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Breathe In Breathe Out...Now What? Improved Pediatric Asthma Outcomes Through Improved Inhaler Technique

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BREATHE IN, BREATHE OUT….NOW WHAT?

IMPROVED PEDIATRC ASTHMA OUTCOMES THROUGH IMPROVED INHALER TECHNIQUE

by

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At the onset of my journey to obtain my Doctor of Nursing Practice (DNP) I knew that I wanted to improve the physical, emotional and social outcomes of my pediatric asthmatic patients; to help them learn how to own their asthmatic health. This journey was one of the hardest endeavors that I have ever undertaken. I want to acknowledge several people who came alongside me and offered their wisdom and expertise.

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Dedication

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Abstract

BREATHE IN BREATHE OUT…. NOW WHAT?

IMPROVED PEDIATRIC ASTHMA OUTCOMES THROUGH IMPROVED INHALER TECHNIQUE

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Asthma is a chronic disease affecting families in the United States; especially pediatric patients aged 5-18. In Pittsfield, Massachusetts the local prevalence of asthma is 14.4% versus 12.1% statewide and 8.4% nationally. These patients miss school days thus causing parental workday loss. In 2016, 14.4 million missed school days occurred due to asthma (Alexander et al., 2016). Unexpected clinic visits, as well as emergency room visits due to asthma, can contribute to rising healthcare costs both locally and nationally. Unexpected asthma visits are a leading reason for visits to this author's clinic.

Asthma is treated with inhaled medications through a metered dose inhaler. Proper use of this device is imperative for patients to achieve the best asthma control.

Research has demonstrated that a lack of proper education and teaching of how to use an inhaler results in less than optimal outcomes. Furthermore, a review of the evidence indicated that most patients do not correctly utilize an inhaler, confirming that this leads to decreased medicine effectiveness and poor patient outcomes. At the author's clinic, verbal inhaler technique education is provided but was not measured for effectiveness.

The Evidence-Based Practice process guided the Doctor of Nursing scholarly project. This project was solidly based on existing evidence to support improved outcomes in the asthma population. Therefore, the question arose, in pediatric patients with asthma, how does the addition of hands-on inhaler education compared to only verbal inhaler education affect inhaler technique, appropriate utilization of medications, clinic exacerbation visits, ER utilization, school attendance, and parent work attendance over a 3-month period of time?

Based on the evidence, the fundamental component of the scholarly project was to provide education to healthcare professionals so that they knew proper inhaler use and how to teach inhaler technique to patients. Following training of healthcare professionals, a protocol to consistently educate patients on correct inhaler technique was initiated. Planned outcomes for this project were improved inhaler technique and tightened asthma control. Outcomes that were planned but were unable to be measured were asthma exacerbation visits to both clinic and emergency room and missed school and parental work days. To evaluate these outcomes properly, ongoing quality improvement methods will be used. Sustainability of the Breathe In-Breathe-Out…Now What program will be contingent upon addressing lessons learned during the three months protocol implementation (Summer-Fall of 2018).

Keywords: Evidence-Based Practice Improvement, EBP, Inhaler Technique, Pediatric Asthma, Asthma Control, School Absence, Parental Work Absence, Emergency Room Utilization

Chapter 1: Development of the Clinical Question and Problem Identification

Background and Significance of the Clinical Issue

Asthma is a chronic disease affecting families in the United States; especially pediatric patients: 868,000 of these visits were for asthma (CDC, 2018). Exacerbations of asthma resulted in 200,000 hospitalizations and 14.4 million school absences in 2016 (Alexander et al., 2016). An average of 4.1 missed school days occurs with each episode of asthma exacerbation (Kouba et al., 2012). The total economic impact of missed days from school, parental work days and total medical costs related to asthma can be close to 56 billion dollars per year (Alexander et al., 2016). Care expenditure for an uncontrolled case of asthma is more than double that of a controlled asthmatic patient's care (Price et al., 2013). Asthma affects all ages, race and socioeconomic levels in the United States.

The Northeast region of the United States has one of the highest incidences of asthma, with Massachusetts being the highest in the area (Massachusetts Department of Public Health Asthma Prevention and Control Program, 2009). The Massachusetts Environmental Public Health Tracking system tracks asthma data from all in-state public, private and charter schools. From this tracking system, the prevalence rate of asthma has increased from 11.5% in 2010 to 12.1% for the 2016-2017 school year (Massachusetts Environmental Public Health Tracking, 2018).

This Scholarly Project took place at Community Health Programs-Berkshire Pediatric Associates (CHP-BPA) in Pittsfield, Massachusetts. One of ten locations within the federally qualified health center, this office provided pediatric primary health care to all patients. Pittsfield is in Berkshire County, which is the westernmost and second most rural county of Massachusetts. Our clinic is not able to accurately report full

asthma information due to an electronic medical record (EMR) that does not have a sophisticated reporting module. However, one can examine Berkshire County and Pittsfield's asthma prevalence. The county's asthma prevalence is slightly lower than the state, with 10.4% in 2010, rising to 12.2% in 2017 (Massachusetts Environmental Public Health Tracking, 2018). The rise across the seven years was three times as high in Berkshire County as it was in the Commonwealth of Massachusetts (1.8% increase compared to 0.6% increase) (Massachusetts Environmental Public Health Tracking, 2017). Figures AA1-3 in Appendix A display the asthma prevalence rates.

Providers at CHP-BPA care for 45% of the pediatric population in Pittsfield and surrounding areas. The rise in asthma prevalence in the city from 2010-2017 was 11.8% to 14.4%; with an increase as high as 16.8% in 2016. Both the prevalence rate and the rise across the seven years (2.6%) are higher than those for both the county and the state (Massachusetts Environmental Public Health Tracking, 2018). These data indicate that this population requires further assessment and possible intervention to reduce the prevalence and mitigate the additional rise in asthma cases. Figure AA3 in Appendix A displays these graphics.

Development of the Clinical Question and Problem

As a chronic lung disease, patients respond differently to the treatment and the condition of asthma itself. Some may only require infrequent therapy for their asthma, while other patients may progressively require increased medications as well as further patient care, such as hospitalization. When an asthma exacerbation occurs, swelling and constriction of the lung musculature follow. Symptoms can include coughing and wheezing. More severe symptoms can lead to increased difficulty with breathing and

even death. With these exacerbations, additional provider visits occur; often in the emergency department. One exacerbation office visit-or emergency department visit equates to uncontrolled asthma. Uncontrolled asthma occurs when current treatment (education or medication) does not stop asthma symptoms (Alexander et al., 2016; Kouba et al., 2012).

Uncontrolled asthma is not an unusual occurrence for the pediatric population in this country. In Massachusetts, almost 47% of the population had poorly controlled asthma (Massachusetts Department of Public Health Asthma Prevention and Control Program, 2009). In 2015, a retrospective chart review took place to evaluate the causal factors of uncontrolled asthma. These factors included poor metered dose inhaler (MDI) technique, poor compliance with treatment, exposures to environmental triggers, and co-morbid conditions. Only 2.8% of the children had treatment-resistant asthma (deGroot et al., 2015).

Uncontrolled asthma leads to increased emergency room usage. In 2012, Massachusetts had 73.08 per 1,000 age-adjusted emergency room visits. Berkshire County had 86.41 per 1,000 age-adjusted asthma-related emergency room visits and had the fifth highest asthmatic emergency visit rate in the state. Pittsfield, Massachusetts has an even higher age-adjusted asthmatic emergency room rate of 121.15 per 1,000 visits further supporting the need for assessment and intervention (Massachusetts Department of Public Health Asthma Prevention and Control Program, 2009; Massachusetts Environmental Public Health Tracking, 2018). Additional costs for asthmatic emergency room visits or hospitalizations can be incurred since Berkshire County does not have a

Pediatric Intensive Care Unit (PICU). Critically ill children must be transported to Baystate Medical Center in Springfield, Massachusetts.

Uncontrolled asthma also leads to decreased school attendance and parental work attendance. 14.4 million school absences occurred nationally in 2016. An average of 4.1 school days is missed with each asthma exacerbation (Alexander et al., 2016; Kouba et al., 2012), which also impacts parental work days lost. 41.1% of asthmatic Massachusetts school students missed at least one day of school in 2010 (Mass.gov, 2018). Nighttime symptoms often occur. With only 1-3 nighttime awakenings due to symptoms, asthmatic children are nearly four times more likely to miss school compared to their counterparts. Uncontrolled asthma is also seen in children with learning difficulties and lower standardized testing scores. Nearly 30% of parents with children who have uncontrolled asthma reported lost work days due to asthma exacerbations (Schmier et al., 2006). Pittsfield's school district has a yearly tuition amount reported for students. These amounts are $12,928 for elementary; $12,939 for middle school; and $13,035 for high school students (Pittsfield public schools FY 2018 tuition rates, 2018). One day missed from school then equates to 71-72 dollars per day just in tuition funds.

The healthcare dollar burden in the United States translates into 200,000 hospitalizations and 868,000 ER visits (Alexander et al., 2016; CDC.gov, 2015 Emergency Department Summary Tables, 2015). The Asthma Prevention and Control Program in Massachusetts estimates of those children with asthma, 66.2% had uncontrolled asthma as of 2010. The program states 2010 is the most up to date information due to small sample sizes with current sampling measures (Mass.gov, 2018). With uncontrolled asthma, healthcare expenditure per case is more than double the cost

as compared to a patient with controlled asthma (Price et al., 2012). The cost of inpatient hospitalized asthma care increased from 57 million dollars in 2002 to 104 million dollars in 2013 with public insurance (Medicaid, Medicare, and other state programs) the expected payers of these costs (Mass.gov, 2018).

Mortality due to uncontrolled asthma remains a threat in the pediatric population. Death is preventable in almost every case of asthma if correct diagnosis, management, and treatment at home occur. Between 1990 and 2006, 1,708 deaths occurred due to asthma. This number represents a 63.8% mortality rate decrease over these years. In 2006, 45 deaths took place between the ages of 0-24 in Massachusetts and 219 deaths nationally in 2015 (CDC, 2018; Mass.gov, 2018).

Inhaled medications are the primary forms of treatment for asthma. A metered-dose inhaler (MDI) is utilized to administer these medications. The MDI is the preferred method of medication delivery with asthma. Inhaled medication is delivered directly to the lungs, thus, requiring a lower dosage, more rapid onset of action, and decreased systemic medication amounts (Capanoglu et al., 2015; Manriquez, Acuna, Munoz & Reyes, 2015; Pedersen, Dubos, & Crompton, 2010). Bronchodilators, or rescue medications (i.e., pro-air, Ventolin) are fast-acting medications that quickly relieve inflammation in the lung airways to alleviate symptoms- wheeze, cough and improved ability to breathe. Inhaled corticosteroids are controller medications (i.e., Flovent, q-var). As the name implies, the function of corticosteroids is to aid in decreasing inflammation in the lung airways to reduce asthma symptoms- and to reduce the need for rescue bronchodilator use.

Most patients who utilize an MDI are unable to do so effectively (Burkhart, Rayens, & Bowman, 2005; Carpenter et al., 2015; Janssen, Spoelstra, & Brueren, 2003; Kamps, VanEwjik, Roorda, & Brand, 2000); however, most patients and families assume their technique is correct (Alexander et al., 2016; Burkhart et al., 2005; Capanoglu et al., 2015; Carpenter et al., 2015; Foland et al., 2002; Kamps et al., 2000; Sleath et al., 2012). Dependent upon the particle size of the inhaled medications, a large amount of the particles can naturally deposit in both the oral pharynx and esophagus. With incorrect inhaler technique, the amount of this deposition can increase. This increased deposition is especially true in children due to smaller airways. As patients' asthma control decreases, prescription costs increase due to either added on oral medications or step up therapy with inhaled medications (Price et al., 2012). Therefore, it is imperative to both teach this population how to utilize an inhaler properly and to have return demonstration from the patient (Pedersen et al., 2010).

Both pediatricians (MDs), as well as nurse practitioners and physician assistants (NPs and PAs), provide pediatric based care to most children in the United States. However, these providers are not always trained in correct inhaler technique or asthma education. In multiple studies, healthcare providers neither teach inhaler technique to patients nor know how to teach inhaler technique (Amirav, Goren, Kravitz, & Pawlowski, 1994; Duerden & Price, 2001; Jones, Holstege, Riekse, White, & Berquist, 1995; Sleath et al., 2012 Reznik, Ylie-Rosett, 2014).

Since joining the clinic in August 2017, I have had several conversations with both providers and nursing staff regarding current asthma care standards. Currently, the nurses and providers teach patients and their families inhaler technique verbally,

however, no hands-on demonstration or return method occurs. Consequently, the clinic does not know if patients can properly perform proper inhaler technique. Therefore, the question arises, in pediatric patients with asthma (P), how does the addition of hands-on inhaler education (I) compared to only verbal inhaler education (C) affect inhaler technique (O1), appropriate utilization of medications (O2), follow up clinic visits for exacerbations (O3), ER utilization (O4), school attendance (O4), and parent work attendance (O5) over a 3 month period of time?

Selection of EBP Model and Theoretical Model

Clinical scholar model. Evidenced-based practice melds research, clinical practice, and patient preferences into one entity. The Clinical Scholar Model was developed to initiate clinical questions, the spirit of inquiry and to initiate the education of healthcare team members in the evidence-based practice process. A hallmark of the Clinical Scholar Model is providing mentorship to others in evidenced-based practice (Dang et al., 2015). The author of the model believed that point of care nurses could both perform and utilize research at the patient care level. Therefore, nurses and other team members became part of quality improvement at the unit level. Not only does the team learn how research and evidence-based practice (EBP) evolve together, but also how to utilize EBP in the healthcare setting. With EBP, healthcare teams can move practice forwards, rather than remaining stagnant in "how care has always been performed." Sustainability of EBP is a hallmark of the model. EBP begins with a spirit of inquiry then to critiquing and synthesizing the evidence and then placing the evidence into clinical practice by applying the evidence into the care setting and evaluating generated

outcomes (Dang et al., 2015). Dissemination of the outcomes to other healthcare members and teams is an expected endpoint of the process.

The spirit of inquiry is the starting point of an EBP project. The clinical significance of the problem (how to improve inhaler technique and asthma outcomes for pediatric patients) is discovered and discussed. Then, the clinical scholar analyzes the available evidence- both external and internal. The external evidence involves database literature search and then a thorough critique and synthesis of the literature. Internal evidence requires a comprehensive review of the clinic's direct care daily processes: chart reviews, quality, and risk analysis, as well as a review from provider/nursing as well as patient/family perspectives of the clinical issue. A written proposal for action is created, and if required, internal review board (IRB) permission obtained (Dang et al., 2015). Adherence to the EBP process in a scholarly project is both ethically and morally necessary. By adhering to EBP standards, the healthcare provider can make sure that patients and families are not harmed by erroneous information, and justice for the patient is realized.

The Clinical Scholar Model then requires a thorough review of the proposal in action as well as outcomes from the EBP project. Quality measures allow for continuous feedback regarding both outcomes and sustainability of the EBP project in the clinic. EBP scholarly projects are only ethical to do it they are worth doing; in other words, the previous critical appraisal piece is crucial. If the evidence supports a change in practice, it would be ethically negligent to not implement an improved patient care process (O'Mathuna, 2015). Dissemination of the project outcomes then occurs to contribute towards improved nursing practice. Dissemination is also an ethical process. If the

scholarly project has outcomes that will improve patients' lives, then it is imperative to disseminate the information. Likewise, if the project does not have similar outcomes as noted in the evidence or any adverse effects upon patients, then the healthcare world must also be notified of these occurrences (O'Mathuna, 2015). A schematic for the Clinical Scholar EBP Model can be found in Figure AA4 in Appendix A.

Functional mastery of health ownership model. The Functional Mastery of Health Ownership Model (FMHO) is a new model aiding the advanced practice nurse (APRN) to empower the patient and family to own their health. FMHO consists of 4 foundational influences: 1- the patient perception of health, 2- self-efficacy, 3- social resources, and 4- the personal perception of mastery (Donnelley, 2018). Wellness is not merely the absence of disease, but also involves the holistic self: physical, psychological and social wellness (WHO, 2017). The FMHO also allows for the patient and parents to make decisions regarding their care and to gain the responsibility required to achieve wellness (Donnelley, 2018). At each point in the model, supports are present to empower the patient to learn how to care for their self. Thus, the concept of ownership is born. As the patient and parents receive essential tools to aid him/her in health decision, he/she can learn responsibility, mastery as well as obtain improved self-image and self-efficacy skills; all of which are attributes of ownership of health (Nickels-Nelson, 2018). Self-efficacy is the crux of the model; with self-efficacy, the patient or parent has the confidence to perform their health care and are physically able to carry the care plan out. Quality of life measurement is also crucial. The model supports using quality of life measures that document patient and family beliefs of their quality of life over the past two weeks (Donnelley, 2018).

Ultimately, the patient moves to the final stage of personal perception of mastery- how he or she views his or her ability to own one's health. This pivotal point leads the patient either to or away from a state of wellness. How the patient views themselves, as well as his or her diagnosis and treatment, will either allow for ownership of disease and ultimate wellness or hamper the progression towards wellness. This self-identity contributes to the wholeness or holistic view the person holds of self (Karnilowicz, 2010).

FMHO starts by examining the patient's perception of his or her health. These perceptions, such as symptoms and quality of life measures, provides the foundation of how the patient and family regarding disease and its treatment (Laforest et al., 2009). The second foundational point in FMHO is self-efficacy. The patient and family will learn responsibility as well as self-management skills to continue in a state of wellness with their current diagnosis. Knowing that he or she can self-manage his or her disease allows for self-efficacy to occur. Social resource utilization is the third step in the model.

Further education as well as having responsibility for his or her care becomes emphasized. The patient and family learn what resources are available to them for self-managed care; transportation, social networks, and social programs are just a few examples. Personal perception of mastery is the final checkpoint in the FMHO. The patient and family duo have received all the tools necessary to empower ownership of health and wellness. This empowerment leads to the expected belief that he or she will continue to be successful with matters of healthcare. Persons who believe that they are capable of being successful with their health will often have continued engagement with

the medical team as well as seek further knowledge about their condition (Laforest et al., 2009).

Empowering patients and families is an expected outcome of the FMHO. An ethical imperative in this model is to empower the patient and to respect their wants and needs. As healthcare providers, the end goal is to improve outcomes. "The principle of empowerment is reinforced by that of social responsibility, and the principle of respect should be seen as including respect for true personal autonomy where it does not involve harm to others" (Tannahill, 2008, p. 387). Theory helps to guide healthcare interventions and allows for proposed health outcomes to be realized. As Tannahill (2008) continues to note, theory should cover the entire range of ethical principles in healthcare and not just the concept of beneficence. Theory should help guide the evidenced-based process in asking the clinical questions and critiquing the evidence to then put into practice. Then, theory should help answer the question, what effects would an intervention as proposed be likely to have on health (equity) and what reason do we have to believe that it would help empower people?" (Tannahill, 2008, p. 388). Theory helps to guide the clinician to examine potential harms in the proposed interventions and allows the guidance to steer patients and families away from these harms (Tannahill, 2008). A schematic of FHMO is found in Figure AA5 in Appendix A.

Systematic Search for Evidence Process and Results

CINAHL, PubMed, Psych Info, ScholarWorks, and Virginia Henderson databases were utilized to conduct the systematic search of the literature. MeSh terms and search terms comprised in the PICOT question included: *pediatric, asthma, inhaler technique, nebulizers and vaporizers, school abs**, and *emergency room utilization*. Limiting

elements for the search included ages five to eighteen, peer-reviewed, and the English language. A yield of 1,334 articles which met the above search criteria was retrieved.

Of the above 1,334 articles, 1,304 were excluded. The exclusions causations included: 74 duplicate citations and 1,229 of the articles did not meet project needs and outcome goals (inhaler technique, school, emergency room utilization and asthma control) or the population (pediatric aged 5-18). Two articles were located through references noted in the keeper studies. Figure 6 in Appendix A denotes the Literature search process.

The hierarchy of evidence classifies each article into six categories; from the highest levels of evidence to the lowest. These six categories are level I: systematic reviews, level II: Randomized Controlled Trials; Level III: Controlled Cohort Studies; Level IV: Uncontrolled Cohort Studies; Level V: Case studies, Qualitative and Descriptive Studies, EBP Implementation and QI project; and Level VI: Expert Opinion. Utilizing evidence which falls in the higher levels of evidence equates to using knowledge which most likely will relate to current day practice and will allow for reliable healthcare outcomes in practice (O'Mathuna & Fineout, 2015). Table AB2 in Appendix B shows the hierarchy of evidence. Once the hierarchy of evidence is noted the critical analysis can begin.

