants	Summary Effect Estimate from Harris et al. 2019 Meta-Analyses (95% CI)	Direction of Effect
Asthma-related emergency department visits	13 studies 3883 participants	OR 0.70 (0.53, 0.92)	Favors the intervention
Asthma-related hospitalizations	6 studies 1873 participants	SMD: -0.19 (-0.35, -0.04)	Favors the intervention
Unplanned visits to medical provider (general practitioner/emergency department)	5 studies 3490 participants	OR: 0.74 (0.60, 0.90)	Favors the intervention
School absences (all causes)	10 studies 4609 participants	SMD: -0.07 (-0.22, 0.08)	Inconsistent effects
Self-reported asthma-related quality of life	7 studies 2587 participants	SMD: 0.27 (0.18, 0.36)	Favors the intervention

CI: Confidence Interval; OR: Odds Ratio; SMD: Standardized Mean Difference

Fifteen studies reported evidence on one or more of the asthma-related outcomes that could not be included in meta-analyses. Two studies measured differences in emergency department visits (1 favorable, 1 no change). Three studies reported differences in hospitalizations (1 favorable, 1 mixed, 1 no change), and one study measured change in unplanned visits to medical providers (favorable). Seven studies reported changes in school absences with mixed results (4 favorable, 1 mixed, 2 no change). Finally, nine studies reported on differences in asthma-related quality of life and showed generally favorable results (6 favorable, 3 no change).

Twenty of the included studies measured intervention effects on one or more asthma control outcomes. Compared to controls, students in self-management intervention groups reported less need for the use of asthma reliever medications (6 studies) and fewer activity limitations (6 studies), but little or no change in self-reported day-time or night-time symptoms (12 studies) or measures of lung function (6 studies).

Studies provided self-management instruction alone (15 studies) or in combination with additional asthma control activities (15 studies). Reported effects were similar across both groups of studies. Additional activities included asthma-related training and workshops for teachers and staff (10 studies), education or asthma awareness events for parents and caregivers (9 studies), additional interventions for students (e.g., visits with healthcare providers, asthma awareness education; 9 studies), environmental or policy assessments or changes (4 studies), and strategies targeting healthcare providers (e.g., academic detailing and efforts to promote asthma action plans; 6 studies).

Across the included studies, the median study duration was 12 months (interquartile interval [IQI]: 10 to 30 months) with a median loss to follow-up of 14.0% (IQI: 7.0% to 19.0%). Intervention sessions were delivered to groups (22 studies), groups and individuals (3 studies), or individuals (2 studies); 2 studies did not report this information. Interventions provided a median of six sessions (IQI: 3 to 6 sessions) that ranged from 15 to 90 minutes each. More than half of the studies provided self-management instruction encouraging the proper use of asthma medication inhalers, but only 25% of the studies reported providing inhaler demonstration or assessment of proper use as part of follow-up.

Applicability and Generalizability Issues

Most of the included studies were conducted in the United States (19 studies). The remaining studies were conducted in Canada (4 studies), Australia (2 studies), the United Kingdom (2 studies), China (1 study), Jordan (1 study), and Spain (1 study).

Most of the nineteen U.S. studies evaluated programs implemented in higher risk communities (e.g., low income) and reported information about students' race, ethnicity, and socioeconomic status. These studies showed interventions were effective among minority and low-income populations. Sixteen studies included African American students, with a median proportion of 67.5% (IQI: 33% to 95%). Eleven studies reported on Hispanic ethnicity, with a median proportion of 41% (IQI: 3% to 48%). Five of the ten studies that reported family income described student populations in which more than 50% were in the low-income category.

Studies included students aged 5 to 10 years (20 studies), 11 to 15 years (14 studies), and 16 years and older (1 study). Most studies were conducted in elementary schools and/or middle schools (21 studies). Most of the U.S. interventions were set in urban areas (16 studies); only three studies were set in rural settings.

Studies included a median of 259 participants (IQI: 114 to 663 participants). Information on students' asthma severity was inconsistently reported; some studies did not report severity at all, and those that did used different scales or measures of severity. Eleven studies described students' asthma severity using a classification of intermittent or

persistent, with persistent ranging from mild to severe. Most students were classified as having intermittent (median: 42% [range: 22 to 71]; 4 studies), or mild (median: 28% [IQR: 20 to 46]; 11 studies) to moderate (median: 29% [IQR: 14 to 59]; 9 studies) persistent asthma.

Studies most often recruited students by using surveys or announcements (50%), or health records (27%). Interventions were delivered by nurses (27%), teachers (17%), and health educators (13%). More than half of the studies reported training their facilitators (17 studies).

Data Quality Issues

The published systematic review included randomized controlled trials (33 studies) with either individual (student) or group (school) assignment. The authors evaluated study quality using the Cochrane risk of bias assessment tool (Higgins 2011). Summary risk of bias was assessed as low (2 studies), unclear (27 studies), and high (1 study). Important potential limitations included unclear or high risk of bias for selective reporting (17 studies) and unclear or high risk of bias due to incomplete outcome data (18 studies).

Other Benefits and Harms

The published review did not report or postulate on additional benefits of school-based self-management interventions for asthma. The CPSTF postulates that interventions encouraging asthma action plans could increase the number of students with asthma who develop plans with their parents and providers and have them filed with the school.

No harms of these interventions were described or evaluated in the published review or included intervention studies.

Economic Evidence

There was not enough economic evidence to determine cost-effectiveness or cost-benefit for school-based asthma self-management interventions. The economic review included 8 studies (search period 1995 through May 2020). Studies were from the United States (6 studies), Australia (1 study), and the United Kingdom (1 study). Seven studies reported intervention cost, three included the averted cost of healthcare, and two reported return on investment or provided sufficient information for the economic review team to compute it. All monetary values are reported in 2019 U.S. dollars.

Studies included students from elementary or middle schools (3 studies; 37%), middle or high schools (2 studies; 25%), high school (2 studies; 25%), or a combination of these (1 study; 12.5%). Studies were conducted in urban areas (5 studies; 62.5%), rural areas (2 studies; 25%), or mixed settings (1 study; 12.5%). A median of 162 children with asthma participated in the studies (IQR: 141 to 252). Among the 6 studies that reported race and ethnicity, participating students were Black or African American (55.1%), Hispanic or Latino (22%), or other (22.9%). Seven studies that reported socioeconomic status indicated students were drawn from populations with low (71.4%) or mixed (28.6%) socioeconomic status (defined by household or community income levels).

Interventions were delivered in group (3 studies), individual (2 study), or group and individual (2 studies) sessions; one study did not report on delivery format. The median study duration was 12 months and interventions included a median of four sessions (IQR: 3 to 4 sessions). Intervention content included asthma education (8 studies), knowledge checks on asthma and self-management (5 studies), instruction on the proper use of inhalers (7 studies), and knowledge checks on inhaler use (5 studies). Personnel that delivered the sessions were nurses (3 studies), asthma educators (3 studies), teachers (2 studies), and peer educators (1 study), or a combination of these (2 studies).

Components considered to be drivers of intervention cost included the labor cost associated with session delivery and the cost of inhalers and spacers. Components considered to be drivers of healthcare cost included inpatient stays, outpatient visits, emergency department visits, and medications.

The economic review team assessed the quality of cost and benefit estimates based on the capture of drivers and the appropriateness of measurement and methods used to compute them. Of the eight intervention cost estimates, six were of good quality and two were fair. The component of intervention cost most often missing was the cost of identifying students with asthma. One study did not account for the wages of some staff who delivered sessions as part of a team. Of the three healthcare cost estimates, two were of good quality and one was fair. Noted limitations for healthcare cost estimates were as follows: missing inpatient stays or emergency department visits, lack of a control group, and reliance on student or parent self-report.

Intervention Cost

- The median cost per person was \$44 (IQI: \$40 to \$131), based on eight estimates from seven studies.

Economic Benefit

- The changes in healthcare cost per person were -\$208, \$0, and \$62, based on estimates from three studies.

Return on Investment

- The return on investment was -1 and -2.5, based on two studies that reported both intervention cost and change in healthcare cost. The negative values indicate intervention cost exceeded the healthcare cost averted.

