Improving Pediatric Asthma Management:

A Quality Improvement Project

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Abstract

Purpose: To educate clinic staff on interventions and education materials which are suitable for implementation in a pediatric primary care setting, and to improve delivery and documentation of appropriate asthma interventions and inhaler/spacer education.

Background: Asthma is a chronic illness that impacts 10.9% of the pediatric population in Arizona. Poor asthma understanding and management leads to high-utilization of emergency rooms and urgent care clinics, negatively impacting the healthcare economy. Poor asthma management also leads to decreased health outcomes and impacts on the child's academic functioning, mental health, and overall quality of life. Current evidence supports use of written asthma action plans (WAAP) and inhaler/spacer instruction to improve asthma management.

Methods: The intervention was an evidence-based educational session provided to the staff of a military, pediatric primary care clinic in southwest Arizona regarding the use of WAAP, the Asthma Control Test (ACT) and integrated inhaler/spacer instruction. Chart reviews were conducted to evaluate the documentation of use of WAAP, ACT, and inhaler/spacer education.

Results: Charts were collected from pre-intervention (n = 33) and post-intervention (n = 18). Data analysis demonstrated a statistically significant higher use of WAAP ($U = 0.008$, $p < 0.05$, $d = 0.83$). Although there was not a statistically significant change in use of ACT tool, Cohen's value ($d = 0.48$) suggested a moderate positive effect. A Pearson correlation coefficient was also calculated for the relationship between use of ACT tool and use of WAAP, demonstrating a moderate positive correlation (r (49) = .372, $p < .01$).

Conclusions: An evidence-based education session for pediatric staff members is a cost-effective and simple method of improving pediatric asthma management practices.

Keywords: asthma, asthma management, primary care, written asthma action plan

Improving Pediatric Asthma Management

Asthma is a chronic disease of the respiratory system that is characterized by wheezing, chest tightness, bronchospasm, difficulty breathing, and coughing, particularly nighttime and early morning coughing (American Lung Association of Arizona [ALAA], 2016; CDC, 2018; John & Brady, 2017). It is the most common chronic lung disease in children and can range in severity from mild with intermittent symptoms to severe with sustained symptoms (ALAA, 2016; Burns, 2017). Often asthma can be controlled by taking medications as prescribed by a healthcare provider and avoiding things that may trigger an asthma attack (CDC, 2017).

Background and Significance

Problem Statement

According to the most recent data from the Centers for Disease Control and Prevention, approximately 9.2% of children in the United States have a current diagnosis of asthma, while the rate in Arizona is 10.9% (ALAA, 2016; CDC, 2013). Asthma exacerbations and complications from asthma are associated with $8.3 billion in health care expenses, of which 28% is caused by emergency department (ED) visits and hospitalizations (Abir et al., 2017). Asthma is ranked second among the top five mostly costly health conditions for children aged 0-17 years, with a total of 12.1 million children obtaining healthcare for asthma or chronic obstructive pulmonary disease (Soni, 2015). A significant amount of ED visits and hospitalizations can be prevented through proper primary care management, patient education, and home care (Abir et al., 2017; ALAA, 2016).

The Arizona Department of Health Services (ADHS) has established asthma management, both in adults and children, as a public health priority (ALAA, 2016). In Arizona, more than 27,000 ED visits and hospital discharges were attributed to asthma, accounting for

approximately $150 million in healthcare spending (ALAA, 2016). In line with Healthy People 2020, Arizona has established a goal of reducing asthma-related ED visits and hospitalizations, reducing asthma-related missed school and work days, and reducing deaths related to asthma and other chronic lower respiratory diseases by ten percent (ALAA, 2016). In the Arizona Comprehensive Control Plan, the ADHS has established several objectives to achieve their asthma management goals (ADHS, n.d.). Some of the pertinent objectives within Arizona's control plan include: improving patient's knowledge and behavior in the self-management of asthma, educating healthcare providers to ensure the delivery of evidence-based best practice, and increasing the number of asthmatics in Arizona that receive written asthma management plans from their healthcare provider (ADHS, n.d.). The objectives highlight the importance of primary-care based interventions to reduce asthma-related complications, utilization of acute care services, and ultimately deaths associated with asthma.

Pediatric Asthma Patients

In addition to overall health status, poorly managed asthma has a lasting impact on a child's quality of life and missed school days. An asthma diagnosis in children is often associated with increased reported anxiety and depression symptoms than their healthy peers (Santos, Crespa, Silva, & Canavarro, 2012; Walker, 2012). Children with poorly controlled asthma are more likely to experience sleep disturbances, activity limitations, missed days of school, ED visits, and hospitalizations (Santos et al., 2012; Trent, Zimbro, & Rutledge, 2015). In a study by Trent et al. (2015), children with poorly controlled asthma missed 33.3% more days of school than children whose asthma was well-controlled. Missed school days are associated with asthma exacerbations or lack of asthma control, increased ED or urgent care visits, and scheduled clinic visits (Hsu, Qin, Beavers, & Mirabelli, 2015). School absenteeism negatively

impacts a child's academic performance and should be considered when evaluating the effectiveness of current asthma management interventions.

Primary Care Interventions

Asthma self-management includes the patient (or parent) being educated on asthma medications, symptom control, avoidance of triggers, routine scheduled visits with healthcare provider, and implementation of a written asthma control plan. While a written asthma control plan is part of holistic asthma management and increases patient/parent knowledge of asthma, it has not been found to decrease acute visits to the healthcare provider (Tan, Chen, Soo, Ngoh, & Tai, 2013; Wong, Nathan, deBruyne, Zaki, & Tahir, 2012). Despite this fact, asthma action plans assist patient's in making short-term changes to their treatment if their symptoms or peak-flow measurements deteriorate (Global Initiative for Asthma (GINA), 2018). A systematic review found that children preferred symptom-based action plans over peak-flow based action plans and were more likely to continue using these action plans (Bhogal, Zemek, & Ducharme, 2006). Technology-based interventions and asthma action plans are also becoming more prevalent and may increase utilization, especially in the adolescent population. The effectiveness of these technology-based interventions to make a statistically significant impact still requires further study (Marcano-Belisario, Huckvale, Greenfield, Car, & Gun, 2013).

ER and Urgent Care Utilization

When patients or parents of pediatric asthma patients feel that their child is experiencing an asthma exacerbation, they will seek care through an acute visit with their healthcare provider. If these appointments are not available, or if it is after hours, they may be forced to utilize urgent care or emergency departments. In a study of 62 pediatric patients, 13 patients with uncontrolled asthma, compared with 2 patients with well-controlled asthma, utilized the ED. This was found

to be a statistically significant difference in ED utilization (Trent et al., 2015). Another study found that only 36% of patients who utilized the ED reported having a preventative asthma healthcare visit in the past twelve months (Gundewar, David, Frey, Fagnano, & Halterman, 2017). These findings suggest that patients with established primary care and provision of evidence-based management, are more likely to be well-controlled and less likely to utilize ED and urgent care services.

Summary

Effective application of clinical practice guidelines and patient education to improve self-management abilities have a positive impact on how well a patient's asthma is controlled. Uncontrolled asthma has substantial impacts on the child and family quality of life, school attendance, behavioral health, and utilization of ED/urgent care services. Utilization of these emergency services and poorly managed asthma, in general, contribute to significant healthcare cost. It is imperative to implement interventions in primary care that can address these issues and decrease the number of children with poorly controlled asthma.

Internal Data and PICOT

In a military, pediatric primary care clinic in southwest Arizona, asthma patients are managed by either primary care providers or the allergy/immunologist. Asthma management is not standardized, some patients receive a written asthma control plan and others do not. There is not an asthma educator on staff or current availability of a nurse for this type of intervention.

Preliminary interest in this problem led to an inquiry of current evidence to determine the best interventions for asthma management. This literature review has led to the clinically relevant PICOT question, *In pediatric patients with asthma (P), how does implementation of*

enhanced education and a self-management intervention (I) compared to usual care (C),reduce ED/urgent care utilization (O) within 16 weeks (T)?