Chapter 2: Critical Appraisal of Evidence; Model of EPB & EPIP Plan: Part 1

Rapid Critical Appraisal

There are four phases of critical appraisal once the beforementioned literature search is completed. Critical appraisal is required to determine how worthy each study is to the clinical question. Each article is assessed for the following: the level of evidence, the study's validity, the reliability of outcomes and any noted biases; and its applicability to practice. The final step of Critical Appraisal is the evaluation and synthesis of the evidence for the project (Fineout-Overholt, Melnyk, Stillwell, & Williamson, 2010).

Two forms facilitate rapid critical appraisal, the Generalized Appraisal Overview (GAO) and the Rapid Critical Appraisal Checklist (RCAC). The GAO and RCAC provide for a streamlined process to review each article for the purpose, data collection, outcome measures, validity, the reliability of outcomes, and any noted bias. The RCAC further analyzes how each study could be applied within a practice setting. After completing the GAO and RCAC on each of the studies found in the systematic search, 31 keeper studies were identified. A keeper study is a well-performed study that can help answer my clinical question (Fineout-Overholt et al., 2010; Fineout-Overholt, 2015).

Ethics of critical appraisal. The primary purpose of performing a critical appraisal of the evidence in a scholarly project is to make sure the evidence being utilized is valid, reliable, non-biased and applicable to the project at hand; to provide better outcomes for patients. Above all, the number one requirement for healthcare providers is

not to cause harm to a patient; emotionally, spiritually or physically. This concept encompasses both beneficence and nonmaleficence with beneficence being the concept of bringing goodness to a patient and nonmaleficence being not causing harm to a patient (O'Mathuna, 2015). Thus, it is essential to review all evidence minding these two concepts, mainly when working with pediatric and adolescent patients. These patients are not at the age of majority so are not able to make full decisions by themselves. Their parents and guardians put their trust in the healthcare provider. With the pediatric population, not only is the provider caring for the child but also caring for the family unit. The provider must consider the entire family's beliefs and values, not just the patient's. The family expects that the healthcare provider will offer the best care for their child; care that will not cause harm to them. The families trust that the healthcare provider will give the child the "latest data and technology" that is available to produce the best outcomes (Palmer, 2009).

Therefore, as a healthcare provider, it is mandatory that critical analysis of the literature and evidence be carried out in the manner described in the previous section. As O'Mathuna noted, if the EBP process is not entirely carried out in all steps, "poorly designed research studies and EBP project will waste valuable resources. . . and may lead to practice that is neither effective nor beneficent" (O'Mathuna, 2015, p 520). To not partake in the full critical appraisal process would lead to non-ethical practice. To include any research in an evidence-based scholarly project that was poorly performed, filled with bias, or had content which could potentially harm a patient would also be unethical practice (O'Mathuna, 2015). Tannahill (2008) also noted that randomized controlled studies are not the only studies necessary for an evidenced-based scholarly

project. The scholar must employ the studies that consisted of the best research process implemented in the best manner for the situation. Other forms of research, controlled studies, descriptive, quasi-experimental, may provide better information for different situations (Tannahill, 2008). It is therefore imperative for the evidenced-based scholar to perform a complete literature search and review of all the available evidence.

Evaluation

After critically appraising the evidence, I compiled evidence and synthesis tables for this Scholarly Project. All 31 of the keeper studies (plus one DNP scholarly project and one nursing master's thesis) had an average study time of 3 months. Four of the studies utilized interprofessional and intraprofessional providers during study implementation. All the studies noted with both verbal and hands-on patient inhaler education along with a hands-on display of inhaler technique, inhaler technique improved as well as asthma control. The evidence did not show a robust decrease in school or work absences or decreased emergency room visits. The evidence and synthesis tables for this scholarly project are found in Appendix B.

Synthesis

Patient and provider metered dose inhaler technique. The mainstay of asthma treatment includes the use of inhaled medications through MDIs. Inhaled medications provide increased symptom control with a decrease in residual side effects. There are eight steps required for correct inhaler use: 1- Remove the cap of the inhaler; 2- Shake the inhaler and insert into spacer; 3- Exhale breath; 4- Place mouthpiece in mouth and close lips around; 5- Press down on inhaler canister once; 6- Inhale slow and deeply and hold breath for 10 seconds; 7- Breathe out gently; 8- wait 30 seconds before next

dose/puff (Alexander et al., 2016; Bourne, 1996; Deerojanawong, Sakolnakorn, Prapphal, Hanrutakorn & Sritippayawan, 2009; Gillette, Rockich-Winston, Kuhn, Flesher & Shepherd, 2016; Morin, 2012).

Parents, as well as pediatric and adolescent patients, viewed their ability to use an inhaler correctly higher than their actual skills (Alexander et al., 2016; Burkhart et al., 2005; Gillette et al., 2016; Janssen et al., 2003; Kamps et al., 2000). When patients were asked how confident they were in utilizing an MDI, over 75% of the patients stated they had complete confidence. However, both completely confident and not completely confident MDI users missed the same amount of inhaler steps, 1.5-1.8 steps, out of 8 steps (Alexander et al., 2016; Gillette et al., 2016). Rates from 12-92% of patients misusing their inhalers were recorded in the studies both in and out of the United States (Alexander et al., 2016; Burkhart et al., 2005; Chen et al., 2002; Deerojanawong et al., 2009; Duerden & Price, 2001; Foland et al., 2002; Gillette et al., 2016; Janssen et al., 2003; Kamps et al., 2000; Levy et al., 2013; Minai, Martin, & Cohn, 2004; Manriquez et al., 2015; Sleath et al., 2012; Walia et al., 2006; Zivkovic, Radic, Cerovic, & Vukasinovic, 2008). The inhaler technique steps most often missed include removing the cap from the inhaler, shaking the inhaler, exhaling prior to actuation of the device, placing the inhaler in the mouth between the lips, inhaling and holding breath for 10 seconds, and waiting 30 seconds before next dose (Bourne, 1996; Burkhart et al., 2005; Capanoglu et al., 2015; Carpenter et al., 2015; Chen et al., 2002; Deerojanawong et al., 2009; Foland et al., 2002; Gillette et al., 2016; Kamps et al., 2000; Janssen et al., 2003; Manriquez et al., 2015; Morin, 2012; Pedersen et al., 2010; Reznik et al., 2014; Sleath et al., 2012; Turkeli, Yilmaz, & Yuksel, 2016; Walia et al., 2006).

Healthcare providers also do not know how to properly use an inhaler (Duerden & Price, 2001; Jones et al., 1995; Reznik et al., 2014; Sleath et al., 2012). The most recently published national asthma guidelines (2007) also have recommendations for providers to demonstrate correct MDI technique to asthmatic children at all clinic visits (Expert Panel Report 3, 2007). Resident physicians with presumed knowledge of inhaler technique performed 3.7 correct inhaler steps (Amirav et al., 1994). Only 15% of nurses and 28% of physicians could accurately show a patient how to use the MDI device (Duerden et al., 2001). A train the trainer approach has been recommended in the literature. Various means of healthcare provider education has been suggested, including one-one sessions, webinar, video, and classroom-based methods. Even a single one-on-one inhaler technique session can improve a healthcare provider's inhaler technique knowledge (Price et al., 2012).

MDI technique education. Educational programs have been shown to improve inhaler technique (Alexander et al., 2016; Amirav et al.; 1995; Bourne 1996; Burkhart et al., 2005; Capanoglu et al., 2015; Deerojanawong et al., 2009; Expert Report Panel 3, 2007; Foland et al., 2002; Gillette et al., 2016; Janssen et al., 2003; Kamps et al., 2000; Levy et al., 2013; Minai et al., 2004; Morin, 2012; Sleath et al., 2012; Zivkovic et al., 2008). Evidence has shown verbal training alone does not elicit the same outcomes as verbal and hands-on MDI training with return demonstration. By utilizing verbal and hands-on education with patient demonstration, improved inhaler technique occurs (Alexander et al., 2016; Amriav et al., 1995; Bourne, 1996; Burkhart et al., 2005; Foland et al., 2002; Gillette et al., 2016; Janssen et al., 2003; Kamps et al., 2000; Levy et al., 2013; Minai et al., 2005; Morin, 2012; Munzenberger et al., 2007; Pedersen et al., 2010;

Sleath et al., 2012; Walia et al., 2006; Zivkovic et al., 2008). Pediatric inhaler technique scores increased 1.1 to 3.9 steps patients after verbal and hands-on education with return demonstration inhaler technique training (Carpenter et al., 2015, Carpenter et al., 2016, Gillette et al., 2016; Morin, 2012; Turkeli et al., 2016). Over time, the correct inhaler technique decreases due to lack of education and reinforcement of technique. With correct inhaler technique at one visit, can eventually begin to have an incorrect technique in the future; therefore, it is imperative to continue with technique training at each visit (Manriquez et al., 2015; Pedersen et al., 2010). Capanoglu et al. (2007), Munzenberger et al. (2007), and Kamps et al. (2000) noted patients retained the correct inhaler technique after three hands-on and verbal inhaler technique educational sessions. In 2007, younger and older children's inhaler technique were evaluated 2-3 months after one intensive inhaler education program. 60% of the children had decreased inhaler technique measurements after those months (Jones et al., 1995). Therefore, the evidence states inhaler technique training is to be performed at every patient encounter.

Only 60% of primary care pediatric providers performed any asthma medication education during visits. Training regarding daily management, including an explanation of asthma action plans, occurred only 20% of the time. The pediatric patients were only addressed and asked about their thoughts regarding asthma diagnosis and treatment 6% of the time (Sleath et al., 2012). Chen et al. (2002) noted families only sought asthma care services in the event of an exacerbation. Otherwise, asthma care is not administered routinely in the primary care office. The evidenced-based guidelines for asthma care suggest asthma follow up in the office every six months (Expert Panel Report, 2007). Without receiving routine asthmatic care, approximately 22% of patient in one study had

4 or more asthma exacerbations, 40% of children missed school (Chen et al., 2002). Barriers to provider MDI education include lack of time during appointments, patients not bringing MDIs to appointments, sample MDIs not available in the clinic, providers themselves not knowing inhaler technique or how to assess on the checklist, and patient/family disinterest (Chen et al., 2002; Reznik et al., 2013).

Verbal and hands-on MDI education interventions were studied from a minimum of one month to a maximum of three years. Most of these studies were conducted up to three months. Only three studies continued evaluations after their trials. These studies included Minai et al. (2004) (continuation of Foland et al. (2002) study); Walia et al. (2006) (re-measurement in 3 months); and Levy et al. (2013) (3-year chart review).

Outcome measures utilized. Inhaler technique and asthma control outcome measurement tools were also utilized in the evidence. These outcome measures included the asthma control test (ACT) (Carpenter et al., 2015; Carpenter et al., 2016; Expert Panel Review 3, 2007; Sleath et al., 2012): Quality of Life questionnaire (QOL) (Expert Panel Review 3, 2007); spirometry (Expert Panel Review 3, 2007; Foland et al., 2002; Levy et al., 2013; Minai et al., 2004; Zivkovic et al., 2008); Ashtma Action Plan (AAP); (Carpenter et al., 2015; Carpenter et al., 2016; Expert Panel Review 3, 2007; Foland et al., 2002; Minai et al., 2004; Rodriguez-Martinez et al., 2017); inhaler technique checklist (Alexander et al., 2016; Burkhart et al., 2005; Carpenter et al. 2015; Carpenter et al., 2016; DeGroot et al., 2015; Expert Panel 3, 2007; Foland et al., 2002; Janssen et al., 2003; Kamps et al., 2002; Levy et al., 2013; Minai et al., 2004; Rodriguez-Martinez et al., 2017; Sleath et al., 2012; Walia et al., 2006; Zivkovic et al., 2008).

The ACT and QOL assessment are both validated patient completed questionnaires for the pediatric and adolescent age group. The ACT was developed for children as young as age 4. A score of less than 19 on the ACT indicates decreased asthma control over the past month. The ACT is comprised of 4 sections: 1-child response to questions regarding asthma control; 2-activity limitations; 3- nighttime symptoms of asthma; and 4- parental perceptions of daytime and nighttime symptoms (Deschildre et al., 2014). With improved inhaler technique, the ACT measurement increased from 18.6 to 20.3 (Carpenter et al., 2016).

The pediatric QOL questionnaire contains 28 patient answered questions. These questions measure the patient's beliefs towards how asthma has affected their lives over the past week. Questions include how "bothered" their lives are due to asthma as well as how "often" asthma symptoms occur over the past week. The questionnaire further measures how asthma has emotionally affected the children over the past week. The QOL questionnaire was developed for specific age groups: 4-7 years; 8-11 years; and 12-16 years (Everhart, Smyth, Santuzzi, & Fiese, 2010). The FMHO model is based upon self-efficacy; and measurement of quality of life scores over a two-week time frame is vital (Donnelley, 2018).

The inhaler use checklist allows for an objective evaluation measurement of inhaler technique by any provider. This checklist is the only validated tool available for these purposes (Boccuti, Celano, Geller, & Philips, 1996). The checklist is comprised of 8 scoring areas. All areas receive either a score of 0 or 1; with 0 being not performed correctly and one being scored correctly (Boccuti et al., 1996). Spirometry also is an objective measurement metric to measure asthma control. However, FEV1 measurement

did not change with improved inhaler technique. The authors commented since the study was only conducted for one-month FEV1 measurement could improve with a longer intervention time (Minai et al., 2004).

Improved asthma outcomes. With improved inhaler technique, an improvement in asthma knowledge, control, and self-efficacy occur (Alexander et al., 2016; Burkhart et al., 2005; Carpenter et al., 2015; Carpenter et al., 2016; DeGroot et al., 2015; Foland et al., 2002; Gillette et al., 2016; Janssen et al., 2003; Kamps et al., 2002; Levy et al., 2013; Minai et al., 2004; Sleath et al., 2012; Walia et al., 2006; Zivkovic et al., 2008). Faulty inhaler technique correlates with reduced asthma control. With education, improvement in both inhaler technique and asthma control occur (Levy et al., 2013). Parental and patient asthma knowledge increases as asthma control increases. Compliance with asthma care and self-efficacy improve. Fear of asthma decreases, allowing the patient to have improved quality of life (Carpenter et al., 2015; Zivkovic et al., 2008).

Improved asthma control also led to decreased missed school days, and parental lost productivity days. Adolescents with controlled asthma reported less missed days of school (3.5% controlled asthma vs. 34% uncontrolled asthma missing class) as well as decreased tardiness from school or having to leave early due to asthma exacerbations (1.8% controlled vs. 28% uncontrolled). School children also reported an increased ability to concentrate in school with improved asthma control. Parents of children with uncontrolled asthma reported increased work absences due to asthma exacerbations (Gillette et al., 2016; Schmier et al., 2006).

Recommendation

Through the review of the composed evidence and synthesis tables; improved MDI technique is positively correlated to both verbal and hands-on education in the healthcare office. As seen in the evidence, most patients and families deem their inhaler technique is correct. However, upon MDI technique evaluation, only 25-58% of patients had correct MDI technique. Since inhaled medications act upon the small pulmonary airways in the lungs, correct inhaler technique is mandatory for effective asthma control and exacerbation relief to occur. If the patient only receives verbal training, the percentages of improved MDI technique are less than those patients who received both verbal and hands-on inhaler technique training. Therefore, for correct MDI inhaler technique, both verbal and hands-on training with re-demonstration is required at every encounter. To ensure patient education is performed, it will be a requirement for the practice to have an audit system in place to monitor IT teaching and recording.

Healthcare providers do not automatically know how to use an MDI correctly. Providers must also receive inhaler teaching. In the evidence, providers were not able to provide correct inhaler education to patients without first being taught themselves. Guidelines recommend that all asthmatic patients received MDI technique education at every asthma visit. As shown in the evidence, only 20% of providers and nurses perform MDI technique education.

Improved asthma outcomes do not only involve correct MDI technique. Evidence has shown with improved MDI technique there is a correlation between increased asthma knowledge and asthma control. Evidence has also shown with improved asthma control

and knowledge; medication compliance increases as well. Patients can have a decreased fear of asthma and have an increase in self-efficacy.

The cycle of emergent asthma care must be broken to improve asthma outcomes. Any acute care asthma visit (office or ER) is equivalent to treatment failure. This failure is accountable to not following self-management care; such as non-adherence to daily medications as well as not adhering to treatment schedules such as having (or not having) a written asthma plan and maintaining regular asthma chronic care visits in the office. After these acute visits, patients and families often discontinue chronic medications or do not fill ordered prescriptions. As well, primary care chronic management continues to not take place (Ducharme et al., 2010). Therefore, primary care offices must help patients and families take ownership of their chronic asthmatic care.

Objective validated outcome metrics are available and have been utilized to aid with MDI technique measurement. The inhaler use checklist allows for all providers to have one validated metric to streamline the evaluation process and allow for similarity in the testing of MDI technique. The ACT and pediatric QOL, enable the patients to be evaluated with the same measure of metrics. Patient and family can be part of the asthmatic care plan. The AAP provides for the patient and family to have a roadmap of asthma management at home.

Improved MDI technique in the pediatric and adolescent patients require new processes for education and must be put into practice. All healthcare providers in the office will first have their own MDI technique evaluated followed by verbal and hands-on training for any steps that were incorrect. The providers must be given educational

sessions regarding how to evaluate and educate patients and families on how to correctly use an MDI.

At every office visit encounter, asthmatic patients must have their MDI technique evaluated and receive verbal and hands-on education. Asthma control is to be evaluated to aid the patient and family. Inhaler technique must be evaluated using the inhaler technique checklist and ongoing asthma control measured by the ACT and QOL scales. The AAP must be updated at least every six months and as needed to allow for individualized care planning to reduce asthma exacerbations.

EPIP operationalized through EBP Model and Theoretical Model

The Clinical Scholar Model was chosen for this Scholarly Project since the clinic staff had never had an EBP project initiated in the office. I had to both teach all staff and providers the EBP methods as well as mentor the staff throughout the project. This model allows the team to view the forward movement required in each step of the evidence-based process. As well, since the staff was new to both the EBP method as well as an EBP project, mentorship would be required. Thus, the Clinical Scholar Model was chosen. A schematic for the model in practice is noted in Figure AA7 of Appendix A.

> "The FMHO allows for seamless care with the [child] who has asthma. The wellness aspect of the FMHO is vital in that it allows the [child and family] to function in a world of wellness rather than a world of illness with asthma. By focusing upon ownership of health rather than a state of illness, the [child and family] learn how to gain responsibility for their care. The family learns how to own their asthma, meaning, they learn how to utilize the tools given to them by the health care team to appropriately care for their asthma symptoms. The [child and family] learn how to be responsible for asthmatic care, by taking prescribed medications, learning their asthma triggers, and utilizing the beforementioned tools. Mastery of their illness is obtained, and the [child] and family have the keys to own their health and live in a state of wellness" (Nickels-Nelson, 2018).

Figure AA8 in Appendix A is the schematic for the operationalized FMHO theory in this project.

Fully Operationalized Project Plan/Logic Model

A logic model was essential to planning and implementation of this Scholarly Project. Logic models are project planning tools that define the assumptions, inputs, outputs, and outcomes of a project. The logic model allows one to examine what thoughts led to the program design and desired outcomes. Assumptions allow for the initial thoughts of what will occur throughout the implementation process. Key inputs, such as resources of time, people, finances, and supplies are also planned into the project. Barriers and facilitators can also be quickly noted. If the barriers appear to be too powerful to overcome, the new plans can be placed into motion so full implementation will not become a failure. Planned outcomes from short term to long term is noted as well. Outcomes, then, are the endpoint of the logic model. A figure of the logic model is found in Figure AA9 in Appendix A.

Table 2A: Operationalized P0lan of DNP Scholarly Project

<table>
<tr><th colspan="2">Assumptions for DNP Scholarly Project</th></tr>
<tr><td>Staff will learn how to utilize, teach and train inhaler technique</td><td>Patients will learn inhaler technique</td></tr>
<tr><td>Decreased utilization of healthcare resources due to decreased asthma exacerbations</td><td>Decreased school absenteeism</td></tr>
<tr><td>Improved quality of life</td><td>Patients will have improved asthma control</td></tr>
<tr><th colspan="2">Resources & Inputs</th></tr>
<tr><td>People:
CHP-BPA nursing
CHP-BPA medical assistants
CHP-BPA providers
BMC respiratory therapist
Patients
Families</td><td>Organizational Support:
Financial Funding Request
Organizational support from CHP senior management</td></tr>
<tr><th colspan="2">Activities</th></tr>
<tr><td colspan="2">Patients will receive the following care at asthma visits:
Written, verbal & hands-on inhaler training from nursing
Validated tool assessments of asthma control and quality of life</td></tr>
<tr><th colspan="2">Outputs and Outcomes: With the above activities the patient will have:</th></tr>
<tr><td colspan="2">Improved inhaler technique
Improved quality of life
Decreased school absenteeism</td></tr>
<tr><th colspan="2">Impact</th></tr>
<tr><td colspan="2">Improved state of health and ownership of health
Decreased health care costs</td></tr>
</table>

Chapter 3: Project Design and Methodology

Project Design and Methodology Overview

Setting/description of clinic. Pediatrician Dr. Thomas Whitfield started Children's Health Program in 1975 to provide both pediatric office and mobile care. He noted several children presenting for kindergarten physicals yet had never been seen otherwise since early infanthood. These children not only were lacking immunizations but also social skills. Several children had unrecognized illnesses and developmental delays. After 25 years of pediatric services, Children's Health Program applied for designation to become a federally qualified health center (FQHC) due to Berkshire County's need for improved health care in the adult community. Community Health Programs (CHP) was born. The stated mission of the CHP is to, "measurably improve the health of Berkshire County, Massachusetts" with a vision that "Berkshire County's population will be the healthiest in Massachusetts" (Community Health Program, 2017).