The variation in intervention cost per person is partly explained by differences in the size of intervention groups, with smaller intervention costs associated with larger groups. One study that reported an unusually small intervention cost of \$9 per person delivered the intervention to individuals through an interactive website and hired a coordinator to work with parents of students who needed professional health care. Intervention cost did not vary by type of staff delivering the intervention or by delivery format (i.e., group or individual).

The review team could not assess a comprehensive return on investment from the societal perspective because none of the included studies considered benefits to parents from avoided loss of workdays or benefits to school districts from averted loss of revenues associated with school absences.

Considerations for Implementation

Findings of this review support the use of asthma self-management interventions delivered in school settings to children and adolescents with asthma. The CPSTF also recommends [school-based health centers](https://www.thecommunityguide.org/findings/promoting-health-equity-through-education-programs-and-policies-school-based-health-centers) [https://www.thecommunityguide.org/findings/promoting-health-equity-through-education-programs-and-policies-school-based-health-centers] based on evidence of effectiveness for a range of student education and health outcomes, including reduced asthma-related emergency department visits and hospitalizations. School-based health centers can provide a useful location for asthma self-management instruction and may be used to identify students with asthma.

The following considerations for implementation are drawn from studies included in the existing evidence review, the broader literature, and expert opinion.

Guidance is available to inform implementation of school-based asthma self-management interventions and help schools select from a range of strategies.

- The Centers for Disease Control and Prevention (CDC), [National Asthma Control Program \(NACP\)](https://www.cdc.gov/asthma/nacp.htm) [https://www.cdc.gov/asthma/nacp.htm] provides resources and tools to foster [asthma-friendly schools](https://www.cdc.gov/asthma/schools.html) [https://www.cdc.gov/asthma/schools.html].
 - [Strategies for Addressing Asthma in Schools](https://www.cdc.gov/asthma/pdfs/Strategies_for_Addressing_Asthma_in_Schools_508.pdf) [https://www.cdc.gov/asthma/pdfs/Strategies_for_Addressing_Asthma_in_Schools_508.pdf] promotes school action to identify barriers and address environmental triggers.
 - [Success stories](https://www.cdc.gov/asthma/controlling_asthma_factsheet.html) [https://www.cdc.gov/asthma/controlling_asthma_factsheet.html] feature ways schools have worked to prevent and control asthma
 - The [EXHALE technical package](https://www.cdc.gov/asthma/pdfs/EXHALE_technical_package-508.pdf) [https://www.cdc.gov/asthma/pdfs/EXHALE_technical_package-508.pdf] provides an evidence-based group of strategies to help improve asthma control and inform decision-making in communities, organizations, and states.
- [CDC Healthy Schools](https://www.cdc.gov/healthyschools/index.htm) [https://www.cdc.gov/healthyschools/index.htm] provides information specific to managing [asthma](https://www.cdc.gov/healthyschools/asthma/index.htm) [https://www.cdc.gov/healthyschools/asthma/index.htm] at school.
- The American Lung Association provides resources based on real-life activities that have been used in U.S. schools, including step-by-step instructions for a long-term asthma management plan in the [Asthma-Friendly Schools Initiative Toolkit](https://www.lung.org/lung-health-and-diseases/lung-disease-lookup/asthma/asthma-education-advocacy/asthma-friendly-schools-initiative/toolkit/) [https://www.lung.org/lung-health-and-diseases/lung-disease-lookup/asthma/asthma-education-advocacy/asthma-friendly-schools-initiative/toolkit/].
- Examples of school-based asthma self-management programs include [Open Airways for Schools \(OAS\)](https://www.lung.org/lung-health-and-diseases/lung-disease-lookup/asthma/asthma-education-advocacy/open-airways-for-schools/) [https://www.lung.org/lung-health-and-diseases/lung-disease-lookup/asthma/asthma-education-advocacy/open-airways-for-schools/] and the [Roaring Adventures of Puff](https://www.cdc.gov/asthma/interventions/childhood_asthma.htm) [https://www.cdc.gov/asthma/interventions/childhood_asthma.htm]. These programs provide educational and interactive approaches (e.g., group discussion guides, stories, games) to promote and improve asthma control.
- The American Academy of Allergy Asthma & Immunology offers guidance on components for a [comprehensive school-based asthma management program](https://www.aaaai.org/conditions-and-treatments/school-tools/SAMPRO) [https://www.aaaai.org/conditions-and-treatments/school-tools/SAMPRO].
- The National Asthma Education and Prevention Program offers [Managing Asthma: A Guide For Schools](https://www.nhlbi.nih.gov/files/docs/resources/lung/asth_sch.pdf) [https://www.nhlbi.nih.gov/files/docs/resources/lung/asth_sch.pdf]

Implementing a personalized asthma action plan involves the student, family, and asthma care provider. Encouraging students to work with their healthcare providers to develop an asthma action plan is a common element of self-management instruction. Schools may want to establish policies or practices that encourage or require students with asthma to submit an asthma action plan. Following are example plans that can be personalized.

- [Asthma Action Plan](https://www.cdc.gov/asthma/actionplan.html) [https://www.cdc.gov/asthma/actionplan.html] resources from CDC include guidelines and forms that can be printed and completed for immediate use
- [Asthma Action Plan for Home & School](https://www.aaaai.org/Aaaai/media/MediaLibrary/PDF/Documents/Libraries/16-asthma-action-plan-v10_hires.pdf) [https://www.aaaai.org/Aaaai/media/MediaLibrary/PDF/Documents/Libraries/16-asthma-action-plan-v10_hires.pdf] from the American Academy of Allergy, Asthma, and Immunology
- [Asthma Action Plan](https://www.nhlbi.nih.gov/files/docs/public/lung/asthma_actplan.pdf) [https://www.nhlbi.nih.gov/files/docs/public/lung/asthma_actplan.pdf] from the National Institutes of Health, National Heart, Blood, and Lung Institute

School resources and staff time will likely be required to recruit students with asthma to participate. Notices may be sent to parents or students (e.g., email, fliers), students may be recruited through school-based health centers, or schools may start with student-filed asthma action plans.

Parental consent and provider prescription requirements for self-management training, asthma action plans, and rescue medications vary by school district and can be barriers to full participation.

Evidence Gaps

Based on the evidence and findings of the Harris et al. systematic review, the CPSTF identified several research questions for future study.

- How effective are these interventions with high school students who have asthma?
- How does effectiveness vary between programs set in urban and rural schools? Future studies could inform and provide additional evidence on programs and program components in rural settings.
- Does teaching students how to use inhalers and following up with them to ensure proper use have an effect on asthma-related outcomes?
- Do additional school policies (e.g. child inhaler possession and use policies, requirements for asthma action plans) improve student self-management practices and overall asthma control?
- How does effectiveness of self-management interventions vary by asthma severity?
- What is the effect of the intervention on parents' work productivity?
- What is the effect of the intervention on school district revenues associated with asthma-related school absences?
- What is the effect of the intervention on the cost of emergency department visits and inpatient stays?
- What is the return on investment when an intervention is implemented with funding from the local school district, public health agency, or area hospitals?
- What is the economic merit of the intervention in terms of societal cost-benefit and cost-effectiveness?

References

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Sullivan PA, Ghushchyan V, Kayati A, Navaratnam P, Friedman HS, Ortiz B. Health disparities among children with asthma in the United States by place of residence. *J Allergy Clin Immunol Pract* 2019; 7(1):148-55.

Harris KM, Kneale D, Lasserson TJ, McDonald VM, Grigg J, Thomas J. School-based self-management interventions for asthma in children and adolescents: a mixed methods systematic review. *Cochrane Database of Systematic Reviews* 2019, Issue 1. Art. No.: CD011651. DOI: 10.1002/14651858.CD011651.pub2

Disclaimer

The findings and conclusions on this page are those of the Community Preventive Services Task Force and do not necessarily represent those of CDC. Task Force evidence-based recommendations are not mandates for compliance or spending. Instead, they provide information and options for decision makers and stakeholders to consider when determining which programs, services, and policies best meet the needs, preferences, available resources, and constraints of their constituents.