Search Strategy

Databases searched for the literature review included Cumulative Index of Nursing and Allied Health Literature (CINAHL), PubMed, and The Cochrane Library. Keywords included; *asthma management, asthma action plan* and *asthma AND self-management.* The initial search of *asthma management* yielded 2.940 results in CINAHL (Appendix A), 21,978 in PubMed (Appendix B), and 694 in The Cochrane Library (Appendix C). By setting limits to age 18 and younger and publication date from 2012-2018, resulted in a final yield of 353 studies in CINAHL (Appendix A) and 399 in PubMed (Appendix B). Publication date restrictions were not utilized in The Cochrane Library, as the most recent systematic review on pediatric asthma management had been withdrawn, so the most relevant systematic review was last updated in 2010. The final search with date and age restriction of *asthma action plan* yielded 35 results in CINAHL (Appendix A) and 43 in PubMed (Appendix B). The final search with date and age restriction of *asthma AND self-management* yielded 79 results in CINAHL (Appendix A) and 57 in PubMed (Appendix B). The results for each of the searches performed in The Cochrane Library were reviewed for pertinent results based on pediatric population inclusion.

Exclusion criteria included published dates before 2012, with the exception of one landmark study, studies written in non-English language, unpublished works, or those involving adults only. Studies included involved children in primary care, specialty, hospital and community settings in various countries.

From the original database searches, 35 studies were selected using inclusion and exclusion criteria to be hand-examined to determine if they addressed PICOT elements through

review of article title and abstract. After critical appraisal of 35 studies, eleven have been chosen for inclusion in this literature review. From the 35, those excluded were impertinent to this review (studies of technology-based interventions), included interventions that did not meet criteria, or were not feasible. The studies included in the review evaluated the relationship between asthma management or written asthma action plans and various patient health outcomes, ER/acute appointment utilization, provider ability to educate patients, and/or medication compliance (Appendix A).

Critical Appraisal and Synthesis of Evidence

The eleven studies selected were analyzed using Melnyk & Fineout-Overholt (2015) rapid critical appraisal and are presented in evidence tables for analysis of data (Appendix A). Three studies were level I evidence (well-designed systematic reviews), three studies were level II evidence (well-designed randomized controlled trials), three level III evidence (not multi-site studies), one was level IV evidence (questionnaire study), and one was level VI (longitudinal, retrospective study). The level IV evidence provided insight to caregiver understanding of WAAP in multiple primary care clinics and differences in outcomes in patients who receive a WAAP or not (Tan et al., 2013). The level VI evidence evaluated the effectiveness of a comprehensive asthma wellness program (CAWP) in reducing acute healthcare utilization (Safi et al., 2016). All but one of the studies measured acute healthcare utilization in some manner, either ER/urgent care visits, unscheduled doctor appointments, or hospitalizations (Appendix A). Other measurements included various tools to quantify asthma control, asthma quality of life, symptom days, peak expiratory flow, or medication compliance. Four of the RCTs and the questionnaire study performed a power analysis to determine adequate sample size and one of the studies had a 0% attrition rate. Many of the controlled trials utilized a large sample size and

an adequate number of studies/participants were included in the SRs (Appendix A). All studies/reviews required a medical diagnosis of asthma and excluded airway symptoms caused by other diagnoses. All studies also addressed asthma education and patient-specific outcomes.

Several studies documented use of standardized tools for measurement such as the Asthma Control Test (ACT), Asthma Quality of Life Questionnaire, and/or Pediatric Caregivers Quality of Life Questionnaire. The use of these standardized tools suggests reliability and validity of statistically significant data outcomes. Most of the studies were of high quality, documenting specific confidence intervals (CI), means, level of significance (p), and/or covariance (*F*). The two RCTs that were not double-blinded identified the difficulty in blinding participants because of study design, one evaluating providers ability to provide hypothetical patient education based on low-literacy WAAP or standard WAAP and the other attributed single-blind design to limited resources (Appendix A).

A strong degree of homogeneity was recognized in patient age, only one included adult patients in addition to pediatric patients in the analysis, however several studies included information about the caregivers in addition to the pediatric patients. Overall demographics are very heterogenous, including patients in rural locations and more urban areas, offering education and interventions in schools, hospitals, and outpatient clinics to underserved populations and those with access to subspecialists. Despite the heterogeneity of the study locations and demographics, the consensus in findings suggests that most of the results of the studies should be transferable. Overall, descriptive definitions of interventions and analysis allow for replication and implementation.

There was a moderate degree of heterogeneity in interventions applied, ranging from nurse-led or pharmacist-led education sessions, to in-school and day camp education sessions, to

varying degrees of WAAP use. All of the studies addressed asthma education in some manner and five of these demonstrated a statistically significant decrease in acute healthcare utilization and another demonstrated a non-significant decrease in acute healthcare utilization (Appendix B). Other outcomes measured had a great heterogeneity and included patient-specific outcomes, cost-effectiveness, Quality of Life (QoL), and medication adherence. One study was included that varied greatly from the group, to address the impact of using low-literacy WAAP on provider explanations during asthma education. No study could be found that assessed the impact of this intervention on healthcare utilization or other outcomes (Appendix B).

Conclusions

The most consistent outcome across all studies was that an education intervention, when utilized correctly, decreases the use of acute healthcare services. Although not all studies demonstrated statistically significant results, most of them indicated a negative trend in acute healthcare utilization, when it was measured. Overall, provision of a thorough educational program and/or use of a WAAP are both cost- and time- effective and lead to increased patient outcomes and decreased healthcare costs. The Global Initiative for Asthma (GINA) 2018 guidelines cite age-appropriate asthma education, including instruction on device usage, and asthma action plans as appropriate interventions to improve asthma management. These guidelines are reinforced by information obtained from the literature review. Data collected suggests that not all providers are providing this education or utilizing asthma action plans with all pediatric asthma patients.

Purpose Statement

The purpose of this project was to establish consistent guidelines and interventions for the management of asthma, to educate clinic staff on interventions and education materials which

are suitable for implementation in a pediatric primary care setting, and to improve adherence to and documentation of appropriate asthma interventions and inhaler/spacer education. Key stakeholders include the staff of the pediatric clinic, administration of the medical group, and the patients and their families. The providers, nurses, and technicians will expand their knowledge of asthma management strategies while patients and their families will benefit from evidence-based asthma care. The desired outcome and possible benefit, according the current literature, is a reduction in acute healthcare utilization and overall improved quality of life experienced by the patients (Appendix B).

Study Questions

- Does a provider education intervention improve the likelihood of providers to follow the Veterans Affairs/Department of Defense (VA/DoD) Clinical Practice Guideline?
- Does a staff education intervention increase the likelihood that spacer/inhaler instruction will be provided?
- Does a provider education intervention increase the use of a written asthma action plan?
- Does a staff education intervention increase the use of the Asthma Control Test tool?
- Does a provider education intervention combined with a patient/family education intervention decrease the overall utilization of acute healthcare services?

Conceptual Framework and Theoretical Model for Project Development

Bruhn's theoretical framework for asthma self-management will guide the development of an educational intervention at a military, pediatric primary care clinic in southwest Arizona (Bruhn, 1983). This model attempts to explain the multifactorial influences of family, support system, healthcare utilization, health attitudes, health beliefs, general health needs, and specific illness needs. The model emphasizes the interaction of these concepts and the need to assess and

re-assess a patient's situation to provide the best care possible. The factors mentioned can change and evolve, thus contributing to a compliant patient becoming non-compliant. The model stresses the importance of considering the whole picture to promote self-management and overall health.

Military institutions favor a step-wise and organized method for process improvement and change initiatives. The model for evidence-based practice change by Larabee (2009) will be utilized to implement the quality improvement project. This model identifies six steps for practice change; assess the need for change, locate the best evidence, critically analyze the evidence, design the practice change, implement and evaluate the change in practice, and integrate and maintain the change in practice (Appendix C). This model emphasizes deliberate project development and a step-wise approach to facilitate the practice change. Utilizing this model, a need for change in pediatric asthma education was identified, stakeholders were included (providers, management, and staff) and evidence was identified and analyzed (Appendix A & B). Stakeholders were involved throughout the practice change design, implementation and evaluation. Finally, based on results obtained from the practice, the practice change will be implemented or adapted as a part of standard care at this clinic.