In 2018, the FQHC now operated as one practice with ten locations; including internal and family medicine, obstetrical/gynecology care, pediatric medicine, and dental care. After a recent Uniform Data System (UDS) review, 1 out of every 5 Berkshire County persons receives care at the FQHC.

Project design and methodology overview. As was discussed in Chapter 2, this DNP scholarly project was fully developed upon the evidence-based process. A full review of the literature along with a synthesis of the evidence allowed for the creation of

this asthma project. All clinical members of CHP-BPA were involved in the project. These members included the medical assistants, nurses (both licensed practical nurses (LPN) and registered nurses (RN), and providers (nurse practitioners and physicians). The project director (PD) was Gina Nickels-Nelson.

The methodology for this project included hands-on along with verbal inhaler technique training at every asthmatic patient visit to the office. Inhaler technique scores were obtained before any education being given and then recorded again post education. At each care visit, the patient and family also completed the asthma control test and quality of life questionnaires. Each patient also was to receive a completed asthma action plan at each visit. The implementation time for this project was three months, July-October of 2018.

Fully Operationalized Project

The inhaler technique education project was conducted at CHP-BPA from July through October 2018. The project included both a pre-implementation phase and an implementation phase.

Pre-implementation phase. During the pre-implementation phase, the staff at CHP-BPA received education regarding EBP. As well, the project outline, expectations, and outcomes were discussed at length. Since the basis of the project was inhaler technique, the expertise of a respiratory therapist was sought. The head of the RT department at BMC was contacted, and I met with her along with our head nurse to discuss how to both use and teach inhaler technique. This expertise was then brought back to the office, and all nursing staff had their inhaler technique evaluated. The nursing staff learned how to teach and evaluate inhaler technique.

As well, during the pre-implementation phase of the project, all tools were acquired for project implementation and completion. These tools included:

- Inhaler technique checklist
- Emergency room/urgent care utilization questionnaire
- Patient/Family reported school/work absenteeism questionnaire
- Asthma Control Test (ACT)
- Pediatric/Caregiver Quality of Life Questionnaire (QOL)
- Asthma Action Plan (AAP)

CHP also developed an introductory letter describing the new asthma program to families. A take-home inhaler technique letter was also acquired from an online source that allowed for copying to occur.

Implementation phase. All clinical staff of CHP-BPA was active within the project during the time of implementation. At the onset of each day, the medical assistant was to evaluate their provider's schedule and locate any patient aged five and older with an active diagnosis of asthma. These patients were also to have had an MDI ordered as well. Once located, the asthma packet (as described above) was given to the patient to be completed. While the provider was with the patient, asthma control was to be assessed with the ACT and QOL forms; along with exam completion. The provider would then complete the AAP. The AAP is a written plan of care outlining asthma self-care measures and step-up treatments required for worsening symptoms. The form is depicted as a traffic stop light: Green: no symptoms (daily actions needed); Yellow: start of symptoms or cold/allergy symptoms (daily actions plus new controller or rescue

medications and call to provider office); and Red: emergency care needed (daily actions plus emergency actions and immediate patient care required) (Booth, 2012).

Finally, the patient's inhaler technique was evaluated. With the use of a placebo inhaler and spacer in the office, the patient demonstrated their technique. The total number of correct technique steps was noted on the inhaler technique checklist. Then, the patient was given both verbal and hands-on education. After this education, the patient again demonstrated their technique. The total number of scores was noted again on the inhaler technique checklist.

The full implementation process and progress markers are found in tables AC1-2 in Appendix C.

Process indicators with lessons learned, barriers and solutions

Stakeholders. Determining stakeholders in any implementation project is key to project success. Stakeholders can hold active as well as passive rolls and can be both facilitators as well as barriers to the implementation process. All patients aged five and older with asthma had the opportunity to participate in this scholarly project. If the patient was only on nebulized medications, then they were excluded since a nebulizer is a different form of medication delivery.

Table 3A: Stakeholder Analysis

ACTIVE STAKEHOLDERS	PASSIVE STAKEHOLDERS
Pediatricians (6)	Back office staff (3)
Nurse Practitioners (3)	Billing (1)
Physician Assistant (1)	Senior Management CHP (5)
Registered Nurses (5)	Senior management CHP (5)
LPN (1)	Practice Administrator CHP BPA (1)
Medical Assistants (8)	
Front Desk (8)	
Senior management CHP (5)	
Dr. Lamm, CMO (1)	
Practice Administrator CHP BPA (1)	
Patients and Families	

Data collection. Data collection, record keeping, and management were also essential components of the implementation plan and had to be planned before the project began. With the recent merger to CHP, CHP-BPA had started to use a new electronic medical record (EMR). Unfortunately, the EMR was not capable of reporting vital information for many quality measures. Thus, most of the data keeping was required to be kept in a binder as well as monitored through a quality improvement database, Azarahealthcare.

Data collection during the implementation period was vital for both patient privacy as well as implementation success. Each paper record was sent back to PD desk for evaluation. Patients received a patient number that was devoid of any identifying data, such as name or social security number. A master list linking the patient number and identifying patient information was kept in a locked drawer in the PD office. In this manner, the evaluation of the implementation process was continued without sacrificing any HIPPA or privacy matters. The Excel file was kept on PD's personal computer devoid of any identifying information as mentioned above. This personal computer

requires three personal identification markers to log in. After all, forms were inputted into Excel; the forms were placed into HIPPA bins and taken for shredding per CHP policy.

Table 3B: Documentation Metrics for DNP Scholarly Project

Metric	How Document/Records Kept per Implementation Protocol
• Pre-Implementation • Nursing and Provider MDI technique	• Inhaler use checklist form with provider/nurse number was placed in binder on bookshelf behind PD's desk • Metrics were placed into Word Excel file under pre-implementation • Excel was utilized for ease of metric analysis
• Initial Visit and Subsequent Visits • IT assessment • Emergency Room/Urgent Care utilization (on IT checklist) • Asthma Control Test (ACT) • Pediatric/Caregiver Asthma Quality of	• Meditech used to review visits/ Must have account and log in from BMC to utilize • Once logged into Meditech searched by patient name for ER utilization • Initial visit patient packet

Metric	How Document/Records Kept per Implementation Protocol
Life Questionnaire (QOL) • Asthma Action Plan (AAP) completion • Missed School/Parental Work Day questionnaire (on IT checklist)	sheet placed in a binder on the bookshelf behind PD's desk. Was not faxed to EMR since not official part of patient record • Initial patient packet found in Appendices • Metric inputted into Word Excel file for initial visit • Excel file used for ease of metric analysis

Budgetary planning. Since the office was utilizing all the current staff for this project, new staff acquisition was not a requirement. As well, the clinic did not need to acquire any new office equipment. The office already had computers, copy, fax, and label maker machines. All providers had their stethoscopes and watches for assessments.

New costs that were needed to be considered for this project included the time for nursing staff in performing MDI technique education as well as this writer's time in implementing the project as well as metric evaluation. All employees of the office were already receiving their respective salaries. There were not any new monies released for salary with this proposal; however, hours spent on each employee on the project were tabulated. These costs included medical assistant, nursing and provider care and time

with patients and families. Dr. Lamm graciously extended 500 dollars towards the purchase of aerochambers for this project.

The MAs also had a planned 30-minute meeting with PD discussing their requirements for the asthma EPIP project. MA time with patients was consistent with the delivering of asthma patient forms to both patients and PD. A medical assistant's salary is $15 per hour and the expected time per patient was 5 minutes.

Nursing (licensed practical nurse (LPN) and registered nurse (RN)) also had meetings with PD to discuss their role in the Asthma project. The evidenced-based process was also discussed. Nursing also had a 30-minute session with PD measuring their inhaler technique and how to teach inhaler technique to patients and score the inhaler use checklist. Each month, nursing and PD met to discuss the project and brainstorm any changes that were required. Nursing spent on average ten minutes with each patient during an asthma visit to teach, measure and record patients inhaler use. Nursing salary is $30 per hour.

Nurse Practitioners, Physician Assistant, and Physicians (MD/DOs) also had an initial meeting with PD to discuss the project and their roles for the Asthma project. The evidenced-based process was also discussed to differentiate the EBP process from research. The providers also had a planned 30-minute session with PD measuring their inhaler technique and how to teach inhaler technique to patients and score the inhaler use checklist; however, none of the providers except PD performed this task. Therefore, this amount was not recorded in the budget. Review of the ACT, QOL, and AAP was to be discussed. Each month the providers and PD were to have a 30-minute meeting to discuss the project and brainstorm any changes that were to be required. The providers

stated that time was a barrier for these meetings, so very brief 5-10-minute status update meetings occurred. Providers had visits in length from 20-40 minutes depending on visit type (sick visit, prolonged sick visit or well care) in which asthma control was established, treatment plans were discussed with families, and the use of inhalers was encouraged. PDs time for all data collection and analysis was also tallied; however, not paid out for this project. Average Nurse Practitioner salary is $43 per hour, and the average MD salary is $85 per hour.

Office supplies, such as paper, needed to be factored into the budget. These paper supplies were vital since the EMR did not allow for the retrieval of metrics.

A projected budget expense of $16,156 was projected. Once the full project was completed the real budget was decreased. The actual budget spent on this project was $10.065.58. Below is a table of the budget.

Table 3C: Actualized Budget for DNP Scholarly Project

Role/Salary	Duty	Number of Contact Hours	Total cost
Medical Assistant: $15/hour	review patient for protocol; give screening forms	10 minutes x 119 patients	$297.50
Medical Assistant $15/hour	Training time with PD for project	30 minutes	$60.00
RN/LPN: $30/hour	Training of nursing inhaler technique	30 minutes per RN/LPN	$90.00
RN/LPN: $30/hour	Patient inhaler technique education/review for protocol	60 minutes per RN/LPN	$90.00
RN/LPN: $30/hour	Monthly progress meetings with PD	60 minutes per RN/LPN	$240.00
RN/LPN: $30/hour	Education/assessment IT with patients (assumption of 200 patients with 2 visits each)	10 minutes per RN/LPN	$595.00
NP $43/hour	Project protocol training	60 minutes per NP (2 NPs)	$21.50
NP $43/hour	Monthly progress meetings with PD	60 minutes per NP (2 NPs)	$86.00
NP $43/hour	Provider time with asthma patient	30 minutes with NP	$1025.00
MD $85/hour	Training with respiratory therpaist	30 minutes with MD (5MDs)	$0
MD $85/hour	Training time with PD project	60 minutes per MD (x 5)	$148.75
MD $85/hour	Monthly protocol meeting	60 minutes per MD (x 5)	$446.25
MD $85/hour	Provider time with patient	30 minutes with MD	$1005.80

Role/Salary	Duty	Number of Contact Hours	Total cost
Nursing time with patient (nurse visits)	Nurse visits (vaccines, suture removal, etc)	20 minute patient visit	$140.00
GMN project time	Project overview, data entry, analysis	24 weeks	$5,160.00
Total Salary:			**$9,405.80**
Office Supply	**Reason**		**Cost**
Copy paper and ink toner 1309 pages	Copying of assessment forms, verification forms, asthma education forms		$78.55
Missed opportunities copies			76.25
Pens	Filling out packet forms (patients)		$5.00
Aerochambers	2 for placebo inhalers; remainder for patients not able to pay copay for spacer		$500.00
Total			**$659.78**
Grand Total			**$10,065.60**

Revenue generation. Patient billing revenue was performed for every aspect of the asthma inhaler technique program. Billing was generated immediately with each patient encounter. Since CHP-BPA is a federally qualified health center, all providers (both MD and NP) can bill at 100%. The three main commercial health insurance companies seen at CHP-BPA were Blue Cross Massachusetts, Health New England, and Aetna.

On March 1, 2018, Massachusetts Medicaid formed Accountable Care Organizations (ACO) in Massachusetts. These ACOs are arranged by county. Each provider office in Massachusetts was given a choice to either join the ACO or not. By joining the ACO, the payment structure changed from one of volume payment (payment per patient) to one of performance payment (payment for performance). Thus, each enrollee's visit is reimbursed at the same amount, regardless of medical complexity. At the end of each year performance markers, such as asthma care outcomes, are monitored and evaluated. Incentives are then given to high performing offices.

Budget justification. With the intended project outcomes, children would have fewer asthma exacerbations. With fewer exacerbations, the clinic would be able to see other patients for urgent visits. Thus, further revenue would be generated, and decreased use of urgent care and emergency room facilities may be realized. With Berkshire county not having a pediatric tertiary hospital with PICU services, costs savings would also be evident through fever ground/air ambulance transports. In the office, with this project, CHP-BPA would be able to justifiably bill at least a 99214 or 99215 based on asthma severity scoring, quality of life monitoring, inhaler technique teaching and patient visit. With the commercial insurers upcoding could realize:

- From a 99213 to a 99214: increased reimbursement $37
- From a 99214 to a 99215: increased reimbursement of $45
- From a 99213 to a 99215: increased reimbursement of $81

This return on investment (ROI) in asthma education could actualize a 5-14-dollar ROI per asthma education dollar spent (Berkshire Health Systems, 2015). At the onset of the project, I sent each provider and nurse billing data that could be billed since enhanced

asthma teaching was being documented during visits. These codes included MDI technique teaching (94664) as well as codes for patient questionnaires (ACT and QOL) (96160).

An audit of billing was performed of the 119 project patients. All the providers participating in the program submitted superbills after each patient visit. These 119 patients had a combined total of $16,034 gross billable income. Several missed opportunities in billing were realized, including not capturing the modifier 25 coding with a well visit for asthma education as well as inhaler technique education coding. A gross total of $19,983 could have been realized if these two billing measures were captured. Finally, these 119 patients had a collective amount of other missed billing opportunities; they were seen for subsequent visits but did not have any asthma teaching or evaluation performed. If they had received this evaluation, then another $3,074 could have been realized in gross billing. A total of $7,023 missed revenue was realized.

Separate from billable income, as CHP-BPA implements improved asthma care with metrics in daily practice, reportable measures will now be captured within Athena EMR as well as Azarahealthcare. CHP can then report these measured metrics to national quality programs, such as UDS and HRSA. With these reportable metrics and an assumed improvement in asthma care and outcomes within the practice, CHP-BPA will collect increased revenue with quality measures. As stated earlier, the ACO payment structure is now one of performance rather than volume-based payment. Thus, with decreased ER utilization, hospitalization, improved medication compliance, and asthma severity, incentive payments would be available to CHP-BPA. Since the ACO has just initiated in early 2018, these incentive payment structures are not yet available.

Lessons learned and barriers. At the onset of the proposed program at CHP-BPA, I had obtained buy-in from all clinical personnel at the office, except our lead physician. As I look back upon the pre-implementation phase of this project, I spent too much time with our lead physician; attempting to win his favor for the project. Instead, I should have focused more efforts upon the rest of the staff. Ultimately, when it came time to implement; the entire team stated an initial refusal to move forward. Even though all portions of the project had been discussed with each level of provider; all noted no recollection of having a role to play in the project. I, therefore spent an extra week speaking with each member of the team individually. After having discussions with individuals, the nursing staff became champions for this program. A few of the MAs voluntarily participated in the program, but for most of the program I needed to give daily reminders to the staff.

Change was another barrier to this project. Before my arrival at the clinic last year; 3 MDs and 1 NP had retired. The clinic, also facing financial difficulties, decided to merge with CHP. This merger itself caused change. I also created change when I arrived at the clinic; just by being a new provider to the practice. As well, I arrived as a CHP NP, rather than a BPA NP. This, along with my collaboration with the CMO as my industry mentor, has created an "us vs. them" work environment at times.

The medical assistants and nurses also determine the flow of the days and what actions would and would not occur with the patient population. On more than one occasion, one of the nurses interrupted a patient visit to tell me the nurses would not be performing any asthma care that day. The MAs also carry this same power. Many of the MAs would not locate their provider's asthma patients for the day or initiate any asthma

packets for the program. By not locating their patients, I was then required to spend my own time searching for upcoming asthmatic visits and preparing packets. Since patients are scheduled as same-day visit, many of these patients were missed.

The day before the start of my implementation; our practice manager announced her resignation. This resignation also created continued change in the clinic. After her departure was announced, the clinic had resignations of three front and back office personnel (medical records, billing, and reception) as well as one LPN.

With our change to CHP, all patients are required to fill out both a two-page health history form as well as a ten-page patient registration form. This form is only needed to be filled out once; however, we are still having patients arriving for care who have not been seen for over a year or who are new patients to the practice. As well, at every annual physical, each child and teen must fill out a developmental or depression screening tool. Before the asthma program, families were already upset with the amount of paperwork. With the asthma program, patients were now given an additional six pages of forms to fill out. Some families expressed extreme displeasure. One father accused me of "killing a forest." I had one occasion where I walked into an exam room as an MA was telling the mother, "yeah, it is ridiculous how much she is expecting you to do for this."

Our current EMR is not adequate to perform EBP care for our patients. At no time has a reporting module been present to allow for the chart review process to occur. I am not able to obtain a list of patients fitting the demographic criteria for this project. All data had to be searched for retrospectively, and hand entered into excel. This process was very long and tedious. With the EMR not being able to perform a simple search,

each day I must hand search for asthmatic patients fitting the criteria for the project. The expectation at the onset of the project was for MAs and nurses to also watch the schedules and locate any newly added patients to the daily schedules fitting the criteria. However, this did not occur during the project. Thus, a great many of missed opportunities occurred. If the EMR had best care practices (i.e., IT protocol, ACT, AAP locaters) then possibly the staff may have noted these patients required the IT program. The current EMR does currently have a quality measure area and asthma control, and AAP is drop downs on this list. However, this feature is not routinely utilized in the clinic.

I had also planned on utilizing the Azarahealthcare database to help with patient location as well as asthma measures. However, this database is only useful if the patient already has a diagnosis of asthma listed in their problem list. The clinic had transitioned from one EMR system to another in 2017. Patient charts are still not fully loaded with past or current histories. Therefore, the database did not prove to be useful. As well, several patients either had a resolved history of asthma (but the diagnosis was still present on their dashboard) or never had the diagnosis placed as active.

The final barrier to this project was time. In our current scheduling system, all MDs and one NP (myself) have 20 minutes to conduct a well-child physical; 30 minutes for a teenage physical. The other NPs and PA have 30-40 minutes per well exam and 20-30 minutes for sick care. This allotted time does not allow for in-depth discussion of asthma; or for any other physical, mental or social care needs. Therefore, most of the providers declined to participate fully in the program. None of the physician providers would let the quality of life questionnaires be utilized for their patients. Reasonings

included: “not supported by the AAP” (American Academy of Pediatrics);” too much patient paperwork” as well as “time.”

The success of the program was the realization that our patient population does not know how to use an inhaler. This success equates to this; we have much to do in the realm of education and care of our patients at CHP-BPA. Now we have a roadmap to follow to lead to this success. Another success occurred after implementation had finished. Clinic staff were apprised of the results from this program. The providers are now willing to move forward with an asthma medical home. Two MAs routinely come to me now for the asthma packet when I have an asthmatic patient in the office. Our patients also were provided spacers during the program. Many patients had never had a spacer; or where not able to have two spacers (one for home and one for school). Upon learning how to use their inhaler, they learned of the importance for the spacers.

Solutions. Before initiating any new programs at CHP-BPA, I now know that I need to include the buy-in of every person in the clinic, and not to only focus on the lead physician. I have learned of the power that is held by both the MAs and the nurses; thus, I need to have their input and buy-in before moving forward with any new initiative.

This past fall, CHP-BPA acquired a new practice manager. He had already been a practice manager at a sister site within CHP. Thus, he is knowledgeable of both business and personnel flows within the agency. He is also very interested in hearing about this new asthma program and how the program can both positively affect our patients as well as the office financially.