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Appendices of Supporting Documents

Asthma:

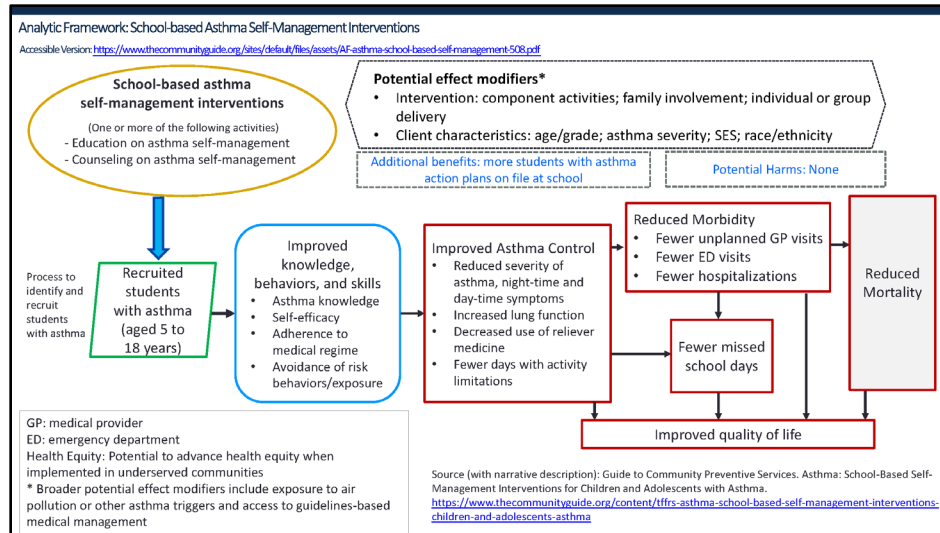
School-based Self-Management Interventions for Children and Adolescents with Asthma

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Appendix A Analytic Framework (Effectiveness Review) Asthma:

School-based Self-Management Interventions for Children and Adolescents with Asthma



Analytic Framework Text Description

The analytic framework depicts how school-based asthma self-management interventions might improve health and quality-of-life outcomes for students with asthma. Interventions would provide self-management instruction or counseling to recruited students who have asthma (Note: the impact of a school-based asthma self-management intervention will depend upon a practical process for identifying students with asthma and recruiting them to participate in the intervention).

Recruited students exposed to the self-management instruction or counseling would be expected to demonstrate an increase or improvement in asthma health-related knowledge, behaviors such as adherence to their asthma management medications and avoidance of risk behaviors and exposure, and skills such as proper inhaler technique. It is postulated these outcomes would translate into improved asthma control which could include improvements in asthma symptoms both during the day and at night, decreased need for use of rescue or reliever medications, fewer days with asthma-related limitations in their activities, and improvements in measurements of lung function. Improved asthma control would be expected to result in reduced asthma morbidity, including fewer or less severe asthma exacerbations requiring urgent or unplanned visits to their medical care provider, fewer urgent visits to the emergency department, and fewer or shorter hospitalizations. In addition, improved asthma control would be expected to result in improved quality of life and fewer missed school days. Better asthma control and fewer or less severe exacerbations would be expected to result in reduced asthma-related mortality. School-based asthma self-management interventions are not postulated to

Legend: Icons in Community Guide Analytic Frameworks	
Icon	Interpretation
	Intervention
	Recommendation outcome
	Other intermediate outcome/variable (that are not recommendation outcomes)
	Population
	Potential Effect Modifiers (affecting causal relationships)
	Potential Additional Benefits/Potential Harms
	Unidirectional block arrows are applied between intervention and population icons
	Unidirectional arrows for causal relationships
	Bidirectional arrows show feedback loops

have any meaningful harms. Interventions may prompt students to develop a personalized asthma action plan with their health care provider and to subsequently file these plans with their school.

Potential effect modifiers include differences in the effectiveness of component activities, whether or not the family is engaged in the intervention, and group or individual format for self-management instruction. In addition, program effectiveness might differ across student characteristics such as age or grade, baseline asthma severity, family socio-economic status, and student race or ethnicity.

Appendix B

Search Strategy and Summary Evidence Table Reference (Effectiveness Review):

Asthma:

School-based Self-Management Interventions for Children and Adolescents with Asthma

Refer to the existing systematic review for information about the search strategy and summary evidence table for this Community Guide review. The CPSTF finding is based on the following published systematic review:

Harris KM, Kneale D, Lasserson TJ, McDonald VM, Grigg J, Thomas J. School-based self-management interventions for asthma in children and adolescents: a mixed methods systematic review. Cochrane Database of Systematic Reviews 2019, Issue 1. Art. No.: CD011651. DOI: 10.1002/14651858.CD011651.pub2

Appendix C
Included Studies (Effectiveness Review):
Asthma: School-based Self-Management Interventions for Children and Adolescents with Asthma

The number of studies and publications do not always correspond (e.g., a publication may include several studies or one study may be explained in several publications).

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- Patterson EE, Brennan MP, Linskey KM, Webb DC, Shields MD, Patterson CC, et al. A cluster randomised intervention trial of asthma clubs to improve quality of life in primary school children: the School Care and Asthma Management Project (SCAMP). *Archives of Disease in Childhood* 2005;90(8):786 91.
- Persaud DI, Barnett SE, Weller SC, Baldwin CD, Niebuhr V, McCormick DP. An asthma self-management program for children, including instruction in peak flow monitoring by school nurses. *Journal of Asthma* 1996;33(1):37 43.

Praena-Crespo M, Fernandez-Truan J, G lvez-Gonz lez J, Murillo-Fuentes A, Castro-G mez L, Cenizo-Benjumea J. Randomised controlled trial of educational intervention directed by physical education teachers in high schools. *European Journal of Allergy and Clinical Immunology* 2010;65:190 1.

Shah S, Peat JK, Mazurski EJ, Wang H, Sindhusake D, Bruce C, et al. Effect of peer led programme for asthma education in adolescents: cluster randomised controlled trial. *BMJ* 2001;322(7286):583 5.

Splett PL, Erickson CD, Belseth SB, Jensen C. Evaluation and sustainability of the Healthy Learners Asthma Initiative. *Journal of School Health* 2006;76(6):276 82.

Srof BJ, Velsor-Friedrich B, Penckofer S. The effects of coping skills training among teens with asthma. *Western Journal of Nursing Research* 2012;34(8):1043 61.

Velsor-Friedrich B, Pigott T, Srof B. A practitioner-based asthma intervention program with African American inner-city school children. *Journal of Pediatric Health Care* 2005;19(3):163 71.

*Bruzzeze JM, Bonner S, Vincent EJ, Sheares BJ, Mellins RB, Levison MJ, et al. Asthma education: the adolescent experience. *Special Issue: Educating and Counseling Children about Physical Health* 2004;55(3):396 406.

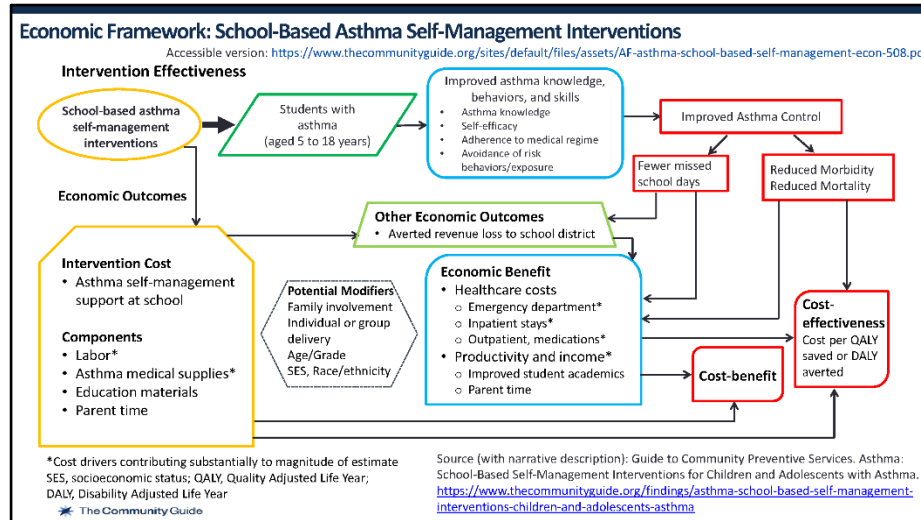
*Mosnaim GS, Li H, Damitz M, Sharp LK, Li Z, Talati A, et al. Evaluation of the Fight Asthma Now (FAN) program to improve asthma knowledge in urban youth and teenagers. *Annals of Allergy, Asthma and Immunology* 2011;107(4):310 6.