Project Methods

Ethical Considerations

Protection of human subjects was ensured through appropriate training of all investigators through Collaborative Institutional Training Initiative (CITI) and approval through Arizona State University (ASU) Institutional Review Board (IRB). There was no collection of identifying information during the chart review process. Data collected through chart review included age and gender of the patient, type of healthcare provider, and compliance with specific asthma interventions. Pediatric clinic staff provided consent through receipt of an email

invitation to the education session and participation in said session. Permission to implement the quality improvement project was obtained from the practice site (Appendix D). Approval for the project was received from ASU IRB on November 30, 2018 (Appendix E).

Setting and Organizational Culture

This project was implemented in a military, pediatric primary care clinic in southwest Arizona. The surgeon general of the hospital (SGH) and chief nurse within the medical group are both supportive of the quality improvement project. The electronic health record used in the clinic is AHLTA which allows for retrieval of needed data.

Participants

The entire staff of the pediatric clinic was invited to participate in the educational intervention, as well as the SGH and chief nurse of the medical group. Participation included four physicians (3 MDs and 1 DO), two nurse practitioners, two nurses, and four technicians. There were eight women and four men.

Intervention

Intervention design focused on discussion of relevant asthma guidelines and the importance of certain asthma interventions on overall asthma self-management. The session also included content on appropriate documentation and coding of asthma interventions to ensure appropriate billing abilities. Clinic staff members were reminded of the impact of appropriate self-management on overall asthma control and related utilization of acute healthcare services. Pediatric primary care providers can improve asthma management and reduce ER/urgent care utilization by employing an asthma action plan and by making easy to understand, robust, age-appropriate education available to all asthma patients and parents.

Outcome Measures

Retrospective chart reviews (RCR) were used to evaluate the effect of the education intervention on the likelihood to use the ACT, WAAP, and provide inhaler/spacer education. RCR are considered inferior to prospective study design but are appropriate in certain circumstances. Advantages of this study design include low cost, use of existing records, and potential to lead to hypothesis for further evaluation which can be completed with prospective design (Hess, 2004). Some disadvantages of RCR include relying on the accuracy of documentation by others, there is no randomization or blinding, and it is difficult to establish cause and effect (Hess, 2004).

Data Collection and Analysis

Effective retrospective chart reviews must include well-defined research questions, have operationalized variables, use of a standardized abstraction forms, and clearly developed inclusion and exclusion criteria (Matt & Matthew, 2013). A standardized abstraction form was developed and used in data collection for pre- and post- intervention charts. Inclusion criteria for this project were charts for all pediatric clinic patients seen during a 30-day period, with any reactive airway or asthma diagnosis. These diagnoses included J45.20, J45.21, J45.22, J45.30, J45.31, J45.32, J45.40, J45.41, J45.42, J45.50, J45.51, J45.52, J45.901, J45.902, J45.909, J45.990, J45.991, and J45.998. Charts were selected from a 30-day period one year before the intervention (January 24 – February 23, 2018) and a 30-day period immediately following the intervention (January 24 – February 23, 2019).

Data extracted during the RCR will be input into IBM SPSS Statistics 24 for data analysis. The nature of the data will allow for descriptive statistics as well as Mann Whitney U

for determining relationships between variables. A Cohen's *d* was performed to determine the effect size. Pearson correlation was calculated to determine correlation between variables.

Outcomes

Demographics

Group One: Pre-Intervention.

Charts included in the analysis were selected from a timeframe of January 24, 2018 until February 23, 2018 (n = 33). The average age of the pediatric patients was 10 years of age (SD = 3.30 years of age). Their ages ranged from three to seventeen years of age (Appendix F). The sample consists of primarily males, n = 22 (67%) and the remainder were female, n = 11 (33%). The charts were divided among three different types of healthcare provider of record: medical doctor (n = 14), doctor of osteopathic medicine (n = 5), and pediatric nurse practitioner (n = 14).

Group Two: Post-Intervention.

Charts included in the analysis were selected from a timeframe of January 24, 2019 until February 23, 2019 (n=18). The average age of the pediatric patients was 8 years of age (SD = 3.43 years of age). Their ages ranged from two to twelve years of age (Appendix F). The sample consists of primarily males, n = 13 (72%) and the remainder were female, n = 5 (28%). The charts were divided among two different types of healthcare provider of record: medical doctor (n = 9) and pediatric nurse practitioner (n = 9).

Statistical Significance

Written Asthma Action Plan.

Prior to the asthma education intervention, a WAAP was only used in 11 of the 32 cases. After the intervention, a WAAP was used in 13 of the 18 cases. A Mann-Whitney *U* test was calculated examining the use of WAAP with and without asthma education intervention. Charts

completed after attending the asthma education session demonstrated a statistically significant higher use of WAAP ($U = 0.008$, $p < 0.05$) than those completed prior to the asthma education session. Cohen's effect size value ($d = 0.83$) also suggested a strong clinical significance (Appendix G).

Asthma Control Test and Inhaler/Spacer Instruction.

Prior to the asthma education intervention, the ACT tool was only used in 9 of 33 charts, while after the intervention it was used in 9 of the 18 cases. While inhaler/spacer instruction was documented in 8 of the 33 charts prior to the intervention and in only 2 of the charts after the intervention, demonstrating a reduction in inhaler/spacer instruction. A Mann-Whitney *U* test was calculated examining the use of ACT with and without asthma education intervention. Charts completed after attending the asthma education session demonstrated a higher use of ACT, although not statistically significant ($U = 0.108$, $p < 0.05$) than those completed prior to the asthma education session (Appendix G).

Clinical Significance

Although the Mann Whitney *U* did not demonstrate a significant improvement in use of ACT after the asthma education intervention, the intervention did demonstrate a positive influence on this variable. Cohen's effect size value ($d = 0.48$) suggested a moderate clinical significance. A Pearson correlation coefficient was calculated for the relationship between use of ACT tool and use of WAAP. A moderate positive correlation was found ($r(49) = .372$, $p < .01$), indicating a significant linear relationship between the two variables. Providers who documented use of the ACT tool were more likely to document use of the WAAP (Appendix G).

Clinical Implications

Impacts of Project

Both patients, providers, and administrative will see far reaching positive outcomes from the implementation of this intervention. Patients and their families will also benefit from a more in-depth understanding of the asthma diagnosis. Secondary gains could include improved management of asthma symptoms, improved Asthma Control Test (ACT) scores, improved school attendance, and improved QoL. Providers also have the opportunity to positively impact the health management of children with a chronic illness and impower the child and parent to improve their self-management skills. Since some of the outcomes were found to be clinically and statistically significant, providers and administration could benefit from data that supports the implementation of a part-time or full-time pediatric asthma educator. Data is still being collected to determine if utilizing written asthma action plans and providing in-depth, age-appropriate asthma education leads to decreased ER and urgent care utilization, the long-term outcome of interest.

Sustainability

Since the focus of this project is implementing screening tools, interventions and patient education in line with all current guidelines for the management of pediatric asthma, continuation of these components is consistent with best-practice. The project was well received by the practice site and staff members were willing to share feedback throughout the process. The administration within the clinic is supportive of the project and would like to see the education continued during unit meetings or huddles on an interval schedule. The staff of the pediatric clinic will be left with a quick-reference card, based on feedback, that lists basic recommendations and relevant coding numbers. Implementation of the recommended

interventions during asthma visits does not place a financial burden on the clinic, and could actually result in higher billing. The administration is also interested in further data and long-term effects to support hiring an asthma educator.