All of CHP is transitioning to another EMR in July 2019. Even though this will be yet another change, I do feel that this EMR will be far superior to our current program. The new EMR will have built-in reporting capabilities. Best practices are also a part of the program. I am hopeful that the superior EMR will be a benefit to our asthmatic patients shortly. We also will not need to rely upon the Azarahealthcare database once this EMR is in place.

Finally, one of the most significant barriers to this project was time itself. After reviewing the outcomes of the project with the providers, all the providers are on board for improving asthmatic health care in our office. We are moving forward to expand care in an asthma medical home environment. Thus, we will have dedicated time every quarter to meet with our asthmatic patients.

Evaluation of EBP model, theoretical model and logic model function within EPIP

All three models (Clinical Scholar EBP, Functional Mastery of Health Ownership and the Logic Model) were instrumental in the development, implementation, and evaluation of this DNP Scholarly Project.

The Clinical Scholar model allowed for the seamless implementation of the evidence-based process to become embedded in this project. The reason for this choice was the mentorship piece of the model. Before this project, CHP-BPA had not had an EBP quality improvement project take place. While the providers were knowledgeable of EBP, the medical assistants and nurses were not. Through mentorship, the staff learned of the importance of EBP and how to effectively implement into practice.

The Functional Mastery of Health Ownership (FMHO) theory also guided this project. Our patients not only learned how to use their inhaler correctly but learned of tools to keep their asthma in control. By giving our patients and families these necessary tools, they learn self-efficacious behaviors that will hopefully lead to asthma control improvement. I did find one new approach to care which will need to be a future consideration to this model. We as health care providers cannot expect our patient to learn how to own their health unless we as providers learn how to own the care that we give to our patients.

The logic model was instrumental in the pre-implementation process. I did find that it helped me to think of potential barriers, facilitators, and resources that would be required for this project. However, I did not find it to be as useful once the implementation started. Several barriers presented themselves, and I did not expect these to occur. I could envision the logic model being re-formatted monthly for future projects to more smoothly guide the implementation process.

Chapter 4: Project Outcomes, Impact, and Results

Over the past three chapters of this DNP Scholarly Project, I have followed the EBP process as it relates to my clinical problem of decreased knowledge of inhaler technique and asthma control. I reviewed the available evidence to develop a best practice protocol to put into place at CHP-BPA. Then, per the Clinical Scholar EBP Model, I mentored my team in the EBP process. The Breathe In Breathe Out Inhaler Technique Education Program was put into practice at CHP-BPA. Now, it is time to evaluate the outcomes. Evaluating outcomes in an EBP best practice pilot project is essential. The effectiveness of the plan needs to be assessed and then later disseminated to assure that patients continue to receive the best care that is evidence-based (Brewer & Wojner Alexandrov, 2015).

Completion Outcomes, Data Collection, Measurement

Demographics. From July 5 through October 19, 2018, 312 asthmatic patients utilizing an MDI between the ages of 5 and 20 received care at CHP-BPA. These patients had a combined total of 518 distinct patient encounters. The age ranged from 5 through 20 with a mean of 11 years. One hundred thirty-six males, 175 females, and one transgender patient were seen during the project. Seventeen insurance payers covered these patients; with Fallon Health ACO covering most of the patients followed by Blue Cross Blue Shield (BCBS) of Massachusetts. The primary residence of most of the patients was Pittsfield; however, the entire Berkshire County had representation along with five towns in Eastern New York State.

Visit types and inhaler technique program. Most encounter type visits were for sick care (187) followed by well care encounters (144). Ninety-three of the visits were solely nursing visits (suture removal, immunizations, etc.). Sixty-nine asthmatic specific visits (exacerbations as well as follow up care) were performed.

Ten pediatric providers along with nursing staff provided care during the inhaler technique program. Of these providers, one physician declined to perform the program. The remainder of the providers and nursing staff participated in the program. One hundred nineteen patient visits received the inhaler technique asthma program. Three hundred ninety-nine missed opportunities otherwise occurred. The reasons for the missed opportunities included "no time," missed chance, MA or nursing forgot; provider not yet in implementation; computer technical error; provider declining to participate, and patient unwillingness. 25% of the patients received the inhaler technique program of care, and 75% of patients did not.

Provider inhaler technique scores. At the onset of this program, the intent was to measure all providers as well as nursing staff with their inhaler technique knowledge. However, all pediatric providers stated they did not have time to teach their patients inhaler technique, thus did not wish to display their inhaler technique. The nurses were all evaluated for inhaler technique before the program. All nurses were able to perform the eight steps correctly before the program.

Inhaler technique checklist demonstration scores. Inhaler technique (IT) demonstration scores ranged from 0, meaning 0 correct IT steps, to 8, indicating eight correct IT steps out of 8 steps. One hundred nineteen patients participated in IT education. Inhaler technique was assessed by either nursing or Gina Nickels-Nelson

(PD) before any training. Then, the patient received both hands on and verbal inhaler technique education; per the developed protocol that was based upon best practice from the reviewed evidence. The patient's inhaler technique score was then reassessed. As was seen in the previously reviewed studies, patients improved their inhaler technique by at least one step after receiving both hands on and verbal inhaler technique education.

Table 4A: Inhaler Technique Checklist Demonstration Scores

Inhaler Technique Checklist Demonstration Score	Number of Steps Correct Before Education	Number of Steps Correct After Education
0	3	0
1	1	0
2	1	0
3	1	0
4	7	0
5	17	0
6	30	0
7	34	3
8	25	116

Thirteen patients were seen on a subsequent visit within the project 3-month timeframe. Each of these patients had a perfect score of 8 at their first visit; however, at subsequent visits, their score decreased to 5 correct steps. These results indicate that inhaler technique must be reviewed and assessed at multiple visits; not just one time per year. The same trends of decreasing inhaler technique were also noted in the reviewed studies.

Asthma control test (ACT). Of the 119 patients who participated in the project, 93 filled out an ACT questionnaire. ACT scoring ranges from 0-27; with 0-18 demonstrating poor asthma control and 19-27 demonstrating good asthma control. The range of ACT scores were 3 to 27. The mean ACT score at the first visit was 21. At a second office visit, 17 patients completed an ACT, with a mean score of 17.

Table 4B: ACT Scores at Visit 1 and Subsequent Visits

ACT Score	Number of Patients, Visit 1	Number of Patients, Visit 2
3	1	
7	1	1
10	1	1
14	2	
15	3	
16	2	2
17	4	
18	12	
19	9	2
20	11	
21	11	4
22	15	2
23	9	
24	10	
25	20	2

26	2	
27	7	

Mini pediatric and caregiver asthma quality of life questionnaires (QOL). A total of 75 patients and 76 caregivers completed the asthma QOL questionnaires at the onset of the office visit. Four out of ten providers declined to utilize this questionnaire. The pediatric questionnaire has three sections: asthma symptoms; emotional symptoms; and activity limitations. All scoring is completed by a Likert scoring system as follows, with lower scores being representative of increased concerns:

- "How bothered have you been during the last week" with symptoms
    - 1: extremely bothered
    - 2: very bothered
    - 3: quite bothered
    - 4: somewhat bothered
    - 5: bothered a bit
    - 6: hardly bothered at all
    - 7: not bothered
- "How often during the last week did you" regarding emotions towards asthma:
    - 1: all of the time
    - 2: most of the time
    - 3: quite often
    - 4: some of the time
    - 5: once in a while

    - 6: hardly any of the time
    - 7: none of the time
- "How bothered have you been in the last week" generalized symptoms/sleeping/activities
    - 1: extremely bothered
    - 2: very bothered
    - 3: quite bothered
    - 4: somewhat bothered
    - 5: bothered a bit
    - 6: hardly bothered at all
    - 7: not bothered

The caregiver asthma quality of life questionnaire measured caregiver reviews of activity limitations and emotional aspects of their child's asthma. This questionnaire is also scored via Likert scoring with lower scores being representative of increased caregiver concern:

- 1: all of the time
- 2: most of the time
- 3: quite often
- 4: some of the time
- 5: once in a while
- 6: hardly any of the time
- 7: none of the time

QOL scores for both patient and caregivers were tallied, and a mean score was derived; with a lower score being representative of concern or decreased performance due to asthma.

Table 4C: Patient Reported QOL Scores

QOL Score	Patient Visit 1	Patient Visit, Subsequent
1	0	
2	0	
3	2	
4	6	1
5	8	2
6	36	1
7	23	2

Table 4D: Caregiver Reported QOL Scores

QOL Score	Patient Visit 1	Patient Visit, Subsequent
1	0	
2	2	
3	2	
4	4	1
5	8	2
6	27	2
7	33	

Even though written responses were not expected on the caregiver QOL questionnaire, some parents left written responses regarding their child's asthma.

- "I am very upset that she has asthma."
- "I don't get mad at him not his fault."
- "Inhalers, neb machine are being used too much, Flovent also."
- "If I can't get out of my black mold apartment won't be able to control his asthma."
- "I feel hurt because I want her to be ok."

Asthma action plan (AAP). An AAP allows for the patient to have a written plan of care at home, school and elsewhere for their asthma. The AAP is written either by nursing and reviewed by the provider or provider written and then given to the patient. All 312 patient charts were reviewed for the presence of an AAP.

Table 4E: AAP Presence in Patient Charts

Presence of AAP in Chart	Prior to Inhaler Technique Education Program	After Inhaler Technique Education Program
Yes	289	191
No	22	120

Healthcare utilization and absenteeism. Only three patients reported an ER visit in the past year; 2 of the patients each reporting two visits each. After the chart review, 37 ER visits were noted. Likewise, self-reported urgent care visits were collected, and families stated that they did not attend any urgent care visits. However, three patients had an urgent care visit at BMC. Self-reported missed school days were also recorded.

Twenty-eight missed school days were noted. Self-reported missed workdays were also noted. Five parental missed workdays were recorded; as well as the loss of one job. All the above metrics were verbally asked and written down on the inhaler technique checklist form. Several families did answer with "don't know" or "unsure" regarding missed school days.

Analysis, Project Results, and Impact

Demographics. Demographically, the patient ages were all similar to the body of evidence. In Pittsfield Massachusetts, the asthma prevalence is noted to be 14.4% as compared to state prevalence at 12.1% (Massachusetts Environmental Public Health Tracking, 2017). As I reviewed the residences of our patients, our geographic range also mimicked reported data; a predominance of our patients resides in Pittsfield. This predominance could be due to geography since CHP-BPA is in Pittsfield.

Patients receiving protocol at practice. As I had reviewed the body of evidence, I had not noted any mention of patients not receiving the protocol in the studies. However, not all of our providers participated in the program, and 75% of our patients did not receive the inhaler technique educational program. Morin, a DNP candidate in 2012, also conducted a DNP scholarly project regarding inhaler technique training in Pittsfield, Massachusetts. His program took place at a private pediatric practice. At the onset of his program, there were two providers (a pediatrician and a nurse practitioner) and Morin. As noted in his scholarly project; he completed nearly 90% more inhaler technique teaching visits as compared to his physician counterpart. The nurse practitioner at the practice had resigned just before his implementation (Morin, 2012).

Barriers reported by CHP-BPA providers to the project included lack of time as well as the lack of components of the program being endorsed by the American Academy of Pediatrics. The clinic staff also reported time as being a significant barrier. Upon further evaluation, the other significant obstacles included the staff forgetting to include the patient into the IT education protocol; and the medical assistants' not searching their provider schedules for asthma protocol patients. The barrier of time was noted in the literature (Chen et al., 2002) but the other obstacles I found during the implementation were not found in the literature.

Provider and nursing IT scores. None of the CHP-BPA providers performed initial IT scoring. All providers, except PD, noted that they did not have the time to teach their patient's inhaler technique during the patient encounter. Before the nurses participated in the IT program, their technique was evaluated. All our nurses were able to complete all eight steps of inhaler technique without an error. This perfect scoring goes against the evidence. In the evidence noted, most of the providers and nurses do not know how to perform, evaluate or teach IT (Amirav et al.,1994; Duerden & Price, 2001; Jones et al., 1995; Sleath et al., 2012; Reznik &Ylie-Rosett, 2014).

Patient inhaler technique. Our patients did not immediately have full knowledge of how to utilize an inhaler correctly. As well, over half of the patients have either never utilized an aerochamber or did not use one at all. The body of evidence noted at least a one to two step improvement in IT post hands-on and verbal education (Alexander et al., 2016; Burkhart et al., 2005; Foland et al., 2002; Janssen et al., 2003; Kamps et al., 2000; Levy et al., 2013; Minai et al., 2005; Sleath et al., 2012; Walia et al., 2006; Zivkovic et al., 2008). Our program also noted this improvement; with five

children having an increase of eight inhaler technique steps. Once the patients received an educational session, almost every patient had nearly perfect technique. However, 13 of these patients had return visits with IT performed, and again missed at least three IT steps. In previous IT studies, retention of IT was noted to drop after only one educational session; therefore, it was recommended for several sessions to occur (Capanoglu et al., 2015; Jones et al., 1995; Kamps et al., 2000; Manriquez et al., 2015). Unfortunately, only 25% of the patients received one inhaler technique evaluation and teaching session. To improve our patients' overall asthmatic health; our office always needs to implement the best practice asthmatic care for all patients; not just when the time allows for it to occur.

Asthma control and quality of life. The evidence also noted with improved IT an improvement in asthma control and quality of life was also observed (Alexander et al., 2016; Burkhart et al., 2005; Carpenter et al., 2015; Carpenter et al., 2016; DeGroot et al., 2015; Foland et al., 2002; Janssen et al., 2003; Kamps et al., 2002; Levy et al., 2013; Minai et al., 2004; Sleath et al., 2012; Walia et al., 2006; Zivkovic et al., 2008). Currently, I am not able to definitively show this same correlation. This is because I had several missed occurrences for repeat IT program visits. As well, this program only covered the months from July until the end of October. My program did not have the same repeat of visits as was noted in the body of evidence. A recommendation would be to continue to monitor these patients over an extended period to evaluate their asthma control and the quality of life.

Twenty-six patients reported an ACT of less than 19. A score of less than 19 indicates poor asthma control. Only two times was this score notated and acted upon by

the provider. Further education of the provider staff needs to occur regarding the use of this screening tool and how to incorporate it into patient care.

In the measurement of quality of life, only24% of the patients were given an opportunity to participate in the questionnaire. Further observation and analysis would be warranted for this group of patients. As well, further provider education must occur. Again, a few parents noted, "I am scared of my child's asthma," and this was not discussed by the provider or the family during the visit.

Asthma action plan. The asthma action plan is a written at home treatment plan that allows for a family to be self-efficacious with their asthma treatments; but also know when to call for help or guidance. Only seven percent of the patients before the program had a written asthma action plan. After receiving IT education; 38% of the patients had a scanned asthma action plan present in the EMR. One of the nurses responded by stating, "Well, I do them all of the time, but I don't scan them (the action plans) into the chart." Most of the providers in the office rely on the nurses to complete these plans for our patients.

Healthcare utilization and absenteeism. Finally, both missed school days and parental work days were not accurately reported during this program. As I compared ER and urgent care visits; the families' self-reporting numbers were much lower as compared to the recorded visits. I am concerned that the self-reporting for school and work is also low. As well, this was a verbal question asked by several different nursing staff members and providers. This amount of people could have led to the reports that were obtained. In the future, a checklist system could be considered for families to mark when their child

is out of school. A partnership with the Pittsfield Public Schools could occur to tabulate these numbers.

Chapter 5: Project Sustainability Discussion, Conclusions, and Dissemination Discussion

Discussion of Project Results

Out of ten pediatric providers, only one provider was 100% vested in the program. One provider declined to participate at all, and one other provider would only allow well patients to participate. The remaining providers were actively enrolled in the program. However, nearly 200 patients were not included in the education program. This number was mostly attributed to the missed opportunities of either the providers declining to participate or the remainder of the medical/nursing team missing opportunities for patient engagement. None of the providers except for myself would personally teach their patients how to use the inhaler. Our nurses all had 100% correct inhaler technique.

Only 25% of the asthmatic patients seen between July and October of 2018 received any recorded asthma teaching. Only 49% of these patients knew how to perform at least seven out of eight inhaler steps correctly. Through the educational program, 100% of the patients could correctly use an inhaler at the end of one training session. As was noted, upon a second visit, 69% of the patients receiving a second screening, again had incorrect inhaler technique. These values mimic the evidence noting that inhaler technique must be a recurrent educational focus at future patient visits. Inhaler technique and asthma education cannot remain once a year visit type focus.

Twenty-six patients scored an 18 or lower on the asthma control test. Only two times was it recorded in the patient's record that this score was discussed. A score of 18 or less denotes poor asthma control. As well, the quality of life scores was not often viewed by the providers. The two most significant reasons for this were: 1- most of the physicians declined to utilize this questionnaire, and 2- since the copyright for this questionnaire would not allow for scanning into the EMR all the questionnaires came directly back to me. After my day was over and the patients had left the office, I noted the low scores on the quality of life.

This project will have a long-lasting impact on our patients at CHP-BPA. As I worked with the patients, several noted: "that no one has ever personally shown us how to use the inhaler." Other parents noted that they "were scared about their child's asthma, but now had a sense that they could talk to our office about their concerns. Many patients had never used a spacer in the past. Through the generosity of Dr. Lamm, 50 spacers were purchased for this program. Patients who were not able to afford a spacer due to the co-pay were now able to have a spacer. As well, several patients were able to have a spacer both at home as well as at school. I was gone from the office for two weeks during the implementation project. The spacers were kept in an unlocked drawer in my desk. Upon my return after each week, the number of spacers in the drawer drastically decreased. Even though the providers did not fully participate in the program, the providers realized the importance of the spacers.

Our patients were able to learn how to use their inhalers! Before education, 50 percent of the patients missed three or more steps of inhaler technique. However, after education, all patient had seven to eight correct inhaler steps. For these patients, we

fulfilled the ability to teach our patients how to use their inhalers! If this teaching can move forward to all our patients, the impact on our practice would be phenomenal.

Impact of project results. Two patients were seen at CHP-BPA throughout the implementation of the project. Each of these patients was seen more than once in the office. However, each patient had a different trajectory of results.

Patient "I" had three appointments between July and October. At all three appointments, she received both inhaler technique training as well as the opportunity to complete ACT and QOL questionnaires. She had a full discussion of her asthma as well as completion of an asthma action plan for school. One of her appointments was for a well visit; the others were for asthma follow up. At each visit, "I's" inhaler technique improved by one step to eventually having all eight steps correct. At a subsequent visit after the scholarly project was completed, she again demonstrated her technique and was immediately able to note that she completed a step incorrectly and verbalized why it was done incorrectly. She did not require any emergency room or urgent care visits during the time of the program. She and her mother completed both ACT and QOL questionnaires at all three visits. Her ACT scores started at 17, increased to 19 and then decreased to 16. Both she and her mother's QOL scores increased from five to six. When asked why she thought her ACT scores decreased, she responded by saying that she could now tell when she was not feeling well due to her asthma and not be able to be in gym or sports with her friends due to her asthma. Her mother noted, "she now has the tools that she needs to be able to be on top of her asthma. We now know when we need to call for help."

Patient "M" had eight visits between July and October of 2018, but only received the inhaler technique educational program twice. He did not receive the program the other six times due to either the provider declining the program during the patient visit or the medical assistant or nursing forgetting to include him into the project. His inhaler technique decreased in correct steps between the recorded visits one and two. He was seen two times in the emergency room for his asthma in this period, and his ACT scores decreased from a 24 to a 10. His reported QOL scores decreased from seven to six; caregiver scores decreased from seven to four

These two cases show the impact of this inhaler technique education program. As was seen in the evidence backing this best practice quality initiative program at CHP-BPA- this program increases the correct number of steps of inhaler technique and increases asthma control as well as the quality of life. Only 25% of our patients received this program at our office. The impact that could have been seen if all 312 patients received the program could have been enormous.

Discussion of Project Sustainability Plans and Implementation

After careful consideration of the above EBP implementation project data analysis, the next step in the evidence-based process is formalizing a sustainability plan. It is ethically required to continue to provide the best, evidence-based care, to the patient population (O'Mathuna, 2015).

Asthma medical home. CHP-BPA must move past the current care model of only assessing asthma one time per year or at asthma exacerbation visits. With the clinic currently being in a state of change, this is an opportune time to implement a new care protocol for all caregivers. The project has also had the same outcomes as did the body

of evidence; thus, proving that this project is commendable and needed for our patients. Repeat encounters with continued emphasis on inhaler technique are required to hone proper technique and to have improved asthma control. For our patient to own their asthmatic health; they must be given the required tools to learn about their asthma. The patients, therefore, must be seen more than once a year or for emergency visits.

While performing the inhaler technique at every patient encounter is recommended in the body of evidence; this model of patient care was not accepted by most of the providers and staff at CHP-BPA. One of the most significant barriers noted by all providers, including me, was the required time. At a well visit, we are only given 20 minutes for ages five to eleven- and thirty-minutes ages twelve and older. This time does include not only the asthma education but also all other wellness aspects of the child's life as well as any other questions the family may have. A sick visit is only scheduled for 20 minutes. The sick visit intends to only focus on the concern at hand; not including an additional asthma educational segment.