*Pulcini J, DeSisto MC, McIntyre CL. An intervention to increase the use of Asthma Action Plans in schools: a MASNRN study. *Journal of School Nursing* 2007;23(3):170 6.

* *Three of the studies included in the review conducted by Harris et al. did not measure any of the outcomes of interest to the CPSTF and were excluded from this analysis.*

Appendix D Analytic Framework (Economic Review) Asthma:

School-based Self-Management Interventions for Children and Adolescents with Asthma



Analytic Framework Text Description

This is the analytic framework for the economic review.

The pathways in the effectiveness analytical framework are diagrammed on the top part of the slide.

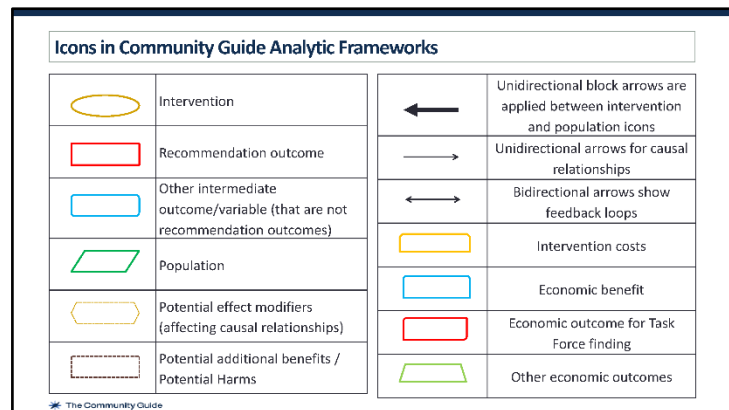
School-based asthma self-management interventions are delivered to students with asthma ages 5 to 18 years. Interventions aim to improve asthma knowledge, behaviors, and skills (i.e., asthma knowledge, self-efficacy, adherence to medical regimen, avoidance of risk behaviors/exposure). It is postulated this will improve asthma control, which will lead to fewer missed school days and reduced morbidity and mortality.

The associated economic consequences and impacts are diagrammed along the bottom of the slide.

Intervention cost is the cost of asthma self-management support at school. Cost components include labor (i.e., staff resources), asthma medical supplies where provided, educational materials, and parent time. The costs of labor and asthma medical supplies are the drivers contributing substantially to the magnitude of the estimate.

Potential modifiers include family involvement, whether interventions are delivered to groups or individuals, students' age or grade level, and students' socio-economic status, race, and/or ethnicity.

Improved asthma control and outcomes are expected to lead to reduced use of healthcare and fewer missed school days. This would lead to economic benefits such as averted healthcare costs (i.e., costs associated with emergency department visits, inpatient stays, outpatient visits, and medication) and



increased productivity (i.e., through improved student academics and parent time saved). Within healthcare, the drivers of the magnitude of change are expected to be emergency department visits, inpatient stays, and medications. Improved health and reduced school absences also mean that productivity is a driver of benefit when parents avoid loss of workdays caring for children with asthma exacerbations and school systems avoid loss of revenue from reduced attendance.

Measures that compare costs and benefits of the intervention are summarized in cost-benefit outcomes. Improved health would be expected to increase quality and disability adjusted life years (i.e., QALY and DALY) which translate to cost-effectiveness outcomes summarized in the cost per QALY gained and cost per DALY averted. application.

Appendix E
Search Strategy (Economic Review):
Asthma:

School-based Self-Management Interventions for Children and Adolescents with Asthma

In May and June of 2020, a research librarian used the terms listed below to search the following databases: Medline, CINAHL, EconLit, ERIC, Cochrane, and CRD at York. The search period covered 1995 through December 2020.

The search was limited to high income countries as defined by the World Bank. The review team also screened reference lists of included studies and consulted subject matter experts about additional studies that may have been missed. Search terms and strategies were adjusted for each database, based on controlled and uncontrolled vocabularies and software.

Database: Medline (OVID)

Date Searched : 05/26/2020

Results: 590

SEARCH STRATEGY

1 exp Asthma/

2 asthma\$.mp.

3 (antiasthma\$ or anti-asthma\$).mp.

4 Respiratory Sounds/

5 wheez\$.mp.

6 Bronchial Spasm/

7 bronchospas\$.mp.

8 (bronch\$ adj3 spasm\$).mp.

9 bronchoconstrict\$.mp.

10 exp Bronchoconstriction/

11 (bronch\$ adj3 constrict\$).mp.

12 Bronchial Hyperactivity/

13 Respiratory Hypersensitivity/

14 ((Bronchial\$ or respiratory or airway\$ or lung\$) adj3 (hypersensitiv\$ or hyperreactiv\$ or allerg\$ or insufficiency)).mp.

15 ((dust or mite\$) adj3 (allerg\$ or hypersensitiv\$)).mp.

16 or/1-15

17 exp Schools/

18 School Health Services/

19 School Nursing/

20 school*.ti,ab,kw.

21 academ*.ti,ab,kw.

22 colleg*.ti,ab,kw.

23 lesson*.ti,ab,kw.

24 pupil*.ti,ab,kw.

25 mobile*.ti,ab,kw. added

26 or/17-25

27 exp Self Care/

28 exp Health Education/

29 Case Management/

30 Patient Education as Topic/

31 educat*.ti,ab,kw.

32 manag*.ti,ab,kw.

33 self-manag*.ti,ab,kw.

34 (self adj manag*).ti,ab,kw.

35 exp Self-Management/

36 self-car*.ti,ab,kw.

37 (self adj car*).ti,ab,kw.

38 train*.ti,ab,kw.

39 instruct*.ti,ab,kw.

40 teach*.ti,ab,kw.

41 patient-cent*.ti,ab,kw.

42 (patient adj cent*).ti,ab,kw.

43 Patient-Centered Care/

44 patient-focus*.ti,ab,kw.

45 (patient adj focus*).ti,ab,kw.

46 coach*.ti,ab,kw.

47 skill*.ti,ab,kw.

48 (knowledge adj develop*).ti,ab,kw.

49 tutor*.ti,ab,kw.

50 (intervention or preventive or prevention or program).ti,ab,kw. added

51 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48 or 49 or 50

52 16 and 26 and 51 total before adding cost related terms

53 (cost minimi* or cost-utilit* or health utilit* or economic evaluation* or economic review* or cost outcome or cost analys?s or economic analys?s or budget* impact analys?s).mp.

54 (cost-effective* or pharmacoeconomic* or pharmaco-economic* or cost-benefit or cost* or income).mp.

55 (life year or life years or qaly* or daly* or cost-benefit analys?s or cost-effectiveness analys?s).mp.

56 ((cost or economic*) and (cost* or cost-effectiveness or markov)).mp.

57 *economics/

58 exp *"costs and cost analysis"/

59 53 or 54 or 55 or 56 or 57 or 58

60 52 and 59

61 60 not (animals not humans).sh.