Strengths and Limitations

Retrospective chart reviews have several disadvantages, one of which is relying on others documentation to retrieve data. In this quality improvement project, subjective information gathered during time in the clinic does not correlate with data extracted from RCR. Technicians and healthcare providers report a high rate of inhaler/spacer instruction, which was not demonstrated during data analysis. One explanation for this discrepancy is that the billing code and related note were not entered by clinic staff, despite delivery of this education. A quick-reference card will be provided to clinic staff to encourage future documentation. RCR allows for inexpensive retrieval of information to determine correlation and suggest hypotheses for further research, which was appropriate for this project.

Delivery of an education session to encourage adherence with pediatric asthma management interventions demonstrated some statistically significant improvement in care delivery. Evidence demonstrates that use of the ACT tool, WAAP, and inhaler/spacer instruction at every visit improves patient self-management of asthma symptoms and decreases overall acute healthcare utilization. While the study period was too short to demonstrate decreased acute healthcare utilization, it did demonstrate a significant improvement in use of WAAP and a clinically significant effect on use of the ACT tool. Documentation inconsistencies were believed to contribute to the lack of statistically significant changes in inhaler/spacer instruction. This project is a cost-effective method to improve delivery of evidence-based practice and potentially impact the long-term management of a chronic pediatric illness.

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Yin, H. S., Gupta, R. S., Tomopoulos, S., Mendelson, A. L., Egan, M., van Schaick, L., . . . Dreyer, B. P. (2015). A low-literacy asthma action plan to improve provider asthma counseling: A randomized study. *Pediatrics, 137*(1), 1-11. doi:10.1542/peds.2015-0468

Appendix A
Evaluation Table

Citation	Theory/ Conceptual Framework	Design/ Method	Sample/ Setting	Major Variables & Definitions	Measurement/ Instrumentation	Data Analysis (stats used)	Findings/ Results	Level/Quality of Evidence; Application to practice
Belice (2017) Effective education parameters for trigger remediation in underserved children with asthma: A systematic review Chicago, IL Funded as part of the Building Healthy Communities Project by BMO Harris Bank No bias stated or found	PRISMA flowchart for study selection	Systematic Review **Purpose:** To identify common educational parameters of existing multi-trigger, multi-component educational intervention approaches	N = 17 n = 3278 children **Inclusions:** peer-reviewed research articles that address asthma education components **Exclusions:** incorrect population; opinion or editorial; not research-based; lacked educational component; no intervention; qualitative study	**IV-** Asthma education **DV1 -** healthcare utilization **DV2** - asthma control **DV3** - medication use **DV4 -** home environment **DV5 –** QoL and other components	EPR-3 guidelines to measure asthma control Healthcare utilization by urgent or unscheduled clinic visits, ER visits, or hospitalizations	Systematic data extraction by one author, verified by a second	**DV1 –** 14 studies demonstrated SS decreased in healthcare utilization Although DV2-DV5 were said to be analyzed – no data was given; authors site lack of EPR-3 guidelines as one barrier and discuss that all but one study evaluated healthcare utilization making it the most broad measure to discuss	**Level I** **Strength** – SR of multiple databases **Weakness –** included studies prior to EPR-3 guidelines which emphasized education **Conclusion** – multi-component home-based interventions showed mixed results **Feasibility** – limited support and too complex to implement in project

Key: **ACT score** – asthma control test; **CG** – control group; **DV** – dependent variable; **ER** – emergency room; **ES** – effect size; **ICS** – inhaled corticosteroid; **IG** – intervention group**; IV** – independent variable; **N** – number of studies; **n** – number of subjects; **NIH** -National Institute of Health; **NINR** – National Institute of Nursing Research; **NHLBI** – National Heart, Lung, & Blood Institute; **outpt** – outpatient; **PEFR** – peak expiratory flow rate; **QoL** – quality of life; **RCT** – randomized controlled trial; **SS** – statistically significant;**WAAP** – written asthma action plan

Citation	Theory/ Conceptual Framework	Design/ Method	Sample/ Setting	Major Variables & Definitions	Measurement/ Instrumentation	Data Analysis (stats used)	Findings/ Results	Level/Quality of Evidence; Application to practice
Bhogal (2006) Written action plans for asthma in children: Review Canada None reported Ducharme has received funding in the past from Glaxo Wellcome and Astra Zeneca and presented at a conference supported by Merck Frost. Bhogal and Zemek report no conflict of interest.	Cochrane methods of systematic review	Systematic Review **Purpose:** To evaluate the independent effect of providing versus not providing a written action plan in children and adolescents with asthma and to compare the effect of different written action plans.	N = 4 n = 355 children **Inclusions:** RCTs that compared a WAAP with no WAAP or that compared two different types of WAAP **Exclusions:** intervention of interest something other than WAAP; non-RCT; participants were adult without subgroup analysis of pediatric participants	**IV-** WAAP **DV1 -** acute care visits for asthma exacerbation **DV2 -** symptomatic days per week **DV3 -** exacerbation requiring oral steroids or admission **DV4 -** school absenteeism **DV5 –** lung function **DV6** - symptom score **DV7** - QoL	PEF was used to quantify asthma	Two authors independently selected the trials, assessed quality, and extracted the data; additional info was collected by contacting original study authors; followed Cochrane methods of systematic review Trials were combined using RevMan analyses	**DV1** – symptom-based WAAP had lower risk (RR 0.73, 95% CI) NNT to prevent one acute care visit was 9 **DV2** – peak-flow based WAAP showed reduction by ½ day (N=2, mean difference 0.45 days/week, 95% CI) **DV3-DV7 –** no significant group differences found	**Level I** **Strength** – Cochrane method of systematic review; analyzed multiple types of WAAP **Weakness –** only 4 studies; inconsistent reporting of adherence to monitoring; no RCT evaluated if WAAP is effective addition to pediatric asthma education **Conclusion** – symptom-based WAAPs are superior in preventing acute care visits **Feasibility** – Supports use of symptom-based WAAP; easy to use; cost-effective

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Citation	Theory/ Conceptual Framework	Design/ Method	Sample/ Setting	Major Variables & Definitions	Measurement/ Instrumentation	Data Analysis (stats used)	Findings/ Results	Level/Quality of Evidence; Application to practice
Horner (2016) Enhancing asthma self-management in rural school-aged children: A randomized controlled trial Austin, TX Grant funding from the NIH, NINR, and NHLBI Bias – none	Bruhn's theoretical model of asthma self-management	longitudinal RCT comparing 2 modes of intervention delivery with a control group **Purpose:** To test the effects of 2 modes of delivering an asthma educational intervention on health outcomes and asthma self-management in school-aged children who live in rural areas.	n=257 IG1 n=84 IG2 n=89 CG n=84 **Mean age:** 8.79 **Setting:** school-aged children (grades 2-5) in 33 schools in 5 rural Texas school districts **Inclusions:** asthma diagnosis on school record; current asthma symptoms in the last 12 mo; speak either English or Spanish; no significant co-morbidity **Attrition:** 12.3%	**IV-** Asthma Plan for Kids curriculum (delivered in school or one-day asthma camp) **DV1-** office visits **DV2 -** ED visits **DV3 -** hospitalizations **DV4 –** Asthma severity **DV5 –** airway inflammation and medication adherence to ICS	16-item home management survey 13-item Asthma Inventory for Children Number of inhaler actuations/prescribed dose over 2-week period RTube™	Latent growth curve modeling in SAS 9.3	**DV1** – $F(1504) = 3.94$, p=0.048 for asthma class **DV2** – $F(1509) = 3.99$, p = 0.046 for asthma camp **DV3** – $F(1266) = 15.65$, p<0.001 for all groups; no significant difference in decrease in hospitalizations across groups **DV4** – $F(1266) = 43.05$, p < 0.001 across groups; $F(1510) = 8.28$, p = 0.004 group effect for asthma class **DV5 –** no significant change; seasonal effect in Spring and Winter (pollen peaks in TX)	**Level II** **Strength** – low attrition rate; calculate effect size and did power analysis; guided by nursing model **Weakness –** limited generalizability due to small region used; control group still received health promotion education **Conclusion** – increased education led to decreased asthma symptoms, better control, & less ED/hospital use **Feasibility** – day camp is less cost-effective but otherwise feasible