Both the American Academy of Pediatrics (AAP) and the National Association of Pediatric Nurse Practitioners (NAPNAP) have separate special interest groups (SIGs) regarding asthma. Each of these organizations bases their asthma education on the National Asthma Education and Prevention Program (NAEPP) 2007 Expert Panel Asthma guidelines.

The American Academy of Pediatrics (AAP) along with the American Asthma Network (AAN) developed Medical Home Chapter Champions Program on Asthma (MHCCPA) in 2008. Since that time, the AAP has sought at least one pediatrician per chapter to be a champion for this program. In an informational website to members of

the AAP, the AAP has addressed the same barriers to care that was noted in this scholarly project. For the biggest concern, time, the AAP noted the following:

> "Chronic care management visits are a great way to incorporate the six Guidelines Implementation Panel (GIP) priority messages from the National Heart, Lung, and Blood Institute (NHLBI) guidelines for optimal asthma care. In a non-acute visit, asthma control and allergen/irritant exposures can be assessed, asthma severity and medications adjusted, spirometry obtained (if indicated) and the child's asthma plan and school medication authorization forms can be completed. For providers who see many patients with asthma, grouping such visits into a single clinic day can streamline care flow and enhance staff familiarity with needed forms and procedures. These visits can be scheduled in longer time slots and coded for time spent in care. By asking your patient to schedule their asthma management visit with you before they leave, they are more l0ikely to return, and you can better predict your workflow" (Planning Care for Children with Asthma in your Medical Home: Addressing Common Concerns of Primary Care Providers, AAP 2014).

The AAP recommends asthma visits to the clinic every two to six weeks for uncontrolled asthma and every three to six months for controlled asthma. At every patient encounter, the AAP also recommends the following;

- Discussion of the Asthma Action Plan (AAP)
- Discussion of asthma medications; how to take and their role in asthma care
- How to use a spacer and an inhaler
- Patient to know their asthma triggers; how to self- monitor their care (Key points for asthma guide implementation, AAP, 2013).

While viewing the NAPNAP asthma SIG website as a non-paying member, NAPNAP does not have the same explicit guidelines found on their website. The only inhaler technique information provided is regarding school nurses and asthma care at school.

Sustainability plan: asthma medical home at CHP-BPA**.** A new proposal at CHP-BPA will be the formulation of asthma medical home care. As noted above, with all the ongoing change at CHP-BPA, this is an opportune time to implement a new care model. Even though the evidence supports inhaler technique evaluation at every care visit, time does not allow for this teaching to feasibly occur. Upon discussion within the clinic, the providers are agreeable to an implementation of quarterly asthma care appointments at the clinic.

Each asthmatic patient would be seen four times each calendar year; with one visit being their yearly well visit appointment. At each of these appointments, the patient would demonstrate their inhaler technique and then have education given to them regarding any technique steps missed. The patient would then return demonstration. The patient and family would also complete the ACT and QOL questionnaires. The provider would have time to review the questionnaires with the families. Medication management would also be discussed. Asthma action plans would be formulated. These visits would be scheduled for 40 minutes; to allow for provider time to fully assess their asthma status.

The social and psychological factors of asthma would also be assessed. A link between the school and our office should be established. Since the asthma medical home program would now be solely an office-based program and not have any affiliation with a teaching university; an IRB would not be required. I would meet with the school nurses to discuss how we could establish a care team- continuing the work as demonstrated by Carpenter and partners (2015, 2016) with school-based nursing inhaler technique training. As well, a system to monitor school absences due to asthma could also be established rather than an immediate recall system as was used in this scholarly project.

The evaluation of both patients, as well as patient/caregiver, views life with asthma is very important. As I saw with a few patients, even though they had an ACT of 27 with near perfect inhaler technique; some patients rated their quality of life as poor. To improve both asthma as well as ownership of their health- we must address the social side of asthma.

Fallon Health Care, the ACO for Berkshire County, has a respiratory therapist. As well, the Berkshire Collaborative, which is a Fallon service, consists of an RN case manager, social worker as well as a community health worker. We could certainly consider having an asthma clinic on a select day in the office. We would have the Fallon workers present to assist with our Fallon ACO patients. We could certainly also reach out to the other carriers, such as Blue Cross Blue Shield, to inquire if they would be willing to have case managers on site to assist their patients.

Electronic medical record (EMR) at CHP-BPA. As has been mentioned in the previous chapters of this project, the current EMR at CHP is not a sophisticated product. No one can run reliable reports. Practices are not able to determine which patients have a diagnosis of asthma or even which patients coming to the practice currently have an asthma diagnosis. The agency is in the process of implementing a new EMR. The EMR will be in place as of July 2019. This new EMR will have an enhanced reporting feature. As well, the day to day functionality of the system should prove useful to both the clinician as well as senior management. Encounters will be documented as a point and click rather than a free texted field. This will enhance reporting capabilities. As well, best practices are a function of the EMR. Therefore, providers will have access to asthma best practices. Since we are still in the process of having the EMR configured for CHP, I

am hopeful that we will be able to have the ACT as a capturable questionnaire in the system. We are also hopeful that asthma action plans will also be easy to format within the system.

Implications of EPIP results to the community/organization, patients, health-care, nursing and advance practice nursing

The impact of this inhaler technique project along with asthma education and allowing families to learn how to own their health will be far-reaching. At a subsequent appointment, one of the mothers of my patients wrote this email to me regarding the program:

> "[My daughter] has been struggling with her asthma for several years. Ending up on several courses of steroid treatments a year. Her asthma seemed to act up more in the winter's months and with any sports activity. Missing days of school, ER visits and multiple doctor office visits, as well as interfering with her sports.
> [My daughter] began seeing Gina Nelson, NP approximately 6 months ago and we began the asthma treatment program with her. Gina switched [my daughter's] inhalers from Flovent to Qvar and added a nightly pill on singulair. We started a new plan as to when to take her inhalers, for example 20 min before sports. [My daughter] did step by step training with Gina on how to properly use the inhalers and chambers.
> Since the new treatment plan started [my daughter] asthma symptoms have significantly improved. She hasn't needed any courses of steroids, has used the rescue inhaler very few times and isn't experiencing interruption with her sports like she used to.
> I would highly recommend this to other parents whose children are suffering from asthma."
> Mother

This is only one patient account that I received during this project. However, I was told by many parents during the time that this was the first time that their child was given guidance on how to use an inhaler. Several parents wrote on their quality of life forms that they were fearful of their child's asthma. These comments do not support the notion that our patients' asthma is under control. This program is needed and essential for this community.

Pittsfield, Massachusetts has an asthma incidence of 14.4% which is nearly double the incidence of the nation. We also have the fifth highest ER rate for asthma in the state. Over this past week, CHP has written a press release about this asthma project. We are hopeful that the efforts that we are going to be engaging in at our practice will help to decrease the consequences of asthma.

The concept of owning one's health with asthma is to allocate to the child and family all the tools that are necessary for the child to function at their greatest physical and emotional extent without an asthma exacerbation. The children and adolescents would be allowed to live lives without the fear of asthma. Rather than only treating asthma during exacerbations and keeping the child and family in an ill state, we need to start focusing on how to keep the child or adolescent in a well or healthy state, without exacerbations of their asthma. For advanced practice nurses- this is our mission. We practice as holistic wellness providers. We need to maintain this state of wellness and ownership at the forefront of our minds. The American Academy of Pediatrics has a very well laid out plan of care for an asthma medical home. Their plan is physician led. We as advanced practice nurses through our practice academies need to also lead the charge for our patients.

A knowledge gap was found with the implementation of this evidence-based program. The current evidence states for inhaler technique demonstration and education to occur at every patient encounter. However, as was noted in this program, this care is not feasible in a pediatric office with each provider seeing a patient every 20-30 minutes. I believe that a nursing scientist or PhD will need to come alongside me to discuss the sustainability plan that is recommended for our office. We would need to work together

to discover how quarterly asthma teaching visits would impact upon the asthma outcomes detailed in this paper. Would the patients and families require fewer or greater visits in order to achieve the outcomes?

Another knowledge gap involves the new FMHO model and pediatric ownership of asthmatic health. I plan to work with Maria Donnelley in the future regarding how families and patients can learn to manage and own their asthmatic health. We will need to discover if this ownership of asthmatic health would impact their lives further into the future. Asthma is a progressive disease and can impact a patient's respiratory and cardiac health far into the future. Further, if a patient could learn how to own their asthmatic health, could they also then learn how to own other chronic health issues in the future?

Key Lessons Learned from EPIP Implementation

Many key lessons were learned during this process. First and foremost, all the providers and nurses deeply care for our patients at CHP-BPA. However, we need to change the way we are currently practicing on both a business as well as healthcare level at this time.

CHP-BPA has been operating in a state of change since I joined in 2017. The practice has merged from being an independent practice for over 40 years to an owned practice. Furthermore, the clinic went from independent practice to a federally qualified health center overnight. These are major changes to any practice. Change needs to be looked at as an opportunity; not an obstacle.

This past fall, CHP hired a new practice manager for CHP-BPA. He was hired from within CHP, so he is knowledgeable of CHP practice environment as well as

processes. He has already attempted to work with the staff at all levels to help us to embrace the changes and to move forward. He is actively involved in the EMR transformation as well as daily practice. I am very hopeful that his presence will allow CHP-BPA to evolve into a new revitalized practice.

I was not aware of the power that both our medical assistants as well as nurses held in the practice until the time of the project. Again, if we as a practice expect changes to occur, then we must all work as a team. We must all collaborate together; however, if a care model needs to be implemented then all team members must work together.

All providers are in favor currently for an asthma medical home. The processes laid out in the sustainability section have been agreed upon by the providers. With the upcoming EMR changes, we are in the process of incorporating the new asthma changes into the practice.

The total amount of expenses for this scholarly project was $10,065.58. The actualized gross billing for this project was $16,034. If all billing were captured, a profit from those three months of $5,968.42 would be realized. However, CHP-BPA providers did not bill to their full extent during the project. At the start of the project, I emailed all nursing and all providers to make them aware of the additional billing that we would be able to justifiably utilize due to the increased education and assessments being done at these visits, including the use of a modifier 25 with well visits. As I reviewed our gross billing documentation, neither the providers nor nursing fully billed to the greatest extent. If we had done so, we would have realized a gross billing of $19,983. If all billing were captured, a profit of $9,917.42 would have been realized; an increase of $3,949.

Only 119 patients out of 312 patients were a part of the educational program. These patients totaled a net of 518 separate billable encounters. Three hundred eighty-two visits occurred without the asthma educational program. Counting for only the 27-dollar gross billing reimbursement for inhaler technique education, this billable amount would have captured a gross billing of $10,314. This amount would have been seen in only three months. Only considering these 312 patients, over a 1-year period of time with four visits each $33,696 would be gross billed just for inhaler technique education; not counting for additional billing coding.

CHP-BPA also has the opportunity for performance reimbursement with the asthmatic population. By maintaining a decreased ratio of quick acting to controller inhaled medications, written and documented asthma action plans as well as keeping patients out of the emergency rooms- CHP can receive incentive payments for these actions. Through the existence of an asthma medical home, all these incentive markers would be met.

Conclusions

The Breathe in Breathe out Inhaler Technique program at CHP-BPA is a best practice evidence-based project at CHP-BPA. Major Bourne, in 1996, wrote her master's in nursing thesis on inhaler technique. She found that pediatric patients did not use inhalers correctly. Twenty-three years later, we are finding that patients still do not know how to use an inhaler correctly. By incorporating an inhaler education program, we found the same outcomes as did the thirty-one scholarly authors found with inhaler technique. With inhaler technique hands-on and verbal education, patients can correctly

utilize an inhaler. It is now time for providers to break the cycle of incorrect inhaler technique.

I also found that our patients do not have as high of a quality of life with their asthma as was thought at the start of this project. We must continue with this best practice program to help our patients learn how to both own their health and to own their asthma so they can have fewer asthma exacerbations. With this program, we will meet CHP's mission statement: "measurably improve the health of Berkshire County, Massachusetts" with a vision that "Berkshire County's population will be the healthiest in Massachusetts" (Community Health Program, 2017).

Recommendations for Dissemination

I submitted an abstract for the background and significance, initial literature search and proposed implementation plan to Doctors of Nursing Practice 2018 conference. My abstract was accepted for a poster presentation. I presented at the 11th Annual Doctors of Nursing Practice conference in Palm Springs in September of 2018.

An accompanying concept analysis regarding ownership of adolescent asthmatic health was also written last year. I submitted this manuscript to Nursing Forum, and it was accepted for publication in December of 2018. The published manuscript is entitled: "Ownership of Adolescent Asthma Health: A Concept Analysis.

I submitted an abstract to Sigma Theta Tau for their 45th Biennial Convention in Washington DC for a podium presentation of this DNP Scholarly Project. My abstract was accepted, and I plan to present in November of 2019. After presenting at Sigma Theta Tau, I will prepare a manuscript for publication of this Scholarly Project.