62 limit 61 to yr="1995 -Current"

Database: CINAHL (Ebsco)

Date Searched : 06/03/2020

Results: 84

SEARCH STRATEGY

S1 asthma*

S2 (MH “Asthma+”)

S3 (MH “Schools+”) OR (MH “School Health Services+”) OR (MH “School Nursing+”) OR school* OR academ* OR colleg* OR lesson* OR pupil*

S4 (MH “Self Care+”) OR (MH “Health Education+”) OR (MH “Case Management+”) OR (MH “Patient Education+”) OR educat* OR manag* OR self-car* OR self n1 car* OR train* OR instruct* OR teach* OR patient-cent*

S5 patient n1 cent* OR (MH “Patient-Centred Care+”) OR patient-focus* OR patient N1 focus* OR coach* OR skill* OR knowledge n1 develop* OR tutor*

S6 S4 OR S5

S7 S1 OR S2

S8 S3 AND S6 AND S7

S9 TX cost minimi* or cost-utilit* or health utilit* or economic evaluation* or economic review* or cost outcome or cost analys?s or economic analys?s or budget* impact analys?s)

S10 TX (cost-effective* or pharmacoeconomic* or pharmaco-economic* or cost-benefit or cost* or income)

S11 TX life year or life years or qaly* or daly* or cost-benefit analys?s or cost-effectiveness analys?s)

S12 TX ((cost or economic*) and (cost* or cost-effectiveness or markov))

S13 (MM “Economics

S14 (MM “Costs and Cost Analysis+”)

S15 S9 OR S10 OR S11 OR S12 OR S13 OR S14

S16 S8 AND S15

S17 S8 AND S15 Limiters – Published Date: 19950101-20201231-

Database: EconLit (Ebsco)

Date Searched: 06/03/2020

Results: 8

SEARCH STRATEGY

S1 asthma*

S2 (MH “Asthma+”)

S3 (MH “Schools+”) OR (MH “School Health Services+”) OR (MH “School Nursing+”) OR school* OR academ* OR colleg* OR lesson* OR pupil*

S4 (MH “Self Care+”) OR (MH “Health Education+”) OR (MH “Case Management+”) OR (MH “Patient Education+”) OR educat* OR manag* OR self-car* OR self n1 car* OR train* OR instruct* OR teach* OR patient-cent*

S5 patient n1 cent* OR (MH “Patient-Centred Care+”) OR patient-focus* OR patient N1 focus* OR coach* OR skill* OR knowledge n1 develop* OR tutor*

S6 S4 OR S5

S7 S1 OR S2

S8 S3 AND S6 AND S7

S9 TX cost minimi* or cost-utilit* or health utilit* or economic evaluation* or economic review* or cost outcome or cost analys?s or economic analys?s or budget* impact analys?s)

S10 TX (cost-effective* or pharmacoeconomic* or pharmaco-economic* or cost-benefit or cost* or income)

S11 TX life year or life years or qaly* or daly* or cost-benefit analys?s or cost-effectiveness analys?s)

S12 TX ((cost or economic*) and (cost* or cost-effectiveness or markov))

S13 (MM “Economics

S14 (MM “Costs and Cost Analysis+”)

S15 S9 OR S10 OR S11 OR S12 OR S13 OR S14

S16 S8 AND S15

S17 S8 AND S15 Limiters – Published Date: 19950101-20201231

Database: ERIC (ProQuest)

Date Searched : 06/04/2020

Results: 40

SEARCH STRATEGY

asthma* AND ((ti(school* OR academ* OR colleg* OR lesson* OR pupil*) OR ab(school* OR academ* OR colleg* OR lesson* OR pupil*)) OR (MAINSUBJECT.EXACT(“High Schools”) OR MAINSUBJECT.EXACT(“Middle Schools”) OR MAINSUBJECT.EXACT(“Elementary Schools”) OR MAINSUBJECT.EXACT(“Public Schools”) OR MAINSUBJECT.EXACT(“School Health Services”) OR MAINSUBJECT.EXACT(“Charter Schools”) OR MAINSUBJECT.EXACT(“Community Schools”))) AND ((ab((educat* OR manag* OR self-car* OR self n/1 car* OR train* OR instruct* OR teach* OR patient-cent*)) OR ti((educat* OR manag* OR self-car* OR self n/1 car* OR train* OR instruct* OR teach* OR patient-cent*)) OR (ti(patient NEAR/1 cent* OR patient-focus* OR patient NEAR/1 focus* OR coach* OR skill* OR knowledge NEAR/1 develop* OR tutor*) OR ab(patient NEAR/1 cent* OR patient-focus* OR patient NEAR/1 focus* OR coach* OR skill* OR knowledge NEAR/1 develop* OR tutor*)))

AND

ti((cost-effective* or pharmacoeconomic* or pharmaco-economic* or cost-benefit or cost* or income)) OR
ab((cost-effective* or pharmacoeconomic* or pharmaco-economic* or cost-benefit or cost* or income)) OR
su((cost-effective* or pharmacoeconomic* or pharmaco-economic* or cost-benefit or cost* or income))

OR

ti((life year or life years or qaly* or daly* or cost-benefit analys?s or cost-effectiveness analys?s)) OR ab((life year
or life years or qaly* or daly* or cost-benefit analys?s or cost-effectiveness analys?s)) OR su((life year or life years
or qaly* or daly* or cost-benefit analys?s or cost-effectiveness analys?s))

OR

ab(((cost or economic*) and (cost* or cost-effectiveness or markov))) OR ti(((cost or economic*) and (cost* or
cost-effectiveness or markov))) OR su(((cost or economic*) and (cost* or cost-effectiveness or markov)))

OR

MJMAINSUBJECT.EXACT.EXPLODE("Economics")

OR

ab(costs N/3 "cost analysis") OR ti(costs N/3 "cost analysis") OR su(costs N/3 "cost analysis")

Limit to 1995-2020

Database: Cochrane (Wiley)

Date Searched: 06/04/2020

Results: 283

SEARCH STRATEGY

#1 MeSH descriptor: [Asthma] explode all trees

#2 asthma*:ti,ab,kw

#3 #1 OR #2

#4 MeSH descriptor: [Schools] explode all trees

#5 MeSH descriptor: [School Health Services] explode all trees

#6 MeSH descriptor: [School Nursing] explode all trees

#7 (school* OR academ* OR colleg* OR lesson* OR pupil*):ti,ab,kw

#8 #4 OR #5 OR #6 OR #7

#9 (educat* OR manag* OR self-car* OR self NEXT car* OR train* OR instruct* OR teach* OR patient-cent*OR
patient NEXT cent* OR patient-focus* OR patient NEXT focus* OR coach* OR skill* OR knowledge NEXT develop*
OR tutor*):ti,ab,kw

#10 MeSH descriptor: [Self Care] explode all trees

#11 MeSH descriptor: [Health Education] explode all trees

#12 MeSH descriptor: [Case Management] explode all trees

#13 MeSH descriptor: [Patient Education as Topic] explode all trees

#14 MeSH descriptor: [Patient-Centered Care] explode all trees

#15 #9 OR #10 OR #11 OR #12 OR #13 OR #14

#16 #3 AND #8 AND #15

#17 (cost-effective* or pharmacoeconomic* or pharmaco-economic* or cost-benefit or cost* or income):ti,ab,kw

#18 (life year or life years or qaly* or daly* or cost-benefit analys?s or cost-effectiveness analys?s):ti,ab,kw

#19 ((cost or economic*) AND (cost* or cost-effectiveness or markov)):ti,ab,kw

#20 MeSH descriptor: [Economics] explode all trees

#21 MeSH descriptor: [Costs and Cost Analysis] explode all trees

#22 #17 OR #18 OR #19 OR #20 OR #21

#23 #16 AND #22 with Cochrane Library publication date Between Jan 1995 and Dec 2020

Database: CRD at York

Date Searched : 06/04/2020

Results: 6

SEARCH STRATEGY

Title: "asthma" AND Title: "school"

DARE, NHS EED, HTA

Limit 1995 to 2020

Appendix F Included Studies (Economic Review):

Asthma:

School-based Self-Management Interventions for Children and Adolescents with Asthma

Atherly A, Nurmagambetov T, Williams S, Griffith M. An economic evaluation of the school-based “power breathing” asthma program. *Journal of Asthma* 2009;46(6):596-9.

Butz A, Pham L, Lewis L, Lewis C, Hill K, et al. Rural children with asthma: impact of a parent and child asthma education program. *Journal of Asthma* 2005;42(10):813-21.

Horner SD, Brown A, Brown SA, Rew DL. Enhancing asthma self-management in rural school-aged children: a randomized controlled trial. *Journal of Rural Health* 2016;32(3):260-8.

Joseph CL, Peterson E, Havstad S, Johnson CC, Hoerauf S, et al. A web-based, tailored asthma management program for urban African-American high school students. *American Journal of Respiratory & Critical Care Medicine* 2007;175(9):888-95.