Key: **ACT score** – asthma control test; **CG** – control group; **DV** – dependent variable; **ER** – emergency room; **ES** – effect size; **ICS** – inhaled corticosteroid; **IG** – intervention group**; IV** – independent variable; **N** – number of studies; **n** – number of subjects; **NIH** -National Institute of Health; **NINR** – National Institute of Nursing Research; **NHLBI** – National Heart, Lung, & Blood Institute; **outpt** – outpatient; **PEFR** – peak expiratory flow rate; **QoL** – quality of life; **RCT** – randomized controlled trial; **SS** – statistically significant;**WAAP** – written asthma action plan

Citation	Theory/ Conceptual Framework	Design/ Method	Sample/ Setting	Major Variables & Definitions	Measurement/ Instrumentation	Data Analysis (stats used)	Findings/ Results	Level/Quality of Evidence; Application to practice
Khan (2014) Effectiveness of personalized written asthma action plans in the management of children with partly controlled asthma in Trinidad: A randomized controlled trial Mt Hope, Trinidad Self-funded Bias – several potentials for bias were addressed and controlled within the study	Biophysical model	RCT – single-blinded **Purpose:** To evaluate the effectiveness of adding a personalized WAAP in the treatment of children with partly controlled asthma	n=91 IG n=45 CG n=46 **Mean age:** 6 **Setting:** pediatric clinic at Chaguanas Health Facility **Inclusions:** partly controlled asthma; history of ER/acute care visit in past 6mo; ability of child/parent to follow written directions **Exclusions:** Uncontrolled asthmatics; co-morbid resp illness; prior asthma education; prior enrollment in similar study; care sought outside of Chaguanas **Attrition:** 0%	**IV-** individualized WAAP **DV1 -** ER revisits for acute asthma care **DV2** - number of acute asthma events **DV3** - repeated ER visit rates (2 or more) **DV4** - number of asthma attacks **DV5** - -number of unscheduled doctor visits **DV6** - number of school days missed **DV7** - number of night-time awakenings with symptoms **DV8** – mean change in PEFR	# of ER visits # of acute asthma attacks # of unscheduled doctor visits # of missed school days # of nighttime awakenings with symptoms PEFR measurement	X^2 test Mann-Whitney U-test Wilcoxon signed ranks test	**DV1 -** Reduced in both groups (p = 0.005 & 0.0002) **DV2** – reduced in both groups (p = 0.0064 & 0.0006) **DV3** – lower in IG but not SS (p=0.374) **DV4** - lower in IG but not SS (p=0.399) **DV5** - lower in IG but not SS (p=0.690) **DV6** - lower in IG but not SS (p=0.280) **DV7** - lower in IG but not SS (p=0.480) **DV8** – better in IG but not SS (p=0.457 at 3-mo visit and p=0.866 at 6-mo visit)	**Level III –** not multi-site **Strength** – did power analysis & calculated ES; intentional bias control; consistent follow-up; blinding of outcome assessor **Weakness –** limited generalizability, study conducted in Trinidad; small sample size; non-concealment of allocation to paediatrician **Conclusion** – better outcomes were associated with use of a WAAP **Feasibility** – cost-effective and easy to implement

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Citation	Theory/ Conceptual Framework	Design/ Method	Sample/ Setting	Major Variables & Definitions	Measurement/ Instrumentation	Data Analysis (stats used)	Findings/ Results	Level/Quality of Evidence; Application to practice
Kuethe (2013) Nurse versus physician-led care for the management of asthma Netherlands No funding reported No bias reported	Cochrane methods of systematic review	Systematic Review **Purpose:** To determine the effectiveness of nurse-led asthma care provided by a specialized asthma nurse, a NP, a PA or an otherwise specifically trained nursing professional, working relatively independent from a physician, compared to traditional care provided by a physician.	N = 5 n = 588 adults and children **Setting:** primary care and hospital **Inclusions:** RCTs **Exclusions:** not related to nurse-led care; not related to follow-up; co-interventions present that distracted from objective of review or had no clear diagnosis of asthma	**IV –** nurse-led asthma management **DV1 –** patient-related outcomes (exacerbations, asthma symptoms) **DV2** - health economic outcomes **DV3** - objective measures of lung function, airway reactivity, and inflammation.	ACT or Asthma Control Questionnaire (ACQ) Asthma Quality of Life questionnaire	Standard methodological procedures expected by Cochrane Collaboration; two review authors independently screened all studies identified by search strategy & independently assessed each study based on pre-defined criteria RevMan 2008	**DV1** – No SS difference in exacerbations between groups (OR 0.86; 95% CI, p=0.674); No SS difference between groups in ACQ scores (physician led group p=0.18 and nurse led group p=0.28) **DV2** – SS lower cost in nurse-led group (EURO156 in nurse-led, EURO 189 in physician-led, p<0.001) **DV3** – no SS differences between groups	**Level I** **Strength** – Cochrane SR; reviews option that may be more cost-effective **Weakness –** only 5 studies **Conclusion** – No significant difference between nurse-led and physician-led care; nurse-led care may be appropriate in pts with well-controlled asthma **Feasibility** – cost-effective; supports use of additional personnel in management of asthma pts

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Citation	Theory/ Conceptual Framework	Design/ Method	Sample/ Setting	Major Variables & Definitions	Measurement/ Instrumentation	Data Analysis (stats used)	Findings/ Results	Level/Quality of Evidence; Application to practice
Olivera (2016) Asthma self-management model: randomized controlled trial Sao Paulo, Brazil Supported by 'Coordenacao de Aperfeiccoamento de Pessoal de Nivel Superior - CAPES' and 'Fundacao de Amparo a Pesquisa do Estado de Sao Paulo – FAPESP', Brazil (a federal, postgraduate education agency and a public research foundation) No bias identified	Asthma self-management model and Wilkinson's learning methodology	Longitudinal, prospective RCT **Purpose:** To test an original self-management model directed at the asthmatic population	n = 119 IG n = 59 CG n = 60 **Setting:** outpt asthma clinic, University Hospital **Inclusions:** asthmatic pts with different degrees of disease severity; access to public health system; without cognitive diseases that would impair participation in the study **Exclusions:** occurrence of severe adverse events; inability to execute the protocol; having conditions that may affect the results of the study; non-adhesion to clinical protocol	**IV-** pharmacist-led self-management meetings, one-hour length, monthly for four months **DV1** - asthma knowledge **DV2** - inhaler handling **DV3** - medication adherence **DV4** - pulmonary function **DV5** - QoL	34-item questionnaire Inhaler use evaluated by a validated tool (not named) Morisky-Green test & prescription renewal tracking Spirometry with Koko spirometer and its programme Outcomes Studies 36-item short form survey with certified translation to Portugese	Means of tables Mixed-effects linear regression models SAS version 9.0 Fisher's exact test R programme for graph construction	**DV1** – statistically significant increase in knowledge ($p < 0.0001$) **DV2** – significant intra- and intergroup increase in correct inhaler handling ($p < 0.0001$) **DV3** – significant increase in adherence in IG ($p = 0.0113$) **DV4** – increase in mean forced vital capacity in IG ($p = 0.0287$) **DV5** – increased QoL in IG, not in CG	**Level III** – single site **Strength** – consistent pre- and post-assessments by one investigator; multi-disciplinary **Weakness –** limited generalizability, conducted at one site in Sao Paulo, Brazil; single-blind study **Conclusion** – asthma self-management programs are effective in improving outcomes and QoL **Feasibility** – cost-effective, requires multi-disciplinary inclusion