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Appendix A

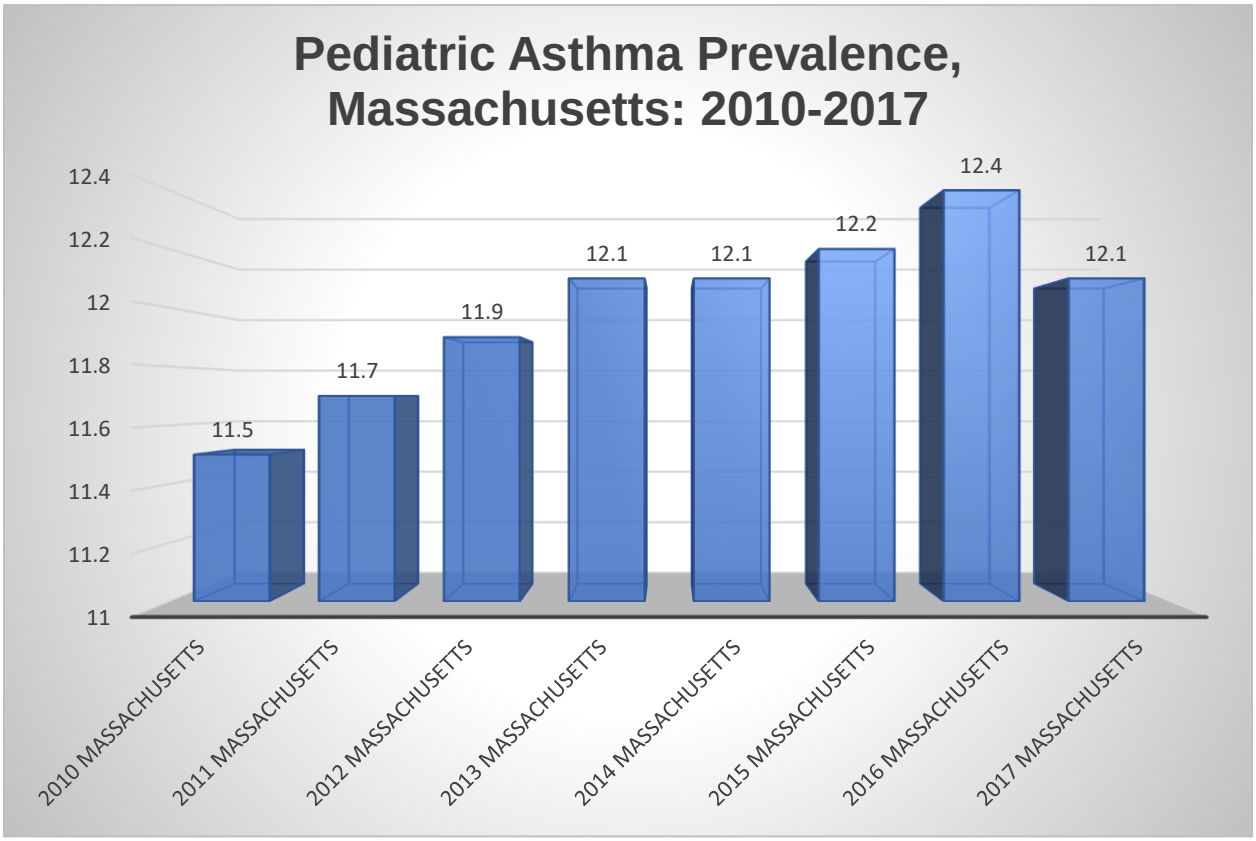

Figure AA1: Asthma Prevalence Massachusetts: 2010-2017

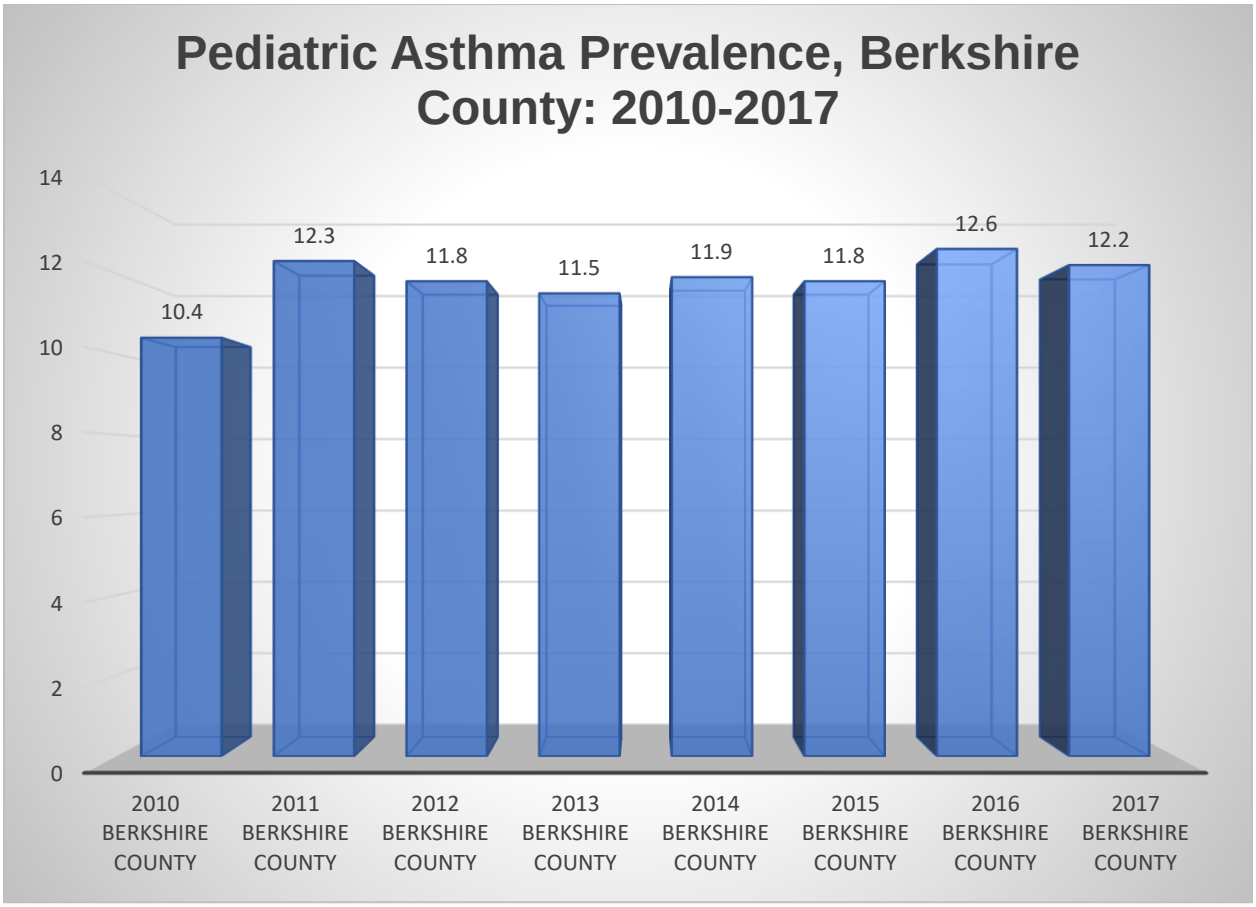

Figure AA2: Asthma Prevalence Berkshire County, 2010-2017

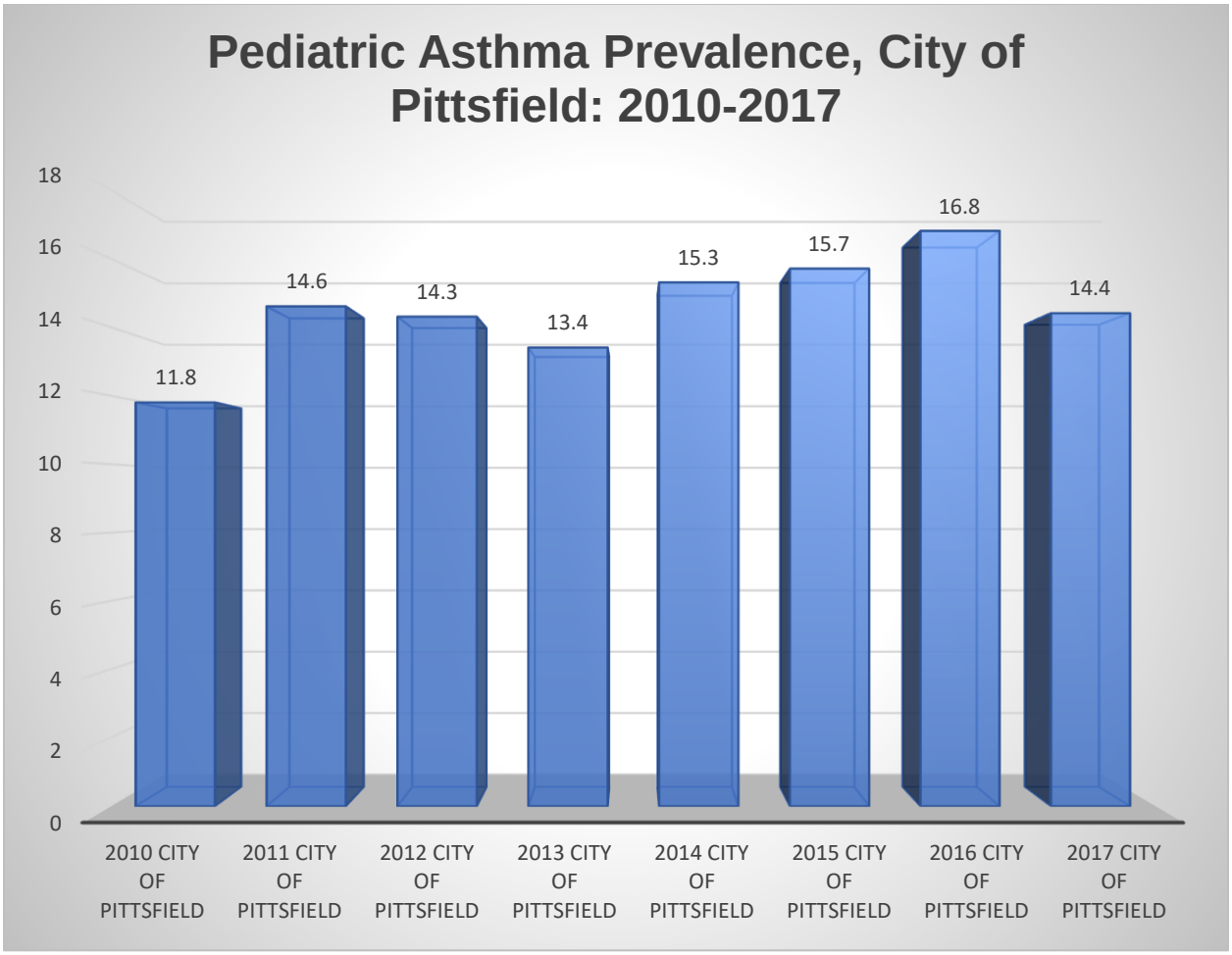

Figure AA3: Asthma Prevalence City of Pittsfield, 2010-2017

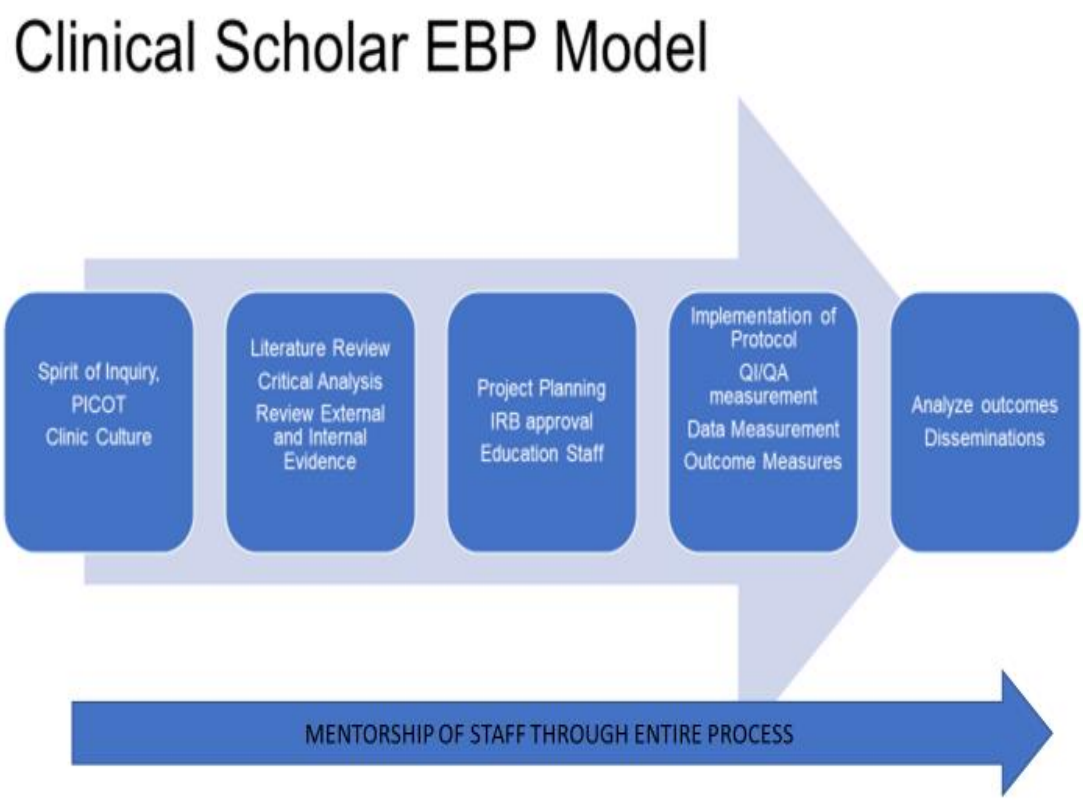

Figure AA4: Clinical Scholar EBP Model Schematic

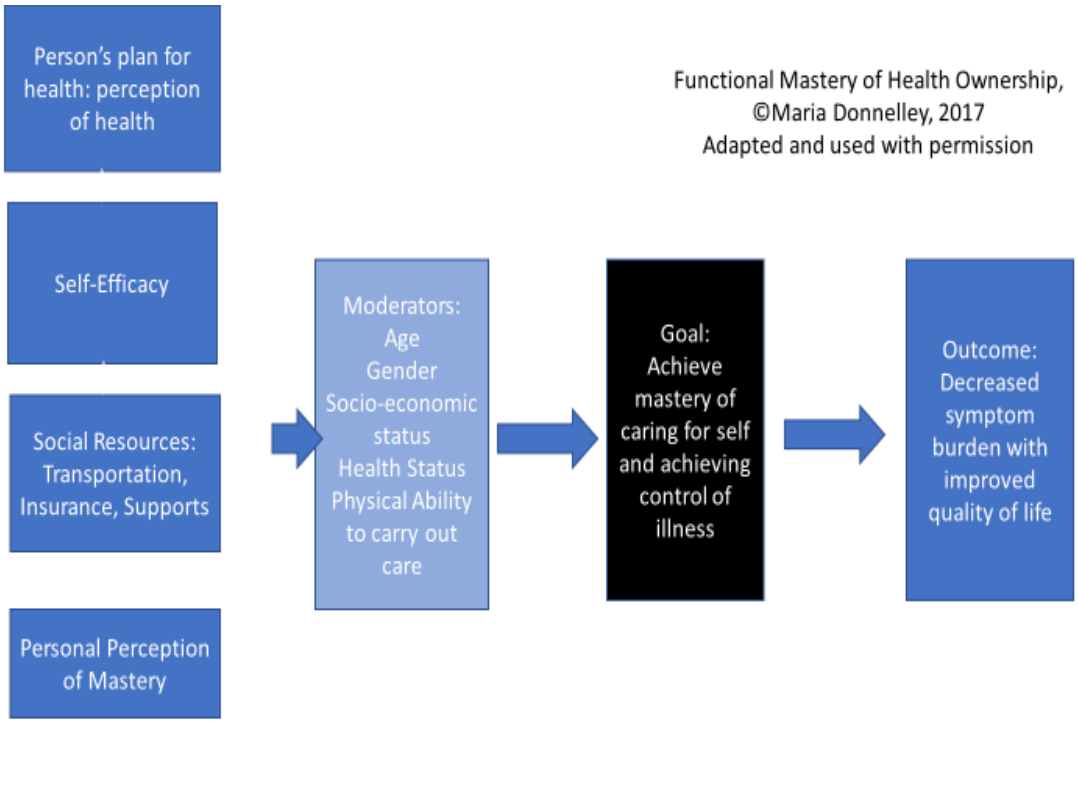

Figure AA5: Functional Mastery of Health Ownership Schematic

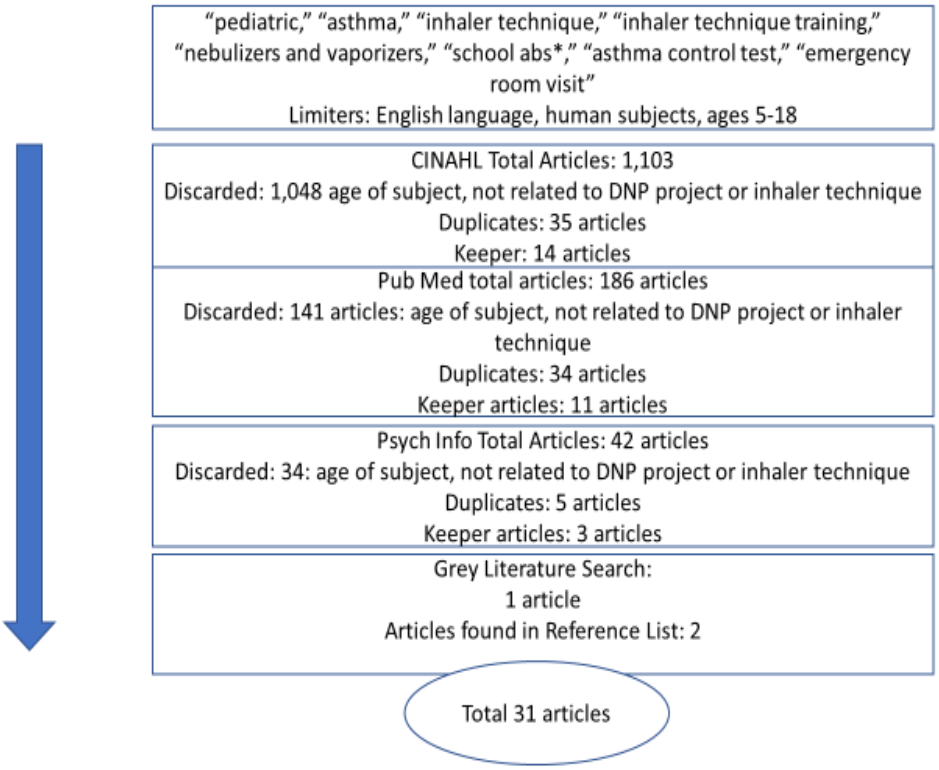

Figure AA6: Literature Search Flowchart Schematic

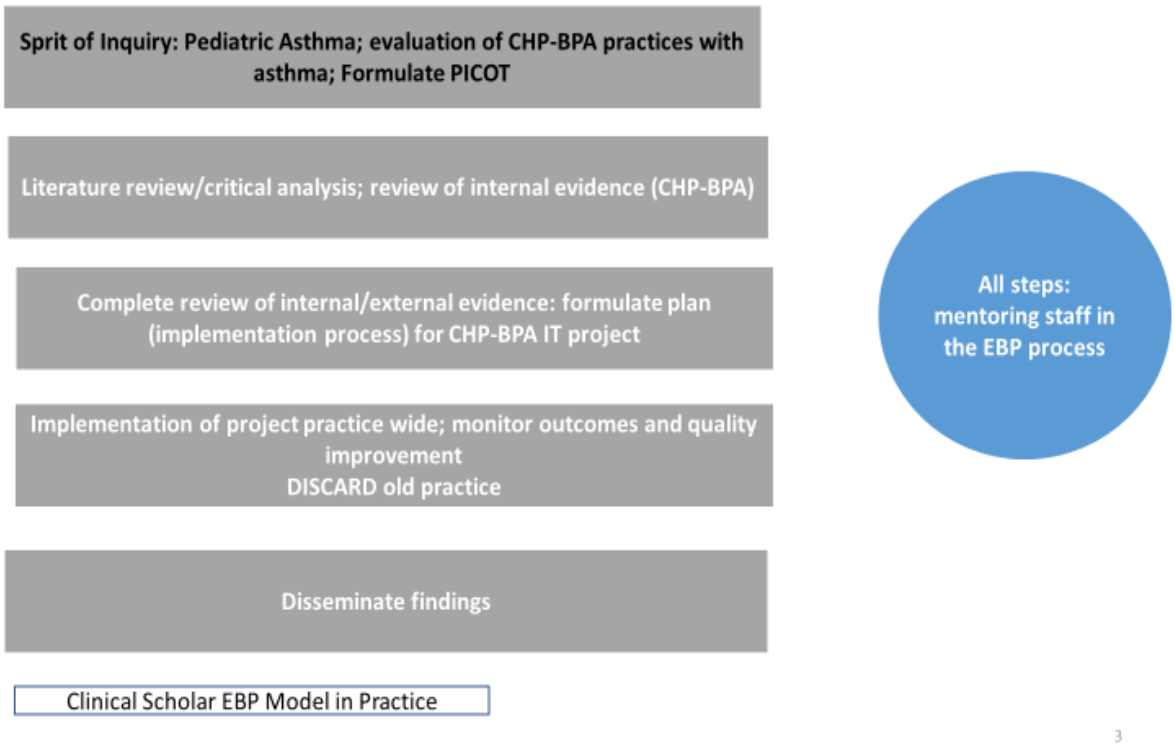

Figure AA7: Clinical Scholar EBP Model in Practice

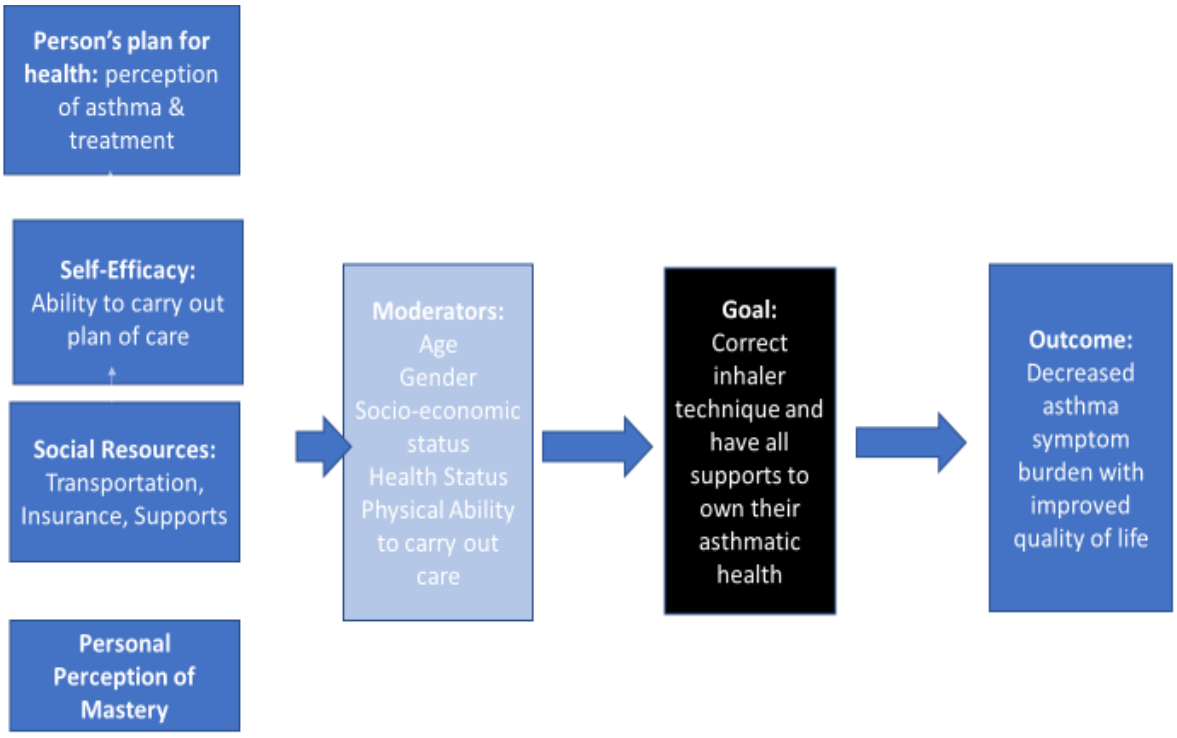

Figure AA8: FMHO Model in Practice

Logic Model for DNP Scholarly Project

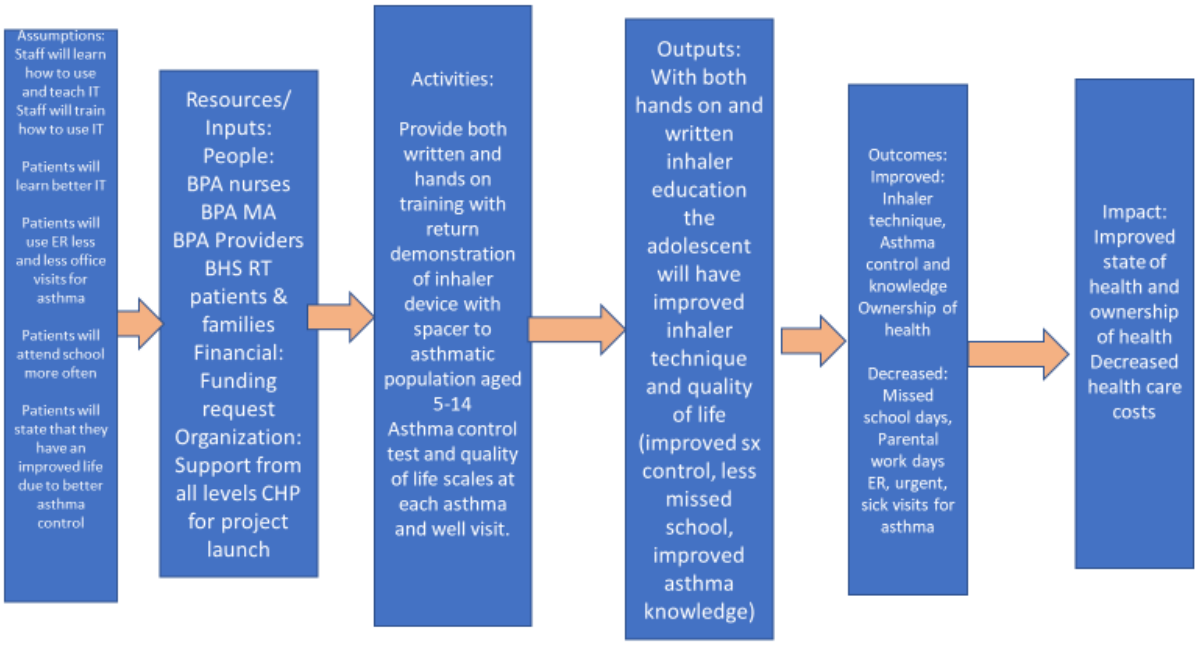

Figure AA9: Logic Model Schematic

Appendices B:

Evidence Tables and Synthesis Tables

Evaluation Table Inhaler Technique

Table AB1: Evidence Table for DNP Scholarly Project

Citation: first author	Purpose of Study	Conceptual Framework	Design/ Method	Sample/Setting	Major Variables Studied and Their Definitions	Measurement of Major Variables	Data Analysis	Study Findings	Appraisal of Worth to Practice Strength of the Evidence (i.e., level of evidence + quality [study strengths and weaknesses]) RECOMMENDATIONS
Gillette, et al, 2016, Academic Pediatrics, *16*,7: 605-615	Prevalence correct IT Educational intervention (s) associated ↑ IT ↑IT= ↑ asthma outcomes?	none	Level I: system-atic review	Experimental & observational studies; -PubMed -cochrane -CINAHL -clinicaltrials. Gov Eligibility: ≥1 outcome measure included/report-ed pedi IT	IT Education IT AC		Downs & Black checklist appraise quality Preferred reporting items for systematic reviews & Meta-Analyses guidelines No statistical analysis recorded	MDI: 0-57% children correct IT 8 steps correct: 18-97% Better IT: -older -having exacerbation -no help using -received instruction -educational pamphlet	Only included English language Inadequate IT can result in ↓ AC-intensified in children d/t smaller developing airways and ↓ IT Very little research actual provider-child communication IT Limitation (noted by author) Pre-identified search terms- may have missed articles due to this Non-statistical review to evaluate effect size Only English language