Liptzin DR, Gleason MC, Cicutto LC, Cleveland CL, Shocks DJ, et al. Developing, implementing, and evaluating a school-centered asthma program: Step-Up Asthma Program. *Journal of Allergy and Clinical Immunology in Practice* 2016;4(5):972-9.e971.

Mosnaim GS, Li H, Damitz M, Sharp LK, Li Z, et al. Evaluation of the Fight Asthma Now (FAN) program to improve asthma knowledge in urban youth and teenagers. *Annals of Allergy, Asthma, & Immunology* 2011;107(4):310-6.

Otim ME, Jayasinha R, Forbes H, Shah S. Building evidence for peer-led interventions: assessing the cost of the Adolescent Asthma Action program in Australia. *Australian Journal of Primary Health* 2015;21(4):438-43.

Salisbury C, Francis C, Rogers C, Parry K, Thomas H, et al. A randomised controlled trial of clinics in secondary schools for adolescents with asthma. *British Journal of General Practice* 2002;52:988-96.

Appendix G
Summary Evidence Table (Economic Review):
Asthma: School-based Self-Management Interventions for Children and Adolescents with Asthma

This table outlines information from the studies included in the Community Guide economic review of School-Based Self-Management Interventions for Children and Adolescents with Asthma. It details study design and economic analysis, population and intervention characteristics, and economic outcomes considered in this review. Complete references for each study can be found in the Included Studies section of the [review summary](https://www.thecommunityguide.org/findings/asthma-school-based-self-management-interventions-children-and-adolescents-asthma). [<https://www.thecommunityguide.org/findings/asthma-school-based-self-management-interventions-children-and-adolescents-asthma>]

Abbreviations Used in this Document

- Study design:
 - RCT: randomized controlled trial
- Measurement terms:
 - DiD: difference in difference
 - Pct pt: percentage point
- Other terms:
 - ED: emergency department
 - NA, not applicable
 - NR: not reported
 - SES: socioeconomic status
 - OLS: Ordinary least square

Notes:

Quality of economic estimates – Studies are assessed to be of good, fair, or limited quality. This valuation is based on two domains: [Quality of Capture](https://www.thecommunityguide.org/about/glossary#quality-based-on-capture) [<https://www.thecommunityguide.org/about/glossary#quality-based-on-capture>], and [Quality of Measurement](https://www.thecommunityguide.org/about/glossary#quality-based-on-measure) [<https://www.thecommunityguide.org/about/glossary#quality-based-on-measure>].

Race/ethnicity of the study population: The Community Guide only summarizes race/ethnicity for studies conducted in the United States.

Study Information	Study and Population Characteristics	Trial Name Intervention & Comparison	Effectiveness Findings	Intervention Costs	Healthcare Cost Averted Productivity Loss Averted	Economic Summary Measure
Author (Year): Atherly et al. (2009) Design: Model from RCT Economic Method: Intervention and healthcare cost Funding Source: None Monetary Conversions: Index year assumed 2003 in U.S. dollars	Location: Kansas City, Kansas Stafford-Fredericksburg, Virginia, USA Setting: Middle and high schools Eligibility: Screening and selection not described. Students from 8 middle and 2 high schools. Sample Size: Intervention 225 Control 233 Characteristics: Mean Age: 13.9 y Females: 46.6% Urban: 100% Percent with symptoms at baseline: 30.8% Days with symptoms per 2 weeks for those with symptoms: 3.05 Time Horizon: School year: 2003-2004 Intervention: length NR	Intervention Name: Power Breathing Intervention: Three educational 90-minute sessions about asthma, control strategies, and psychological concerns. Causes such as irritants are discussed along with avoidance. Control strategies include management plan with peak flow monitoring, discussion of medication classes, and appropriate use. Coping strategies address concerns, fears, barriers, and communication with caregivers and providers. Also asks students to highlight personal aspirations and goals. Staffed with school nurses, teachers, program facilitator. Intervention components: Asthma knowledge, asthma control and avoidance of irritants, medication and proper use. Comparison: Usual care	Measured at 3-month follow-up with intervention length not reported. Symptom days over 2 weeks OLS with baseline symptoms-intervention interaction showed reduction by more than half of baseline days of symptoms for those in intervention group. Study states number of school days missed was reduced, but no estimate was provided. Study states quality of life and asthma knowledge improved but estimate was not reported. Data Source: Self-report surveys Measure Type: DiD	Intervention cost: Total cost: \$6,500 \$30.37 per student per year Components Included: Labor costs, program materials, facility cost. Source and Valuation: Trial records of resources and time use Quality: Good	Healthcare cost: No difference in healthcare cost Components Included in Healthcare Cost: ED, inpatient, outpatient, medication, peak flow meters Source and Valuation: Self-report surveys Measure Type: DiD Quality: Good Change in Mean Productivity: Parent time not monetized Quality: NA	Return on investment: -1 Cost per asthma-free day: \$3.90 Quality: Good Limitations: Short follow-up Only benefits considered are healthcare costs averted.

Study Information	Study and Population Characteristics	Trial Name Intervention & Comparison	Effectiveness Findings	Intervention Costs	Healthcare Cost Averted Productivity Loss Averted	Economic Summary Measure
Author (Year): Butz et al. (2005) Design: RCT Economic Method: Intervention cost Funding Source: National Institute of Nursing Research Monetary Conversions: Index year assumed 2004 in U.S. dollars	Location: Seven counties in Maryland, USA Setting: Elementary schools, local libraries, school for parent education; after school hours Eligibility: Children ages 6-12 years who are living with asthma diagnosis (symptoms for at least 12 months), currently taking medications, and waking at night (for at least one month), and who do not have pulmonary co-morbidities. Children were recruited through letters to parents. Sample Size: Intervention: 112 Control: 89 Characteristics: Mean Age: 8.02 y Females: 33.8% White: 58.5% African American: 34.6% Hispanic: 3.1% Other: 3.8%	Intervention: After school educational intervention targeting rural students and parents or caregivers delivered by asthma educators. Intervention staffed with community health workers (asthma educators) and a research nurse. <u>Parent education</u> One, 1-hour session that included early warnings of exacerbation, levels of severity, avoidance or rural environment exposures such as from farming activities, types of medications, asthma action plan, cue cards for provider communication, and demonstration of correct use of peak flow meter and metered inhaler with spacer. Participants also received a quarterly newsletter, and a list of allergy test and smoking cessation resources. <u>Student sessions</u> Two, 2-hour, interactive sessions taught by asthma educator. Content	Recorded end of 10-month study No significant difference in counts of ED, inpatient, or specialty visits Caregiver asthma knowledge improved, self-efficacy and quality of life not significantly different. Child self-efficacy improved. Source: Self-report questionnaire Measure Type: DiD	Intervention cost per student per year: \$95 Components included in intervention cost: Labor of research nurse and community health worker; travel costs Source and Valuation: Trial records of time and wages. Quality: Fair	Healthcare cost Not monetized	No summary economic measures Limitations: Healthcare utilization not monetized. However, the study notes there was no difference in counts of healthcare utilization. No estimates provided for effects on school days missed or parent time.

Study Information	Study and Population Characteristics	Trial Name Intervention & Comparison	Effectiveness Findings	Intervention Costs	Healthcare Cost Averted Productivity Loss Averted	Economic Summary Measure
	Parents less than high school education: 9.3% Annual household income less than \$10,000: 10% Mothers employed: 80% Rural: 100% Time Horizon: Study over 1 academic year 10 months. Recruited August 2001 to August 2003.	included anatomy of asthma, types of medications (e.g. reliever and controller), warning signs, correct use of peak flow meters and metered inhaler, rural and home environmental exposures, description of asthma action plan, demonstration of correct device use. Materials (written at a 2-3 grade level) included coloring book, peak flow meter, and spacer device. Comparison: Usual care with quarterly newsletters				
Author (Year): Horner et al. (2016) Design: RCT Economic Method: Intervention cost Funding Source: National Institute of Nursing Research, National Heart, Lung, and Blood Institute	Location: Five school districts in Texas, USA Setting: Elementary schools; asthma day camp Eligibility: Students in grades 2-5 with diagnosed asthma in rural areas. Must have had asthma symptoms for at least 12 months and no significant comorbidity. Invited	Intervention: Two study arms in intervention: (1) in school, and (2) asthma day camp. In school arm was delivered by teachers over five week period (16 sessions, each 15-minutes long and held during lunch break). Day camp arm was delivered by a program coordinator on one day; a registered nurse was added per regulations.	Effects measured over 12 months Outpatient visits reduced for in school students more than day camp or control group students. ED reduced significantly for day camp students. Inpatient stays decreased for in school and day camp but not significantly. Asthma severity	Cost per student per year: In school: \$130.50 Day Camp: \$142.75 Control: \$128.50 Components Included in Intervention Cost: Teachers' and coordinator's time. Teaching	Healthcare cost Not monetized	No summary economic measures Limitations: Healthcare utilization not monetized. No estimates provided for effects on school days missed or parent time.