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Citation	Theory/ Conceptual Framework	Design/ Method	Sample/ Setting	Major Variables & Definitions	Measurement/ Instrumentation	Data Analysis (stats used)	Findings/ Results	Level/Quality of Evidence; Application to practice
Safi (2016) A comprehensive pediatric asthma management program reduces emergency department visits and hospitalizations. Ann Arbor, MI Supported by the University of Michigan School Department of Pediatrics and Communicable Diseases No bias identified	Asthma self-management model	Longitudinal, retrospectice study **Purpose:** To assess the effectiveness of the Children's Asthma Wellness Program (CAWP) in reducing ED visits/hospitalizations and improving asthma management	n = 172 **Setting:** outpt asthma clinic **Program Inclusions:** age 36 months to 18 years; at least one recent ED visit or hospitalization due to acute asthma symptoms **Program Exclusions:** asthma symptoms caused by diagnosis other than asthma, such as recurrent aspiration or airway malacia **Study Exclusion:** patients without 1-2 yrs of pre- and post-program data available	**IV-** comprehensive program that includes initial clinical assessment, frequent follow-up, asthma education, facilitation of support services, and clinical monitoring of outcomes; optional in-home allergen assessments **DV1** - ED visits **DV2** – hospitalizations **DV3** - hospitalization days	Review of charts over 9 year period	Wilcoxon matched-pairs signed-rank test; mean & median	**Preprogram** **DV1** – 0.99 **DV2** – 1.19 **DV3** – 3.61 **Postprogram** **DV1** – 0.23 **DV2** – 0.14 **DV3** – 0.34 P<0.0001	**Level VI** **Strength** – limited analysis to pts with 1-2 yrs of pre- and post- data **Weakness –**no consideration of QoL, pulmonary function, asthma control test scores or steroid use; possibly missing data from care at outside hospitals **Conclusion** – demonstrates + effect of program on ED /hospital use **Feasibility** – implementation of entire program would be costly and not time effective, but one part is intense asthma and device use education

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Citation	Theory/ Conceptual Framework	Design/ Method	Sample/ Setting	Major Variables & Definitions	Measurement/ Instrumentation	Data Analysis (stats used)	Findings/ Results	Level/Quality of Evidence; Application to practice
Sheares (2015) Do patients of subspecialist physicians benefit from written asthma action plans? New York, NY NIH/NHLBI grant and the National Center for Advancing Translational Sciences, NIH Bias: Patients recruited to the study were being seen by subspecialists, not primary care	Biophysical model	Prospective, RCT with parallel groups; randomized block, mixed-effects factorial design was used, as double-blinding was not possible **Purpose:** To assess the efficacy of written instructions in the form of a WAAP provided by subspecialist physicians as part of usual asthma care during office visits.	n = 407 IG n =204 (141 children) CG n =203 (131 children **Setting:** seven hospital-based subspecialty clinics in New York City; 5 of which served primarily minority patients **Inclusions:** new patients to the practice, never seen by a subspecialist before, never received a WAAP **Exclusions:** comorbid condition affected lung health **Attrition:** 20.6%	**IV-** WAAP **DV1 -** asthma symptoms frequency **DV2** - ER visits for asthma **DV3** - asthma QoL **DV4** - hospitalizations **DV5** - days with activity limitation	3-item questionnaire about asthma symptoms Juniper Mini Asthma QoL Questionnaire for adult patients Pediatric Asthma Caregivers QoL (PACQOL) Questionnaire for pediatric patients 3-item questionnaire regarding WAAP	Poisson regression analysis Linear regression analysis Paired t-test Chi-squared test Fisher exact test SAS 9.2	**DV1 -** both groups demonstrated a significant reduction in all three asthma symptom variables ($p<0.0001$); no significant difference between groups **DV2** – significant reduction in ER visits for asthma in both groups ($p<0.0001$ for IG & $p=0.0006$ for CG) **DV3** -no between group differences in PACQOL but a significant increase in scores in both groups ($p<0.0001$) **DV4** – no significant reduction **DV5** – significant decrease in both groups	**Level II** **Strength** – power analysis was conducted **Weakness –**only included subspecialists; limited demographic variability **Conclusion** – considering pts treated by a subspecialist, there was no significant difference noted between groups provided with a WAAP & those who received provider instruction only. **Feasibility** – use of a WAAP or provider-based instruction is feasible; sometimes referral to a subspecialist is not available

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Citation	Theory/ Conceptual Framework	Design/ Method	Sample/ Setting	Major Variables & Definitions	Measurement/ Instrumentation	Data Analysis (stats used)	Findings/ Results	Level/Quality of Evidence; Application to practice
Tan (2013) Effects of a written asthma action plan on caregivers' management of children with asthma: a cross-sectional questionnaire survey Singapore Received a small grant from SingHealth Polyclinics and Ngee Ann Polytecnic (Singapore) No bias stated or found	Asthma self-management model	Questionnaire survey to caregivers of children with a WAAP and without a WAAP **Purpose:** To determine the differences in outcomes between children with a WAAP and without a WAAP	n = 169 IG n = 94 CG n = 75 **Setting:** nine public primary care clinics in eastern and southern Singapore **Inclusions:** primary caregivers (at least 75% of awake hours) of children diagnosed with asthma **Attrition:** 0%	**IV-** WAAP **DV1-** caregiver understanding of asthma symptoms **DV2** - use of asthma medications **DV3** - acute care consultation **DV4** - self-management	Asthma Control Test (ACT) Questionnaire	X^2 test Logistic regression analysis Odds Ratio estimate STATA software V.11	**DV1-** IG caregivers had increased understanding in two categories (p=0.025; p=0.005) **DV2** – overall greater knowledge in IG **DV3** - no SS in comfort discontinuing meds without contacting physician first **DV4** – no SS in caregivers' preference for self-adjustment & confidence in self-management (p=0.382 & p=0.817)	**Level IV** **Strength** – performed power analysis; based on previous well-designed qualitative study **Weakness –** not RCT; no info on caregiver literacy or socioeconomic status; limited generalizability, conducted in 9 districts in Singapore **Conclusion** – A WAAP improved caregivers' understanding of asthma & symptom management **Feasibility** – WAAPs are widely available and easy to implement; cost-effective

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Citation	Theory/ Conceptual Framework	Design/ Method	Sample/ Setting	Major Variables & Definitions	Measurement/ Instrumentation	Data Analysis (stats used)	Findings/ Results	Level/Quality of Evidence; Application to practice
Wong (2012) Does a written asthma action plan reduce unscheduled doctor visits in children? Kuala Lumpus, Malaysia WAAP printing was sponsored by GlaxoSmithKline (GSK) Malaysia Bias – GSK was not involved in the design of the WAAP, protocol of the study or collection of data, analyzing of data, interpretation of results or decision to publish; no other bias stated	Asthma self-management model	Single-blinded RCT **Purpose:** To evaluate the impact of a WAAP vs. verbal counseling on reducing unscheduled doctor visits, on asthma control, and QoL in children with all severities of asthma	n = 80 IG n = 40 CG n = 40 **Mean age:** 12 **Setting:** pediatric asthma clinic at University Malaya Medical Centre **Inclusions:** pediatric asthma patients ages 6-17 **Attrition:** 6.25%	**IV-** symptom-based WAAP **DV1 -** ER visit or acute physician visit **DV2** - asthma exacerbations **DV3** - asthma control **DV4** - ACT score **DV5** - QoL **Definition:** Asthma – recurrent episodes of wheezing, cough and shortness of breath and still requiring asthma treatment at the time of enrollment	Asthma Control Test or Child Asthma Control Test Standardized Pediatric Asthma Quality of Life Questionnaire (PAQLQ) Parental recall about asthma exacerbations and unscheduled doctor visits	SPSS version 16 Chi-square test Fisher's exact test	**DV1 –** no significant difference between groups **DV2 –** no significant difference between groups **DV3** – no significant difference; overall increase in patient's with controlled asthma in both groups **DV4** – no significant difference between groups **DV5** – no significant improvement in scores between visit 1 and visit 4	**Level III –** single-blinded **Strength** – explores a previously unstudied comparison of WAAP vs. none; computerized randomization **Weakness –** only single-blinded; most pts were well controlled; small sample size **Conclusion** – No significant reduction in asthma exacerbations or improvement in asthma control or QoL **Feasibility** – does not demonstrate positive effect of WAAP, especially in well-controlled asthmatics