1: Gillette et al. (2016); 2: Rodriguez-Martinez et al. (2017); 3: Alexander et al. (2016); 4: Amirav et al. (1994); 5: Burkhart et al. (2000); 6: Carpenter et al. (2015); 7: Kamps et al. (2000); 8: Zivkovic et al. (2008); 9: Bourne (1996); 10: Capanoglu et al. (2015); 11: Carpenter et al. (2016); 12: Chen et al. (2002); 13: Foland et al. (2002); 14: Janssen et al. (2003); 15: Jones et al. (1995); 16: Levy et al. (2013); 17: Minai et al. (2004); 18: Munzenberger et al. (2007); 19: Sleath et al. (2011); 20: Turkeli et al. (2016); 21: Deerojanawong et al. (2009); 22: Walia et al. (2006); 23: Schmier et al. (2007); 24: Manriquez et al. (2015); 25: Reznik et al. (2013); 26: deGroot et al. (2014); 27: Duerden, et al. (2001); 28: Pedersen et al. (2010); 29: Price et al. (2013); 30: Morin, 2012

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Citation: first author	Purpose of Study	Conceptual Framework	Design/ Method	Sample/Setting	Major Variables Studied and Their Definitions	Measurement of Major Variables	Data Analysis	Study Findings	Appraisal of Worth to Practice Strength of the Evidence (i.e., level of evidence + quality [study strengths and weaknesses]) RECOMMENDATIONS
				Limitations: English language Age 6-18 studied 2000-2015 28 studies				-level satisfaction with provider Incorrect MDI steps: -inhalation technique -holding breath 10 seconds -waiting 30 seconds before 2nd puff MDI w/spacer: Correct IT: 0.6%-55% Missed steps: -shaking inhaler -waiting 30 seconds 2nd puff -holding breath 10 seconds Education: Teach correct IT=↑ IT regardless	Authors do not believe publication bias present

1: Gillette et al. (2016); 2: Rodriguez-Martinez et al. (2017); 3: Alexander et al. (2016); 4: Amirav et al. (1994); 5: Burkhart et al. (2000); 6: Carpenter et al. (2015); 7: Kamps et al. (2000); 8: Zivkovic et al. (2008); 9: Bourne (1996); 10: Capanoglu et al. (2015); 11: Carpenter et al. (2016); 12: Chen et al. (2002); 13: Foland et al. (2002); 14: Janssen et al. (2003); 15: Jones et al. (1995); 16: Levy et al. (2013); 17: Minai et al. (2004); 18: Munzenberger et al. (2007); 19: Sleath et al. (2011); 20: Turkeli et al. (2016); 21: Deerojanawong et al. (2009); 22: Walia et al. (2006); 23: Schmier et al. (2007); 24: Manriquez et al. (2015); 25: Reznik et al. (2013); 26: deGroot et al. (2014); 27: Duerden, et al. (2001); 28: Pedersen et al. (2010); 29: Price et al. (2013); 30: Morin, 2012

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								clinic/school, who performed ↑ times taught=↑ IT Education & return demo = ↑↑ IT Telemedicine appt w/education ↑IT Video education ↑ IT, but ↓IT after 1 month ↑IT=↑ asthma outcomes? 5 studies: ↑AC, ↓ER, ↓symptoms, ↓school absence 7 studies: ↑ self-mangement, ↑ self-efficacy, ↑AK	
Rodriguez-Martinez, et al, J of asthma, 2017, 54(2): 173-185	Systematic review instruments evaluating MDI IT; evaluating	None	Level 1 system-atic review	24 studies included 24 instruments identified	Tools utilized to measure MDI IT		Streiner checklist	Authors selection best instruments:only these included report validity, reliability, & utility -Boccuti	Author noted limitations: -methodology used to critique better suited for scales rather than checklists Did not include grey literature, dissertations, unpublished works

1: Gillette et al. (2016); 2: Rodriguez-Martinez et al. (2017); 3: Alexander et al. (2016); 4: Amirav et al. (1994); 5: Burkhart et al. (2000); 6: Carpenter et al. (2015); 7: Kamps et al. (2000); 8: Zivkovic et al. (2008); 9: Bourne (1996); 10: Capanoglu et al. (2015); 11: Carpenter et al. (2016); 12: Chen et al. (2002); 13: Foland et al. (2002); 14: Janssen et al. (2003); 15: Jones et al. (1995); 16: Levy et al. (2013); 17: Minai et al. (2004); 18: Munzenberger et al. (2007); 19: Sleath et al. (2011); 20: Turkeli et al. (2016); 21: Deerojanawong et al. (2009); 22: Walia et al. (2006); 23: Schmier et al. (2007); 24: Manriquez et al. (2015); 25: Reznik et al. (2013); 26: deGroot et al. (2014); 27: Duerden, et al. (2001); 28: Pedersen et al. (2010); 29: Price et al. (2013); 30: Morin, 2012

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	measure properties		PubMed & Embasse Inception database-2015 Any language	Child age 1 month-18years Inclusion articles: Any article evaluating tool MDI use Exclusion: If not MDI not included				-Sleath -Welch; only age 1-6 -Kamp	
Alexander et al, J of Asthma, 2016: 53(1), 107-112	Quantify over-confidence IT Measure number incorrect steps Demogrphic or clinical pattern effect IT	none	Level II RCT Same sample/ method as 3 minute video IT: steps perform correct SE: 1 item Bursch et al: how	Inclusion: N=91 Age 7-17 IV: 46 (3 minute asthma video) Control: 45 (3 minute health promotion video) (same sample as 3 minute video)	IT DV: SE Confidence of use	IT performed Scale of confidence given	T-Test/Chi Square: IT P=0.05 LR: baseline data CC assess demo/ clinical factor predict overcon-fidence	IT: -CC miss 1.5 -NCC miss 1.8 Demographics CC/NCC: -age: p0.28 -gender p0.85 -race p0.48 -AS: p 0.96 -Years asthma: p0.15 ICS: p0.09	Continued evidence missed IT and not able to utilize inhaler correct Not enough to ask if know how to use inhaler, CC still missed steps Limits: only 2 centers, had to miss step IT to qualify, Hawthorne effect

1: Gillette et al. (2016); 2: Rodriguez-Martinez et al. (2017); 3: Alexander et al. (2016); 4: Amirav et al. (1994); 5: Burkhart et al. (2000); 6: Carpenter et al. (2015); 7: Kamps et al. (2000); 8: Zivkovic et al. (2008); 9: Bourne (1996); 10: Capanoglu et al. (2015); 11: Carpenter et al. (2016); 12: Chen et al. (2002); 13: Foland et al. (2002); 14: Janssen et al. (2003); 15: Jones et al. (1995); 16: Levy et al. (2013); 17: Minai et al. (2004); 18: Munzenberger et al. (2007); 19: Sleath et al. (2011); 20: Turkeli et al. (2016); 21: Deerojanawong et al. (2009); 22: Walia et al. (2006); 23: Schmier et al. (2007); 24: Manriquez et al. (2015); 25: Reznik et al. (2013); 26: deGroot et al. (2014); 27: Duerden, et al. (2001); 28: Pedersen et al. (2010); 29: Price et al. (2013); 30: Morin, 2012

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			sure of IT are you -1:not -2:a little -3:fairly -4:quite -5:com-pletely Divide 2 groups -NCC answer 1-4 -CC answer 5	8 families lost f/u English/Spanish speaking/read MDI user Incorrect IT Mild-severe asthma Time: 15 months Mean age: IV: 10.9			(IT incorrect)	Demo/clinical not effect CC/NCC IT missed: -shake and hold breath 10 seconds both CC/NCC LR: Clinical characteristics not associated incorrect IT. CC boys more likely miss/girls p=0.04	
Amirav et al, 1995, J Allergy Clin Immun: 95(4): 818-824	Develop, implement, evaluate IT education pediatric residency	None	Level II RCT -pt ed IT/spacer written Residents received:	All pediatric residents in program years 1-3 Total: 54 residents 20 (37%) 1st year	IV: continued education Control: no further education past 1st session	Pre education/post education testing IT	Means SD	IV group: Pretest IT: MDI: 3.7/7 correct 13/25 theory correct Post test: 6.3/7 IT 18/25 theory	Healthcare providers receiving 1:1 education have improved IT and AK as compared to those who do not receive

1: Gillette et al. (2016); 2: Rodriguez-Martinez et al. (2017); 3: Alexander et al. (2016); 4: Amirav et al. (1994); 5: Burkhart et al. (2000); 6: Carpenter et al. (2015); 7: Kamps et al. (2000); 8: Zivkovic et al. (2008); 9: Bourne (1996); 10: Capanoglu et al. (2015); 11: Carpenter et al. (2016); 12: Chen et al. (2002); 13: Foland et al. (2002); 14: Janssen et al. (2003); 15: Jones et al. (1995); 16: Levy et al. (2013); 17: Minai et al. (2004); 18: Munzenberger et al. (2007); 19: Sleath et al. (2011); 20: Turkeli et al. (2016); 21: Deerojanawong et al. (2009); 22: Walia et al. (2006); 23: Schmier et al. (2007); 24: Manriquez et al. (2015); 25: Reznik et al. (2013); 26: deGroot et al. (2014); 27: Duerden, et al. (2001); 28: Pedersen et al. (2010); 29: Price et al. (2013); 30: Morin, 2012

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			-theory IT and med- AK 25 question survey; personal prescript-ion practice -sample MDI/ spacer-demons-trate IT with immed-iate feedback -small group session ER rotation 1 teacher:2 resident sessions discuss	18 (33%) 2nd year 16 (30%) 3rd year 28 IV 26 control Excluded if had AK assessment year prior				(p<0.01) "significantly higher than control group per figures" (no data numerically represented; able to view figures)	

1: Gillette et al. (2016); 2: Rodriguez-Martinez et al. (2017); 3: Alexander et al. (2016); 4: Amirav et al. (1994); 5: Burkhart et al. (2000); 6: Carpenter et al. (2015); 7: Kamps et al. (2000); 8: Zivkovic et al. (2008); 9: Bourne (1996); 10: Capanoglu et al. (2015); 11: Carpenter et al. (2016); 12: Chen et al. (2002); 13: Foland et al. (2002); 14: Janssen et al. (2003); 15: Jones et al. (1995); 16: Levy et al. (2013); 17: Minai et al. (2004); 18: Munzenberger et al. (2007); 19: Sleath et al. (2011); 20: Turkeli et al. (2016); 21: Deerojanawong et al. (2009); 22: Walia et al. (2006); 23: Schmier et al. (2007); 24: Manriquez et al. (2015); 25: Reznik et al. (2013); 26: deGroot et al. (2014); 27: Duerden, et al. (2001); 28: Pedersen et al. (2010); 29: Price et al. (2013); 30: Morin, 2012

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			all above and IT						
Burkhart, et al, Nursing Clinics N America, 2000, 40: 167-182	Describe accuracy IT common mistakes IT Does teaching IT makes a difference or not	none	Level II RCT IT assessed pre/post Teach at visit 1 then 1-4 weeks later RN assess IT then education Repeat IT right away Same RN assess each visit	Study length: 5 weeks West Virginia N=42 Aged 7-11 Mean: 9.6 Asthma dx of at least 4.6 years 36 brought MDI to each visit/ 6 did not. If did not bring to at least 2 of 3 visits- not included in data	IV: education DV: IT DV2: common mistakes	IT pre/post intervention	Desc stats: mean, SD, frequency distribu-tion McNemar test for 6 steps IT Wilcoxon signed-rank test for change IT pair stats P 0.05 used	Incorrect IT pre/post 92%/19% Most common mistakes: Not holding breath: 56% Not waiting 1 minute between puffs 50% Inadequate shaking 42% Not inhaling correct: 42% Not using spacer 22% Pre/post Wilcoxin p<0.0001 McNemar p<0.005 for shake,inhale and hold breath;	Education along with demonstration ↑ IT Weaknesses: small study size; mostly white suburb homes 6/42 (1/7) of children forgot medication- so not part of IT calculation States that it is a RCT- however randomization/control is not evident. I would label this more quasi experimental Level IV Continue to show importance of education given each visit to improve IT/ correct mis-steps of IT Statement of NHLBI guidelines: • Verbal and written guidelines • Demonstrate each step • Patient demonstrates • Assess each visit • Provide feedback

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			good: 6/6 steps -fair: some steps -poor: no steps Own spacers/ placebo inhaler					Remaining IT steps not use McNemar since 100% correct all steps post assess Parental/patient thoughts on use inhaler higher than actual use	
Carpenter, et al, J Asthma, 2015, *52*(1): 81-87	videos ↑ IT immediately & 1 month Video ↑ confidence IT & ↑ AC at 1 month	none	Level II, RCT Control: nutrition video Exp: IT video IT assess pre/post video then 1	Inclusion: N=91 Age 7-17 English/Spanish speaking/read MDI user Incorrect IT Mild-severe asthma IV: 46	IV: 3 min video IT. education Control:3 min nutritional educational video DV_1: IT DV_2: inhaler SE	IT SE ACT	Priori anything <1 step change NS; N=100 80% power IT & 2nd outcomes: linear mixed model	IT: control group mean Δ: 0.03 IV: mean Δ: 1.12 Mean difference both: 1.08 CI: 0.53-1.63 P<0.003	Brief use of videos during a visit can have ↑ IT; however this effect does not last IT SE did not improve with one video AC did not improve with one video Weaknesses: Lost study funding- could only enroll 91/100 families

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			month later Length: 1 month Given wallet card w/web site to watch video after clinic	Control: 45 8 families lost to follow up	Likert scale of confidence of use AC: ACT			1 month f/u IT control mean Δ: 0.32 IV mean Δ: 0.87 Mean difference both: 0.55 CI: 0.02-1.11 P<0.056 IT SE Control Δ: 0.10 IV Δ: 0.28 Change both: 0.38 CI: 0.00-0.76 P<0.052 AC Control Δ: 1.20 IV Δ: 1.93	Only 42% of subjects using MDI controller medication- this could have lessened the AC impact Self efficacy scale used at time of study had not been reported in the literature Video could be effective use of time and energy in clinic- able to set up and have family view/ demonstrate IT/ view video again if needed. Would need to investigate if able to obtain the video used in this study. Using new video could alter the evidence (i.e. making our own video)

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								Mean both: 0.73 CI: 1.02-2.49 P<0.407 Missed steps: Shaking inhaler Not holding breath	
Kamps, et al, Ped Pulm, 2000, 29:39-42	Evaluate usefulness of IT instruction Hypothesis: receive IT instruction ↑ IT	none	Level II RCT ??: IT info, who gave info; time given education Control: IT ed given at least twice over 4 week period;	Netherlands Sept 1997-June 1998 Age 1-14 N=95 IV: 66 -demonstrate IT -assess on checklist -parents ?? on instructions -did parents feel child did good IT	IV: only IT assess, parental ?? Control: 2 education only sessions, then assess IT 6 weeks later DV: IT	IT ?? data 60/66 IV group had already received IT training; hypothesis on IT instruction could not be measured	Contin-gency table Chi square	Initial- 58% correct IT/ 97% perceived correct IT control: 93% correct IT p<0.0006 pharm ed 79% correct IT MD/RN ed: 39% correct IT P<0.0014 ?? data: -Pharm ed: IT displayed and	Single short instruction re: IT rarely successful Patients whom received ↑ personalized education with repeated education and demonstration had ↑ IT Just verbal education ↓ IT Weaknesses: Intervention group and control groups were not equal (did not discuss why or if power analysis was done) Some bias noted in discussion: authors stated none of children from disadvantaged background so most likely no compliance issues- that may not equate- disadvantaged can have good compliance and visa versa

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			Pharm or MD/RN 6 weeks later IT review	Control: 29 -IT instructed and reviewed x2 over 4 weeks -6 weeks later IT assess by MD Aged 1-14 Mean 5				reviewed til correct IT (30 min) Missed IT steps: Not shaking Not placing in mouth between lips -MD/RN office: verbal instruction without demonstration; no longer than 5 minute (qualitative data- no stats given)	No CI Very short reference list
Zivkovic, et al, World J Ped, 2008, 4(4): 267-274	AEI (asthma education intervention hypothesis: ↑asthma mgmt.w/ed benefit pt, parent, school, hospital budget	none	Level II RCT Time=12 months Control: asthma ed at discharge Given "meet	Serbia Recruited at hospital admission AE & ER Inclusion: asthma dx, aged 5-18, no co-morbidities 414 initially assessed- but 26	IV: received full asthma school program Control: usual instructions	IT Parental perception AS Parental knowledge of asthma Adolescent knowledge asthma Adolescent perception of asthma	Chi-square & ANOVA analyze between groups P<0.05 significant	-compliance↑ pre 69.2%/post 87.6% p<0.05 -IT: 20.1%/2.3% p<0.001 Dosage ICS↓ 83.6%/71/8% p<0.001 -LABA use ↑ 8.7%/17.1% p<0.001 Parental concern AS	With education, video and demonstration- increase in IT, compliance, AK, ↓ fear, Those patients who received only regular education- no video or other specialized education did not show same effect Weaknesses Intervention group=231/ control 71- large difference My project: this study over a 12 month period of time whereas most studies much

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	-educate Burkparents ↑AK and ↑QOL -educate children self-assess and mgmt.		your asthma"" IV: AEI: -lecture -video - 2 ½ day sessions -?? All: PE, clinical scoring, PFT	excluded due to above Mean age 10 N= Intervention: 231 Control: 71				↓ concern asthmatic child: 72.6%-50.5% p<0.05 -parental AK ↑ IV: 63.1%/82.8% p<0.05 Non-IV group: parental AK 55.4%/69.3% p>0.05 Adolescent knowledge baseline/12 months IV:↑ 55.2%-74.1% p<0.05/ Non-IV NS 55.4%-69.3% p>0.05 Adolescent perception: AK in IV group: 55.2%/74.1% p<0.05 AK non-IV: 55/4%/69.3% p>0.05	shorter duration. As well, more into an asthma ed program- which practice working on- however project just IT. However, could possibly role my project into the bigger. Must think about if by doing that would any change be due to the IT portion or to the full new education portion.