Study Information	Study and Population Characteristics	Trial Name Intervention & Comparison	Effectiveness Findings	Intervention Costs	Healthcare Cost Averted Productivity Loss Averted	Economic Summary Measure
Monetary Conversions: Index year assumed 2014 in U.S. dollars	to participate through letter signed by school nurse. Project coordinator contacted family to schedule home visit to obtain assent. Two high and nine low SES schools randomly assigned to three arms. Sample Size: In school: 84 Day camp: 89 Control: 84 Characteristics: Mean Age In school: 8.83 y Day camp: 8.82 y Female In school: 44.6% Day camp: 38.5% Race and Ethnicity In school: White: 22.9% Hispanic: 55.2% African American: 21.9% Day camp: White: 23.9% Hispanic: 60.9% African American: 15.2% Rural: 100% Time Horizon:	An asthma 7-step curriculum was developed for students in rural areas. Program includes lung function; asthma symptoms and triggers; and skills to manage symptoms, including peak flow score interpretation, communication with providers, medication and inhaler use, evaluation and management of symptoms, and safe physical activity and sports. In school format relied on handouts and vignettes to improve problem-solving and decisions. Day camp used same handouts but stressed group work and game-like learning activities. Materials were workbooks, supplies, peak flow meter, asthma action plan. Comparison: Attention control and general health education.	declined for in school students. No change reported in medication adherence. Improved management by parents for day camp but effect was not significant. Source: Self-reported by parents Measure Type: DiD	and activity materials, and peak flow meters. Added nurse and food at day camp. Data Source: Trial records Quality: Good		

Study Information	Study and Population Characteristics	Trial Name Intervention & Comparison	Effectiveness Findings	Intervention Costs	Healthcare Cost Averted Productivity Loss Averted	Economic Summary Measure
	Intervention length: 5 weeks Day camp: 1 day Study dates not reported.					
Author (Year): Joseph et al. (2007) Design: RCT Economic Method: Intervention cost Funding Source: None Monetary Conversions: Index year assumed 2005 in US dollars	Location: Detroit, Michigan, USA Setting: High schools Eligibility: Participants drawn from screening survey of students in in grades 9-11 in six public high schools. Students were eligible for intervention if they had an asthma diagnosis along with symptoms, asthma medication use, or asthma care in the previous 30 days, OR if they had no diagnosis but experienced symptoms of mild asthma. Sample Size: Intervention: 162 Control: 152 Characteristics: Mean Age: 15.3 y; Female: 63.4%;	Intervention Name: Puff City Intervention: Staffed by referral coordinator, with mean contact time of 31 minutes. The tailored, web-based Puff City application was delivered on school computers. Students completed four sessions over 180 days. Data was transferred to study center daily. The program addressed three behaviors: medication adherence, rescue inhaler carrying behavior, smoking cessation. Consecutive computer sessions were tailored based on baseline data collected from student input. Parents and caregivers received a letter describing availability of referral coordinator to help get physician visits or medications. Referral coordinator used risk	Effects measured at 12 months School days missed during previous 30 days: 0.4 for intervention and 1.2 for control Symptom free days in last 2 weeks: 2.1 for intervention and 2.8 for control Adherence (used controller medication on 5 or more days within the previous 7 days): Maintained or improved adherence in 20.4% for intervention and 12.6% for control. Adherence worsened in 17.1% for intervention and 23.8% for control. Rescue inhaler carrying behavior (carrying rescue	Intervention cost: \$6.66 per student Components Included in Intervention Cost: Salary of referral coordinator Data Source: Coordinator's contact log and salary data. Quality: Fair	Healthcare cost: NR	No economic summary measures Limitations: Healthcare utilization not monetized

Study Information	Study and Population Characteristics	Trial Name Intervention & Comparison	Effectiveness Findings	Intervention Costs	Healthcare Cost Averted Productivity Loss Averted	Economic Summary Measure
	African American: 98.6% Mean of 52% of students in the 6 schools qualified for subsidized lunch Medicaid: 49% Urban: 100% Time Horizon: Sessions to be completed over 180 days. Participants were followed for 12 months. Study dates were not reported.	assessment report from key questions in survey to proactively contact students. Comparison: Usual care -- students were directed to generic asthma education websites and given referrals to providers.	inhaler during 5 of the previous 7 days): Maintained or improved rescue inhaler carrying behavior in 38.8% for intervention and 32.2% for control. Rescue inhaler carrying behavior worsened in 12.5% for intervention and 24.5% for control. Healthcare utilization past 12 months: ED visits: 0.5 for intervention and 0.8 for control Inpatient: 0.2 for intervention and 0.6 for control 12-month Quality of Life Score: 5.3 for intervention and 5.0 for control Data Source: Post only, self-reports from survey			
Author (Year): Liptzin et al. (2016) Design:	Location: Denver, Colorado, USA Setting:	Step-up Asthma School nurse is link from school to rest of team. Program delivered by	Knowledge about inhaler technique increased 2.76 points	Intervention Cost: NR	Total healthcare cost savings: \$46,000	No summary economic outcomes Limitations:

Study Information	Study and Population Characteristics	Trial Name Intervention & Comparison	Effectiveness Findings	Intervention Costs	Healthcare Cost Averted Productivity Loss Averted	Economic Summary Measure
Pre to post Method: Healthcare cost Funding Source: Colorado Department of Public Health and Department of Environment Monetary Conversions: Index year assumed 2011 in US dollars	Elementary and middle schools Eligibility: Schools selected for low SES based on school lunch eligibility, minority representation, and asthma prevalence. Students recruited through referrals, flyers, back to school nights, and nurse letters to parents, and during registration. Sample Size: Intervention: 252 Characteristics Mean Age: NR Female: 42% African American: 32% Hispanic or Latino: 53% White: 5.5% Other: 9.5% Medicaid 59%, Children's Health Insurance: 5% Private insurance: 26% Uninsured: 6% Urban: 100% Asthma Score (where 5 is	three trained lay asthma counselors, each covering five schools with 75 to 100 children assigned to each counselor. Medical advisory panel of pediatricians and asthma specialists provided oversight. Asthma education and care coordination based on Inner City Asthma Model. Seven main components: case identification; asthma risk assessment; asthma control tests with feedback to students, parents, and providers; care coordination involving student, school nurse, family, and provider; self-management skills; asthma education curriculum; asthma education for school and ancillary staff; safety net provision of controller medication. Minimum of four sessions for care coordination provided in addition to the education sessions. Communications occurred with family and physicians, as needed.	Open Airways for School score that measures self-management skills and recognizing asthma triggers increased 7.11 points, which is favorable. Kickin' Asthma score that measures severity, healthcare utilization and symptoms decreased 2.97 points, which is favorable Asthma exacerbations requiring steroid bursts reduced from 0.22 to 0.01 (geometric mean) ED or urgent visits reduced from 0.45 to 0.1 School days missed reduced 1.25 to 0.9 Source: Approximated from Figure in study. Based in self-report questionnaire. Measure Type: Pre to post		Change in healthcare cost per student per year: Reduced \$182.54 Components Included in Healthcare Cost: ED Source and Valuation: Self-reported 46 ED visits averted at \$1000 per visit. Measure Type: Pre to post Quality of Capture: Fair Quality of Measurement: Fair Change in Mean Productivity: NR	Healthcare cost based on ED visits only No control group Benefits from asthma-free days not monetized