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Citation	Theory/ Conceptual Framework	Design/ Method	Sample/ Setting	Major Variables & Definitions	Measurement/ Instrumentation	Data Analysis (stats used)	Findings/ Results	Level/Quality of Evidence; application to practice
Yin (2015) A low-literacy asthma action plan to improve provider asthma counseling: A randomized study New York, NY and Chicago, IL Health Resources and Services Administration; career development grants from Robert Wood Johnson Physician Faculty Scholars program; Kids of NYU Foundation No bias stated or found	Health literacy skills framework	Randomized-controlled study **Purpose:** To examine whether use of a low-literacy WAAP can improve provider asthma counseling, as assessed with a hypothetical scenario involving a parent of a child with persistent asthma	n = 119 IG n = 61 CG n = 58 Similar demographics between groups regarding age and variation of training **Setting:** two academic centers **Inclusions:** pediatricians who care for children with asthma **Exclusions:** Must at least be at end of intern year **Attrition:** 0%	**IV-** low-literacy WAAP **DV1-** provider description of timing of medications **DV2** - use of spacer **DV3** - maintenance medications **DV4** - explanation of signs & symptoms **DV5** - time of counseling **Definition:** Asthma – recurrent episodes of wheezing, cough and shortness of breath and still requiring asthma treatment at the time of enrollment	Trained RA interviews with pediatricians Audio recordings were transcribed by RAs blinded to intervention status with verification by 2nd RA Analyzed according to evidence-based characteristics	SPSS 20.0 2-tailed t-test X^2 and logistic regression	**DV1-** IG was more likely to mention timing of medications (96.7% vs 51.7%, p<0.001) **DV2** – 80% of IG mentioned spacers, less than 50% of CG did (p<0.001) **DV3** – IG was more likely to reinforce need for everyday medications (93.4% vs 34.5%, p<0.001) **DV4** – IG was more likely to us explicit respiratory signs (54.1% vs. 3.4%, p<0.001) **DV5** – similar timing of counseling in both groups (3.9 vs 3.8 min, p=0.8)	**Level II** **Strength** – performed power analysis; analysis of DV was blinded to RAs **Weakness –** not a study of real-world practice; did not address time to fill in WAAP; only studied physicians; convenience sample – affects generalizability **Conclusion** – low-literacy WAAP improves providers education delivery **Feasibility** – very simple to implement; no increased time commitment; cost effective & useful

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Appendix B

Synthesis Table

		Belice	*Bhogal*	*Horner*	*Khan*	*Kuethe*	*Olivera*	*Safu*	*Sheares*	*Tan*	*Wong*	*Yin*
Basics	*Year*	*2017*	*2006*	*2016*	*2014*	*2013*	*2016*	*2016*	*2015*	*2013*	*2012*	*2015*
	LOE	*I*	*I*	*II*	*II/III*	*I*	*II/III*	*IV*	*II*	*VI*	*III*	*II/III*
	Design	*SR*	*SR*	*RCT*	*RCT*	*SR*	*RCT*	*LR*	*RCT*	*CQ*	*RCT*	*RCT*
	Length	*14y*	*25y*	*1y*	*1y*	*12y*	*19m*	*9y*	*4y*	*6m*	*18m*	*4m*
Interventions	***AE***	***X***	***X***	***X***	***X***	***X***	***X***	***X***	***X***	***X***	***X***	***X***
	WAAP		*X*		*X*				*X*	*X*	*X*	*X*
	NL	*X*				*X*						
	PL						*X*					
	SC	*X*		*X*								
	HAA	***X***						***X***				
	FFU							***X***				
Outcomes	*AHU*	*↓SS*	*↓SS*	*↓SS*	*↓↓*			*↓SS*	*↓↓SS*		*NS*	
	S/SS		*NS*	*↓SS*		*NS*			*↓↓SS*		*NS*	
	LF (PEF)		*NS*		*↑*	*NS*	*↑SS*					
	QoL		*NS*				*↑*		*↑↑*		*NS*	
	Asthma Knowledge						*↑SS*			*↑*	*NS*	*IE↑*
	School Absence		*NS*		*↓*				*↓↓SS*			

Key: **AE** – asthma education; **AHU** – acute healthcare utilization; **FFU** – frequent follow-up; **HAA** – home allergen assessment; **IE** – inferred effect; **LF (PEF)** – lung function (peak expiratory flow); **LOE** – level of evidence; **NL** – nurse-led; **NS** – no significance or no change; **PL** – pharmacist-led; **QoL** – Qualify of Life; **SC** – specific curriculum; **SS** – statistically significant; **S/SS –** Symptom/Severity Score; **Sx** – symptoms; **WAAP** – written asthma action plan; **↓↑** - increase or decrease in outcome; **↑↑** - increase in outcome in both IG and CG

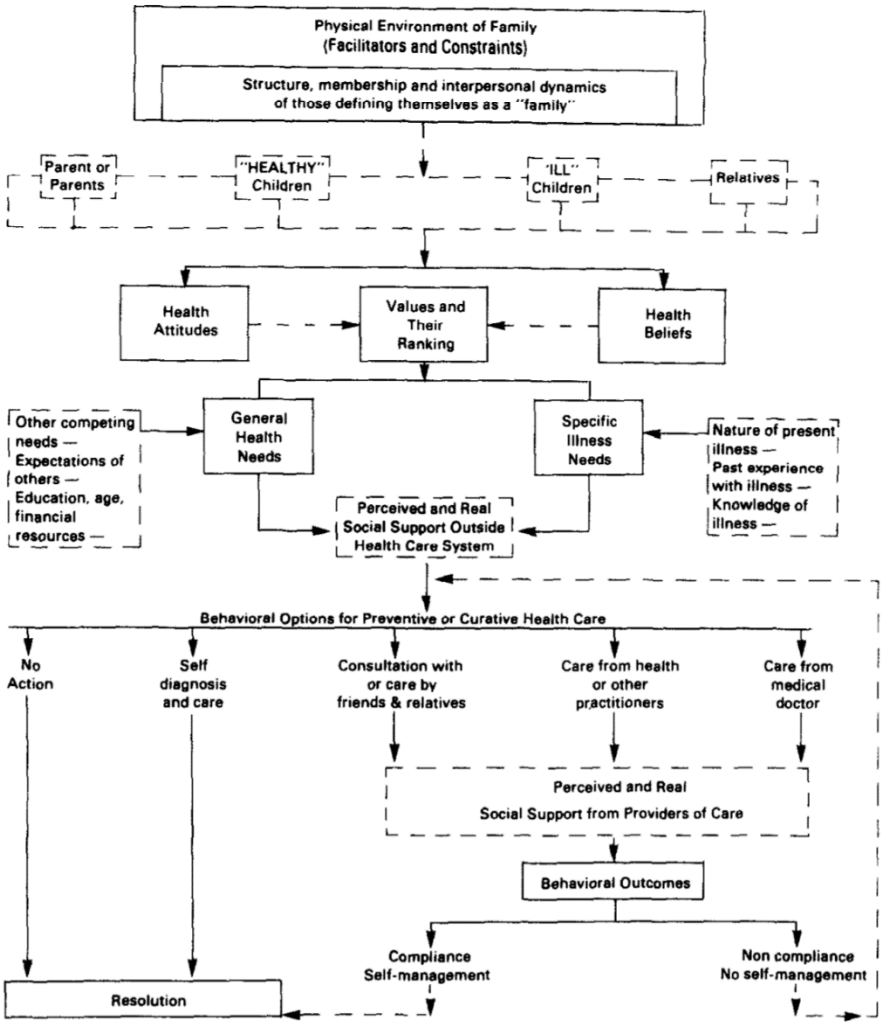
Asthma Exacerbation			*↓↓SS*	*NS*				*NS*	
Sx Days	*↓SS*					*↓↓SS*			
Med Adherance		*NS*			*↑SS*		*X*		
Proper Use					*↑SS*		*↑*		
Steroid Needed	*NS*								
Nighttime sx			*↓*						
Understandable									*↑SS*

Key: **AE** – asthma education; **AHU** – acute healthcare utilization; **FFU** – frequent follow-up; **HAA** – home allergen assessment; **IE** – inferred effect; **LF (PEF)** – lung function (peak expiratory flow); **LOE** – level of evidence; **NL** – nurse-led; **NS** – no significance or no change; **PL** – pharmacist-led; **QoL** – Qualify of Life; **SC** – specific curriculum; **SS** – statistically significant; **S/SS –** Symptom/Severity Score; **Sx** – symptoms; **WAAP** – written asthma action plan; ↓↑ - increase or decrease in outcome; ↑↑ - increase in outcome in both IG and CG

Appendix C

Figure 1

Bruhn's Theory of Asthma Self-Management



Appendix D

Site Approval Letter

DEPARTMENT OF THE AIR FORCE
AIR EDUCATION AND TRAINING COMMAND

6 November 2018

MEMORANDUM FOR ARIZONA STATE UNIVERSITY

FROM: 56th Medical Group
7219 N. Litchfield Road
Luke AFB, AZ 85309-1525

SUBJECT: Quality Improvement Project: "Improving Pediatric Asthma Education"

1. On behalf of Luke Air Force Base (AFB), 56th Medical Group, I am pleased to support the quality improvement project titled "Improving Pediatric Asthma Education" as proposed by Dr. Sarah Bay and Jennifer Brown, RN, BSN, graduate student. Captain Brown has worked in the 56th Medical Group Pediatric Clinic as a Doctor of Nursing Practice (DNP) student for the past eighteen months. We are looking forward to the opportunity to continue to collaborate with her to improve our management of pediatric asthma patients.

2. In doing so, our organization agrees to serve as the quality improvement project site for education sessions and data collection with the provision that all patient, practice and physician specific identifying information be removed from any and all publications arising from this project.

3. Thank you for providing the 56th Medical Group the opportunity to be a part of this important project. Please feel free to contact Colonel Alison T. Forsythe at 623-856-4922 with any questions or if you require additional information.

LAMAR.DANIEL.L.1154563845 Digitally signed by LAMAR.DANIEL.L.1154563845 Date: 2018.11.06 14:13:37 -07'00'

DANIEL L. LAMAR, Col, USAF, MC, FS
Commander, 56th Medical Group

Appendix E

IRB Approval Letter

APPROVAL: EXPEDITED REVIEW

Sarah Bay
CONHI: DNP
-
Sarah.Ambrose@asu.edu

Dear Sarah Bay:

On 11/29/2018 the ASU IRB reviewed the following protocol:

Type of Review:	Initial Study
Title:	Improving Pediatric Asthma Education: A Quality Improvement Project
Investigator:	Sarah Bay
IRB ID:	STUDY00008774
Category of review:	(5) Data, documents, records, or specimens
Funding:	None
Grant Title:	None
Grant ID:	None
Documents Reviewed:	• Acknowledgement of Privacy Practice, Category: Consent Form; • Invitation and Consent, Category: Consent Form; • Updated 503 11-14, Category: IRB Protocol; • Military Health System Notice of Privacy Practices, Category: Consent Form; • Improving Asthma Education_IRB.pptm, Category: Participant materials (specific directions for them); • AAP Asthma Management Handout.pdf, Category: Technical materials/diagrams; • Clinic Approval Letter, Category: Off-site authorizations (school permission, other IRB approvals, Tribal permission etc);

The IRB approved the protocol from 11/29/2018 to 11/28/2019 inclusive. Three weeks before 11/28/2019 you are to submit a completed Continuing Review application and required attachments to request continuing approval or closure.

If continuing review approval is not granted before the expiration date of 11/28/2019 approval of this protocol expires on that date. When consent is appropriate, you must use final, watermarked versions available under the "Documents" tab in ERA-IRB.

In conducting this protocol you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

Sincerely,

IRB Administrator

cc: Jennifer Brown
Jennifer Brown

Appendix F

Outcome Demographics

Figure 1

Group One Age

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Age	33	3.00	17.00	10.1212	3.29543
Valid N (listwise)	33				

Figure 2

Group One Gender

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	22	66.7	66.7	66.7
	Female	11	33.3	33.3	100.0
	Total	33	100.0	100.0	

Figure 3

Group One Provider Type

Provider

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	MD	14	42.4	42.4	42.4
	DO	5	15.2	15.2	57.6
	NP	14	42.4	42.4	100.0
	Total	33	100.0	100.0	

Figure 4

Group Two Age

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Age	18	2.00	12.00	7.7222	3.42664
Valid N (listwise)	18				

Figure 5

Group Two Gender

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	13	72.2	72.2	72.2
	Female	5	27.8	27.8	100.0
	Total	18	100.0	100.0	

Figure 6

Group Two Provider Type

Provider

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	MD	9	50.0	50.0	50.0
	NP	9	50.0	50.0	100.0
	Total	18	100.0	100.0	

Appendix G

Statistical Outcomes

Figure 1

Mann Whitney U

Test Statistics[a]

	Use of ACT	Use of WAAP	Inhaler/Spacer Education
Mann-Whitney U	229.500	181.500	258.000
Wilcoxon W	790.500	742.500	429.000
Z	-1.607	-2.633	-1.118
Asymp. Sig. (2-tailed)	.108	.008	.264

a. Grouping Variable: Pre- and Post- Group

Figure 2

Cohen's d for ACT use

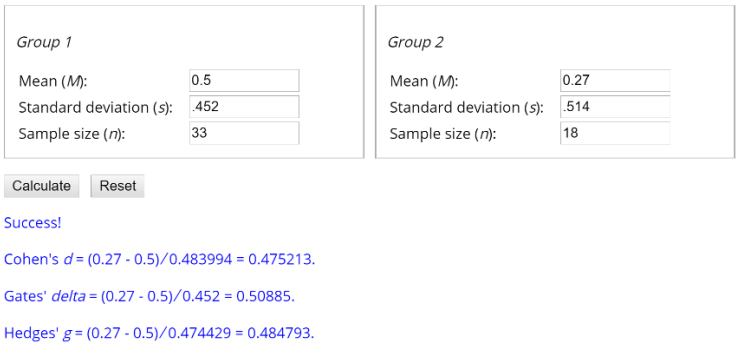


Figure 3

Cohen's d for WAAP

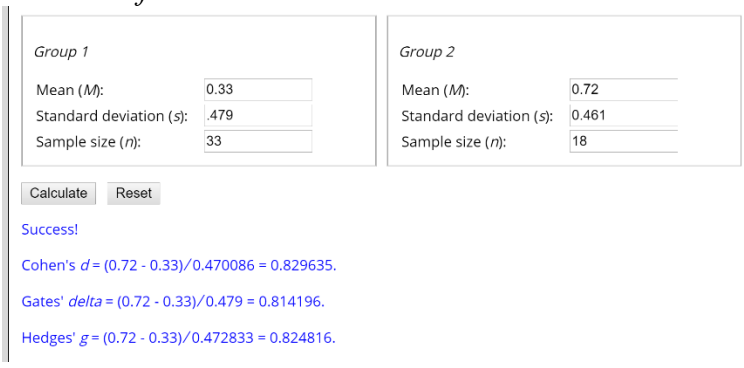


Figure 4

Spearman's rho

Correlations

			Provider	Use of ACT	Use of WAAP	Inhaler/Spacer Education
Spearman's rho	Provider	Correlation Coefficient	1.000	-.302*	.000	.052
		Sig. (2-tailed)	.	.031	1.000	.717
		N	51	51	51	51
	Use of ACT	Correlation Coefficient	-.302*	1.000	.372**	-.158
		Sig. (2-tailed)	.031	.	.007	.268
		N	51	51	51	51
	Use of WAAP	Correlation Coefficient	.000	.372**	1.000	-.070
		Sig. (2-tailed)	1.000	.007	.	.626
		N	51	51	51	51
	Inhaler/Spacer Education	Correlation Coefficient	.052	-.158	-.070	1.000
		Sig. (2-tailed)	.717	.268	.626	.
		N	51	51	51	51

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).