Study Information	Study and Population Characteristics	Trial Name Intervention & Comparison	Effectiveness Findings	Intervention Costs	Healthcare Cost Averted Productivity Loss Averted	Economic Summary Measure
	uncontrolled asthma): 5: 35% 4: 8% 3: 56% Time Horizon: Intervention is 12 months. Piloted 2010-2011 and followed up 2011-2012.	Physicians of enrolled students received a letter informing them about the program and requesting a school asthma action plan. Students received assistance locating a provider and accessing medications. Lack of asthma control prompted additional steps to improve control. Six group education and self-management sessions for grades 3-5 and four group education sessions for grades 6-8. Students received tool kits with peak flow meters, inhaler holding chamber, and instructions. Comparison: None				
Author (Year): Mosnaim et al. (2011) Design: RCT Economic Method: Intervention cost	Location: Chicago, Illinois, USA Setting: Mixed elementary and middle schools Eligibility: Participants were from 26 Chicago area schools in which 70% or more	Fight Asthma Now (FAN) Program delivered by four FAN educators from Respiratory Health Association of Metropolitan Chicago plus Americorp volunteers who were college-educated with no prior healthcare or asthma training.	Asthma knowledge and spacer knowledge regression adjusted differences for intervention versus control. Asthma Knowledge: Youth 2.14 points higher (baseline 11)	Intervention cost: \$38.93 per child over four sessions Components Included in Intervention Cost:	Change in healthcare cost: NR Change in Mean Productivity: NR	No economic summary measures Limitations: No averted healthcare cost No averted asthma days

Study Information	Study and Population Characteristics	Trial Name Intervention & Comparison	Effectiveness Findings	Intervention Costs	Healthcare Cost Averted Productivity Loss Averted	Economic Summary Measure
Funding Source: Abbott Laboratories Monetary Conversions: Index year assumed 2009 in U.S. dollars.	of the students were eligible for subsidized school lunch. Participants were selected from those who had ever received an asthma diagnosis from a physician. Sample Size: FAN Youth Intervention: 271 Control: 69 FAN Teen Intervention: 141 Control: 51 Characteristics: Youth Median Age: 10 y Female: 41.5% African American: 65.5% Hispanic: 11.6% Other: 22.3% Urban: 100% Teen Median Age: 13 y Female: 48.2% African American: 62.7% Hispanic: 7.1% Other: 7.1% Urban: 100% Time Horizon: Recruitment during September 2007 and August 2008.	Volunteers underwent Certified Asthma Educator-led 1-day training with three hours about asthma knowledge and four hours about delivery of the FAN curriculum and how to administer knowledge and spacer tests. Training supervised by FAN trainer who accompanied educators to each school and provided feedback. Program included four 45-minute education sessions in school on consecutive days. Content included: asthma knowledge, triggers and avoidance, self-monitoring with peak flow meters and asthma action plan, appropriate medication use, warnings of exacerbations, tobacco use, and social and peer pressures, and self-management. Comparison: Usual care	Teen 0.85 points higher? (baseline 11) Spacer Knowledge: Youth 3.77 points higher (baseline 0) Teen 3.94 points higher (baseline 0) Data Source: Written test for asthma knowledge and observations for spacer knowledge Measure Type: DiD	Supplies, materials, staff time Data Source: NR. Presumed to be study records. Quality: Good		

Study Information	Study and Population Characteristics	Trial Name Intervention & Comparison	Effectiveness Findings	Intervention Costs	Healthcare Cost Averted Productivity Loss Averted	Economic Summary Measure
	Intervention length and follow-up not reported.					
Author (Year): Otim et al. (2015) Design: Post Only Economic Method: Intervention cost Funding Source: Poche Center of Indigenous Health, Sydney Medical School, University of Sydney Monetary Conversions: Index year assumed 2013 in Australian dollars	Location: Sydney, Australia Setting: Five high schools Eligibility: NR Sample Size: 825 students Baseline Characteristics: Schools had 10-20% aboriginal and Torres Strait Islander students. Mean Age: 11.5 Urban: 100% Time Horizon: Study examined intervention cost for one year. Dates not provided.	Adolescent Asthma Action (Triple A) Peer-led school-based program to improve asthma self-management and prevent smoking uptake. Program delivered by 20 university student educators per school, 20 school peer educators per school, one university project officer, one Aboriginal Education Officer, and 20 student educators (age 15-16) per school. Four facilitators trained 20 university students during 5-hour workshop. School teachers managed classes while student educators (age 15-16) taught their juniors (age 11-12). Materials addressed asthma and its management and smoking prevention; included games and activities. Comparison:	No effectiveness outcomes reported Multiple papers cited for Triple A effectiveness in Australian trials.	Intervention cost: \$50 per targeted student per year \$8,212 per school \$41,060 total for five high schools Excluding volunteer labor and venue cost dropped cost to \$14 per targeted student. Components Included in Intervention Cost: Salaries: \$20,563 (\$11,869 was volunteer) Cost of facility rent: \$11,660 Data Source: Activities from study and unit price from literature	Healthcare Cost: NR Productivity: NR	No summary outcomes Limitations: Change in healthcare cost not estimated No effectiveness estimates

Study Information	Study and Population Characteristics	Trial Name Intervention & Comparison	Effectiveness Findings	Intervention Costs	Healthcare Cost Averted Productivity Loss Averted	Economic Summary Measure
		None		Quality: Good		
Author (Year): Salisbury et al. (2002) Design: RCT Economic Method: Intervention cost and healthcare cost Funding Source: National Health Service (NHS) Research and Development Programme on Asthma Management and South West NHS Research and Development Directorate Monetary Conversions: Index year assumed 1999 in UK pounds	Location: Southwest England, UK Setting: Secondary school (middle and high); two schools from low SES and two schools from high SES Eligibility: Participants recruited based on screening questionnaire administered at school in years 7 to 11 referenced against computerized prescribing records from local general practices. Eligible students had at least one affirmative response in screening questions and an asthma prescription within past two years. Sample Size: School clinic: 157 General practice clinic: 151 Control: 142	Intervention: Staffed by nurse with school nursing experience and specialist training. School asthma clinic held weekly. Nurse delivered in-school intervention and offered care similar to asthma care in general practice but with discussions targeted to needs and interests of students. Changes to medications followed national guidelines. Normal follow-up at one month and then at six months after baseline. Those who needed to change their treatment or had poor control additionally followed up at three months. Comparison: Usual care by nurse or physician in asthma clinic or general practice external to the school.	Measured at 6-month pre and 6-month post. Significantly more in school-clinic students had asthma review (90.8%, baseline 25.5%) than practice-clinic (51%, baseline 17.5%) or control (58.1%, baseline 21.3%) students. No significant difference in quality of life or symptoms (post Steen score were school-clinic 17, practice-clinic 17, control 18). Knowledge of asthma significantly higher in school-clinic students (2.64) versus practice-clinic (2.26), or control (2.39) students. Inhaler technique higher with median scores for school-clinic (4) versus	Intervention cost per student over six months: £21.65 Components included in intervention cost: Nurse and administration labor cost, materials, and postage Source and Valuation: Records from trial and area wages and prices Quality: Good	Program plus healthcare cost per student per year: In-school: £56.60 In clinic: £38.08 Control: £35.72 Components Included in Healthcare Cost: Asthma related ED, inpatient, outpatient, medication Source and Valuation: Parent/student questionnaire checked against general practice records Measure Type: Post only Quality: Good Change in Mean Productivity: NR	No summary economic outcomes

Study Information	Study and Population Characteristics	Trial Name Intervention & Comparison	Effectiveness Findings	Intervention Costs	Healthcare Cost Averted Productivity Loss Averted	Economic Summary Measure
	Characteristics: Median age: 13 y Females in-school: 48.7% Females in practice clinic: 53% Time Horizon: 1999-2000 academic year Intervention length: six months		practice-clinic (3), and control (3). The percent of students with at least one school day lost was similar in the school-clinic 30.6%, practice-clinic 32.6%, control 30.2%. Data source: General practice records, tests, and questionnaire Measure Type: Post only			