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								↓Fear of asthma: 35.6%/7.8% p<0.01 ↓ concern meds: 31.1%/11.1% p<0.01 Compliance: 66.7%/88.3% p<0.05 Reduced fear: IV↓ 35.6%-7.8% p<0.01 Compliance: ↑ 66.7%-88.3% p<0.05	

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Bourne, J 1996	Examine effectiveness teaching tool for IT	Orem	Level IV: quasi-experi-mental Use of IT checklist 1:1 MDI teaching 1st visit: -PFT -IT eval, 2 puffs MDI -PFT 2nd visit 2 weeks later -same as 1st visit but no teaching	Military pediatric care Aged 8-12 Convenience sample; 400 asthmatic children 12 children enrolled	IT PFT Steps missed	PFT IT checklist	Statistical analysis	All subjects improved IT post teaching. Slow inhalation step without 100% correct technique 10% IT improvement PFT did not improve with subjects	Only 1 examiner for IT; author noted consistency; however potential bias Some patients used MDI morning prior to appt; could skew results (mainly PFT) Education patients for IT ↑ IT

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Capanoglu, et al, J of Asthma, 2015, 52(8): 838-848	Address problem correct IT, adherence to ICS, effects of these problems on AC	None	Level IV Obs IT evaluated per evidence checklist After IT-education 2 groups: IT eval correct & IT eval incorrect Ad-herence ICS: "good" use: miss <2 times week "partial" miss > 2 times week	171 children Aug-Dec 2013 Ankara, Turkey Asthma, f/u at least every 6 months Exclusion: co-morbidities; only use rescue MDI	IT Use of ICS AC	Inhaler use checklist ?? ICS use, if no: frequency of use; reasons non-adherence AC- ACT AC- TRACK (<5 yr ??)	#/% discrete variables Mean/SD, IQR contin-uous variables Chi-square discrete 2 unrelated groups Mann-whitney U test constant variable non normally distri-buted AC risk: logistic regression Sig-nificance <p.05	Mean f/u: 10-36 months AC: 40.9% controlled GINA guidelines 57.9% controlled ACT/TRACK Adherence: 77/132: "good" Irregular: 22% -partial 1.7% -poor 21% Cause irregular: -forget to take 51.3% -complicated technique 25.5% -feel well, don't need 15.4% -fear side effect 7.8% AC:adherence	Correct IT and ↑ adherence equated to ↑ AC Incorrect IT: 42.2% Irregular use: 22.9% Education has to be repeated to maintain IT ; at least 3 times of teaching for IT to be correct IT should be evaluated before making therapy change- AC could ↓ with ↓ IT Weakness of study: parental report only on adherence- no other observable metric for adherence (stated by authors as well) What steps of IT missed most in study to look at in CHP-BPA F/U 3 months after intervention- one of few studies with follow up

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			"poor" using prn For stat analysis "good= regular" & "poor/ partial= irregular" Why miss ??					Regular: 46.2% vs irregular 23.1% p<..01 MDI/spacer: 119 (69.5%) DPI: 52 (30) Correct IT: MDI 68.1% vs DPI 34.6% p<0.001 Missed steps: -hold breath 10 sec: 24.4% - shake inhaler 21%	
Carpenter, et al, J of Ped Nursing, (2016), 31: 380-389	tailored video ↑ IT: feasible for school RN; improve IT	none	Level IV Descr Pilot study, RNs trained in IT; review pt IT	Convenience sample 7 school RNs from 7 different schools Children eligibility: 7-17 years old	IV: tailored video DV_1: IT	IT Focus group of school RN impression of program	Descriptiv stats- Non para-metric Wilcoxon signed rank	MDI w/spacer: Mean steps correct: BV: 6.4 AV: 7.6 P=0.03 1 month f/u: 100% accuracy p=0.01	Video use as education did help to ↑ IT. Authors have not concluded if just the video or if combination of rapport with school RNs and video included Only a 5 minute video. Dependent upon cost, this could easily be feasible within our practice

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			IT score to video program Tailored video to child w/ self picked Avatar Video train IT Recheck IT after video 1 month later re-do of process Tailor video used again Focus group	Speak English Dx asthma Using MDI N=25 Mean age 11.5 Time 1 month			Qual. Analysis	MDI no spacer: Mean steps correct: BV: 4.5 AV: 7.2 p<0.01 1 month f/u: 7.3/8 correct p<0.01 video dynamics: 96% chose avatar same gender 70% same race Focus group: Overall: RNs thought feasible 5 minutes to implement video with each child Children reacted well to positive vibe from video	Praise given to the children- not just want did wrong- very important in this age group Weaknesses: Small sample size Authors noted that avatars not of different age groups- may make a difference Authors noted, as do I, that school nurses wanted to be part of study, could have more interest or buy in with their students than other school nurses or school programs As tech savvy as our population is- this would be an excellent avenue to look into. Short implementation time and high yield of results. Would need to see how we would be able to acquire this video program

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			w/school RNs -thoughs -feasible -resource Needed -student Reaction Improve-ments						
Chen, et al., Ann of Allergy, Asthma & Imm, (2002), 89: 311-315	Evaluate skills needed for IT	none	Level IV, cross sectional; descript-tive corre-lational AK scale IT checklist for IT eval	N=132 Aged 8-13 Persistent asthma Taipei Convenience sample 8 schools Used MDI ≥ 6 mos			Descrip-tive stats t-tests linear regression	Average 5.2 IT correct ↑AK=↑IT ↑age= ↑IT Linear regression: ↑IT r/t asthma exacerbation, ↑AK, ↑asthma education Review: ½ of participants no follow up care	Our population similar; lack of regular f/u care; only seeking care for exacerbation Participants decreased knowledge regarding asthma and asthma care; same as our clinic Similar barriers- lack of time and assumption patients know how to perform IT

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				21% had ≥ 4 asthma attack over 12 months 39% missed ≥1 day school 9% hospital admit					
Foland, et al, Cur Ther Res, (2002), 62 (2): 142-147	Assess AC and coach family ↑ IT	none	Level IV obs/desc 1st visit then single coach session, f/u ½ hour visit 2.4 months later on average Evaluate on NCLBI: meds, PFT, hx	Cleveland OH July 1999-November 2000 N=40 Age range 5-17 Mean age 9.2 Prior to coaching- 3/26 children proper IT Pre: 64 hospital visit, 17 PICU, 44 ER	Control: initial IT Intervention: one hands on coaching session with measurement of IT DV: IT DV: hospital visit, ER	IT: pre/post eval of IT Pre: 3/26 (12%) perfect IT Steps correct 1st: • 1: 92% • 2: 73% • 3:27% • 4:88% • 5:65% • 6:42% • 7:46% • 8:27%	IT: chi square Paired compar-ison t-test	Between 1st and next visits P: value: • 3:p<0.005 • 5:p<0.001 • 6:p<0.001 • 7:p<0.001 • 8p<0.002 Start-finish 34% improvement (54% vs 88%)IT: P<0.001 Missed IT steps:	1 single hand on and verbal coaching session improved IT in children Weaknesses: did not perform study with a spacer; in actuality have to consider if my patient population uses spacer at home Authors stated that FEV1, meds and AS measured each visit; but this data not given in article. Authors state that at time of publication-further study being performed to see when children lost any gains with IT. This study utilized the ability to allow children to come in on a walk in basis. This would also be a very interesting concept to explore if our clinic would be willing and able to allow this to occur (support personnel. Possibly, could have

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			PFT all IT all Demo by RT/MD IT Pre/post eval	Study length: 2.4 months		Steps correct post: • 1:100% • 2:96% • 3:65% • 4:100% • 5:88% • 6:88% • 7:92% • 8:69% FEV & AS		• Exhale fully • Breathe in/hold breath • Exhale gently • Wait 30 seconds before next dose	hours on certain days of week where this could occur.) Statistical testing stated- only p values given. Not given further statistics
Janssen, et al, Eur J Gen Prac, 2003, 9, 143-145	Evaluate the IT of asthmatic children in gen practice	none	Level IV Obs/Des-criptive IT assess IT eval by train MD: adequate not adequate	7 practices Netherlands 114 invited N=72 Aged 6-16 Mean:10	IT Past education	IT through assessment trained MD	Contin-gency table Chi-square test Mann-Whitney test $p<0.05$ significant	Correct:incorrect IT 25%/75% Most common-failure to exhale Waiting 30 seconds next dose 90% received some instruction at time of script; only 15% received repeated instruction	Most children and parents consider their IT is adequate when in reality this generally is not the case. This study 75% of children could not use correctly even though thought had good technique In questionnaire- most children received some form of education at time of MDI being prescribed- but did not receive education again. In this study, again, 75% children poor IT The more education/instruction given the better the IT

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			Adequate all steps correct Not adequate: miss steps ?? Age,sex, inhaler type, whom Rx, whom gave ed Parent/ Child opinion IT					Repeat instruction ↑IT: p=0.014 Instructor/method no significance 5 years use or more ↑IT: p=0.008 All children and parents scored IT as adequate even with 75% missing steps Mann Whitney Age 0.577 User duration 0.008 Chi square: Sex 0.891 Instructor (type of medical provider) 0.590 AC on IT p=0.014	Age, type of instructor not have effect on IT AC and length of use of inhaler effects IT My practice- most patient state can use inhaler- but we are not currently eval IT. I would be very interested to incorporate this knowledge into my project as well

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Jones, et al, Ann of Emergency Med, 1995, 26(3): 309-312.	Evaluate ability ER providers & pt demonstrate correct IT	none	Prospec-tive cross sectional Level IV Given placebo inhaler-demon-strate IT; no ability to use resource book	5 teaching hospitals Michigan N=185 health care providers (60 ER house staff; 50 ER attending; 75 ED RN) N=100 ER pt asthma, MDI 3 months	Knowledge of IT: ability to demonstrate correct IT	Number correct IT steps	2 tailed fisher exact contin-gnecy table P<0.05 significant	41% providers 5/6 steps correct 49% patients 5/6 steps correct p>0.05 p=.11 difference health care providers 15% providers/17% patients estimate amount medication in canister 90% providers knew about spacer 28% describe spacer	Provides & patients do not have correct IT greater than half the time No significant difference between types of health care providers IT knowledge Decrease spacer knowledge
Levy, et al, Prim Care Respir J, 2013, 22(4): 406-411.	Relationship: AC:IT	none	Level IV Obs Retro-spective chart review ?? IT eval with	UK 2009 Age: <16->76 N=3981 All IMPACT practices select pt -BTS 1-3	IV: education DV: IT DV: AC	IT AC	Chi Square OR	IT 3 visits failed: 58, 52, 38% incorrect IT on 3 attempts -flow -synchronized breathing -breath-holding AC:IT:	↓IT=↓AC Need to assess IT in order to order and continue with MDI treatment Spacer use ↑IT Used in-check dial for IT assess Weakness: no control group Since retrospective not able to ascertain if abiding by guidelines or if noncompliance issue

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			education after AC GINA strategy IT assess AIM: color coded response to IT At least 2 AIM meetings and education In-check device utilized	-no AC review 15 months -no IT assess 15 months -not compliant meds -using >SABA 12 months -hospital admit 12 months				-Incorrect IT 4x higher uncontrolled asthma; 2x in partially controlled Chi square: 1+asthma exacerbation: fail IT (68%) P=0.03 Short course steroids: ↓IT (67%), p<0.05 OR 0.50-0.89 Use of spacer:↑IT (68% vs 51%) p<0.0001 Chi square value 20.16	Project: office has availability to in-check dial- 2nd study to utilize Very important to consider this study with project—several patients have less than desirable asthma control- we do not currently measure IT. Again, another study noting improved AC with improved IT Several patients in practice have oral steroids at least once per year- do not routinely check IT

1: Gillette et al. (2016); 2: Rodriguez-Martinez et al. (2017); 3: Alexander et al. (2016); 4: Amirav et al. (1994); 5: Burkhart et al. (2000); 6: Carpenter et al. (2015); 7: Kamps et al. (2000); 8: Zivkovic et al. (2008); 9: Bourne (1996); 10: Capanoglu et al. (2015); 11: Carpenter et al. (2016); 12: Chen et al. (2002); 13: Foland et al. (2002); 14: Janssen et al. (2003); 15: Jones et al. (1995); 16: Levy et al. (2013); 17: Minai et al. (2004); 18: Munzenberger et al. (2007); 19: Sleath et al. (2011); 20: Turkeli et al. (2016); 21: Deerojanawong et al. (2009); 22: Walia et al. (2006); 23: Schmier et al. (2007); 24: Manriquez et al. (2015); 25: Reznik et al. (2013); 26: deGroot et al. (2014); 27: Duerden, et al. (2001); 28: Pedersen et al. (2010); 29: Price et al. (2013); 30: Morin, 2012

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Minai, et al, Resp Care, 2004, 49(7): 600-606	2nd article on PACT in Ohio sustainability of IT/ PFT↑/ ↑ asthma outcomes	None	Level IV Obs PFT each visit RT IT ed/ review AS: likert 1-4 PFT likert 1-4 2 data times: T1-1st visit T2: 2nd visit	Time: mean 9.8 months PACT clinic: Inclusion: N=60 ≥4 years Excessive ER visits Difficult asthma MDI prescribed	IV: PACT to individualize tx	IT PFT & FEV1 (pulm fuction) AS	Para & non- para-metric testing Descript-ive stats variables t-test pulmon-ary variables between 2 visits 1-way analysis variance and linear regression for IT& other pulm measures Chi-square expect and observed	T1:T2 comparison: -IT correct: 53%/81% -PFT severity: 2.4/2.1 -AS score: 2.6/2.3 FEV1 87/87 FVC: 92/95 FEF: 70/69 T score: MDI: ↑ p0.001 AS: p0.10 PFT: 0.10 FEV1: 0.96 FVC: 0.15 FEF 0.87	With repeated demonstration and education ↑IT FEV and PFT not affected; authors ? if would see improved PFT after further time Weaknesses: no control group Small number f/u was determined by AS- so some children received ↑ ed compared to others some of our patients would also receive ↑ ed than others; ? possibility of having individualized education

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							frequen-cies Stat sig-nificance at p<0.005		
Munzenber-ger, et al; J of Asthma (2007) 44, 769-773	Evaluate % IT retained between visits	none	2 group parallel non-random-ized open study Visit 1: education program IT evaluated by pharmD	Asthma/allegy clinic Michigan Pt aged 4-18 Jan 2002-June 2005 72 patients Group 1: MDI only (24 pt) Group 2: MDI & Discus use (48 pt)	% correct IT between visits % correct individual component IT between visits	Inhaler use checklist	% score % item t test Mann Whitney U test Fisher exact test P<0.05 significant	Group 1: mean 2.7 months to f/u Group 2: mean 3.8 months to f/u Group 2 older; asthma longer; ↑ time used MDI Group 1 ↑ spacer use Group 1 ↓ AS Overall ↓ IT to f/u appt: 60% ↓ IT Group 1: 12/24 correct IT Group 2: 14/48 correct IT Each component IT:	Authors compared their results to Kamps- with Kamps study ↑ IT with visits- one thought ↑ younger children in this study with adult supervision; vs older children alone Author noted bias in groups- MD preference to treatment required open non randomized design- could have influenced outcomes Utilized an 8 item inhaler use checklist; authors noted if used a different checklist outcomes could have been different

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								No significance between group 1 & 2 Even with 1 intense education session, ↓IT by next visit Hands on with verbal education recommended	
Sleath, et al (2011). Pediatrics 127(4): 642-650	Describe IT children; Extent providers demo IT	Social cognitive theory	Level IV Descript-ive IT review child Audio of visit-to eval if provider demo IT	5 pediatric practices NC Aged 5-18; speak English N=291 children Using MDI Classified into AS categories Providers as well in study N=41 providers (4NP)	IV: provider education DV: IT	Medication recorded AS reviewed by pulm MD IT-assessment by team Provider demo/education by audiotape	Descrip-tive states for variables Bivariate stats between variables: t-test, pearson if ↑ bivariate then multi-variate analysis	8.1% correct IT patient (pearson r 0.20 p<0.001) Providers asked 5.4% MDI users/2.3% children w/missed steps IT to demo IT to them Provider demo IT: 3.8% all MDI/ 2.3% poor IT children	Shows use of inter/intra collaboration in order to increase IT both child/provider Provider needs to know how to utilize as well These results most likely very common in most clinics Self efficacy: ↑SE=↑behavior (use MDI, undertake behavior). Model use of MDI can ↑ SE

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Turkeli, et al, Tuberk Toraks, 2016, 64(2), 105-111	Evaluate influence standardized education on IT & AC; identify factors assoc w/ results	none	Level III Cohort Follow 2 months IT education Hands on demo IT Child demo IT Return education Return IT demo RTC 2 months later to demo IT	Uncontrolled asthmatic children 38 children aged 2.5- 13 Recruited pediatric allergy/ pulmonary office Use MDI/spacer Exclusion: Co-morbidity; already received AE	ASS: asthma symptoms score: assessment daily asthma symptoms AC IT	Demographics Parent demographics Asthma symptom score (ASS) ACQ (aka ACT) IT: inhaler use checklist	Mean/SD demo-graphic info ASS, ACQ paired t test IT pearson chi square P<0.05 significant	Mean duration asthma 21 months Mean months MDI use 17.4 IT: Before education: 4.9 (1.3 SD) After education: 7.8 (0.4 SD) steps P<0.001 ASS: Before education: 4.3 (3.6 SD) After education: 0.2 (O.7 SD) P<0.001 Errors IT steps before education: Lack mouth rinsing 78.9%	Common missed IT steps as seen in other studies 2 step improvement in IT with education (verbal, hands on redemonstrations)- one of few studies listing step increase with education Decreased asthma severity noted with inhaler technique education

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								Lack exhaling before inhalation (65.8%) Not shaking inhaler (60.5%) Most common errors IT steps after education: Not shaking inhaler Not exhaling before inhalation Lack rinsing mouth (all 2.6% of cohort)	
Deerojana-wong, et al.,Asian Pac J Allergy & Immun., 2009, 27: 87-93	Evaluation of MDI use w/ & w/o spacer. Identify skills required for MDI use	none	Level IV descript-ive pro-spective Thailand Measure IT with IT check-list	Asthmatic children out-patient setting Jan-Dec 2004 93 children Ages 3-14	IV: education IT	IT	Mean % Chi Square ANOVA	Factors correct IT: -MDI given by caregiver: 28% correct IT ->age 10: 66% correct IT -first instruction trained HCP: 28% -frequency ITT: once 33%	Author noted bias: children selected mostly had controlled asthma within the clinic Combination of MDI with spacers and without spacers; those w/spacers had improved IT

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								-frequency ITT: twice: 47% Most frequent error: inhalation error	
Walia, et al, Ped Pulm, 2006, 41: 1082-1087	Assess IT w/spacer to pediatric chest clinic and determine factors associated with incorrect IT	none	Level IV Descriput -ive Cross Sectional North India IT form to patient w/retrun demo f/u every 12 weeks stable ↓ AC f/u every 2-4 wks	July 2004-Dec 2004 N=213 Age 5months-18 years 152 urban/61 rural IT eval Exclusions: not using MDI, newly referred not previously receiving IT instruction, acute exacerbation	IV: education	IT Care of inhaler/spacer	Number (%) or mean (SD) Chi-square test for IT P<0.05 significant	88.3% correct IT -age p=0.021 -gender 0.239 -rural/urban 0.422 -materanl education 0.673 -paternal education 0.359 -income 0.979 -AS 0.445 -duration spacer use 0.013 -MD assess AC 0.909 1 mis-step 7% Miss all 4.2%	This clinic had excellent results in regards to relatively good IT among patients. Clinic also had set program of frequent IT education with patients Stated weakness: no control group without regular IT training Only allowed in patients who had originally received education from their clinic- if newly referred excluded- could be bias with that Acute exacerbation excluded- again could be bias with those results- their IT may be faulty which is causing them to have exacerbation

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			Care of device					Most common mistake: Cap removal Shake inhaler Hold inhaler Exhale/mouth Inhale ↑IT=↑AC p<0.009 8 pt never cleaned device 5 changed spacer >1 year 7 never checked inhaler empty	
Schmier et al (2007) Annals Allergy, Asthma &Immunology 98: 245-253	Evaluate asthma activity limitations & productivity children and caregivers	none	Cross-sectional cohort Surveys sent to families	Sept 1, 2005-December 31, 2005 John Hopkins Asthmatic pediatric patients listed from previous research	AC- perception of AC QOL perception Missed school/work days ER/care visit	ACT Pediatric asthma QOL HWQ questionnaire Parental: asthma QOL caregiver survey	Means SD Cronbach (QOL) Bivariate analysis (QOL, cost:	Past year caregiver survey: -45% minor difficulty with asthma; however -70% asthma exacerbation -32% ED visit	Very needed information correlating asthma severity to school and ED and QOL. With improved asthma, QOL is improved

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				239 children: 131 age 4-11 108 age 12-18		HWQ parental Surveys on school/work missed/ER health visits Costs due to asthma survey	demo &AC) Para-metric and non-parametric testing	-6% hospitalization -58% controller medication past week -90% rescue medication ACT scoring (<19=uncontrolled) -mean 15.3: 16 adolescent; 14.6 younger child Adolescent <19 ACT increased impairment QOL (mean SD): -symptoms 4.2 -emotions 4.8 -activities 4.8 -overall 4.5 (p <0.001) Work/School: Control asthma: 3.5% missed 1 day	

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								Uncontrolled asthma: 34% reported missing 1 day (p<0.001) Arrive 1 hour late: Controlled: 3.5% vs uncontrolled 34% p<0.001) Left school early: Controlled 1.8% vs uncontrolled 21.3% p .003) Developed asthma sx at school: Controlled 29.3% vs uncontrolled 76.6% p<0.001) Parental work: Reported more missed work days with asthma: Missed due asthma 2.5 days vs not asthma 1.5 p .08	

1: Gillette et al. (2016); 2: Rodriguez-Martinez et al. (2017); 3: Alexander et al. (2016); 4: Amirav et al. (1994); 5: Burkhart et al. (2000); 6: Carpenter et al. (2015); 7: Kamps et al. (2000); 8: Zivkovic et al. (2008); 9: Bourne (1996); 10: Capanoglu et al. (2015); 11: Carpenter et al. (2016); 12: Chen et al. (2002); 13: Foland et al. (2002); 14: Janssen et al. (2003); 15: Jones et al. (1995); 16: Levy et al. (2013); 17: Minai et al. (2004); 18: Munzenberger et al. (2007); 19: Sleath et al. (2011); 20: Turkeli et al. (2016); 21: Deerojanawong et al. (2009); 22: Walia et al. (2006); 23: Schmier et al. (2007); 24: Manriquez et al. (2015); 25: Reznik et al. (2013); 26: deGroot et al. (2014); 27: Duerden, et al. (2001); 28: Pedersen et al. (2010); 29: Price et al. (2013); 30: Morin, 2012

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								HWQ: controlled asthma improved productivity (SD): control vs uncontrolled -self domain 1.3/2.1 -other domain 1.3/1.9 -concentration 2.1/1.8 -irritabilility 2.2/2.4 P .01 Resource use/cost: means: Asthma exacerbation: 0.7 ED: 0.32 Overnight hospital: 0.06 Asthma exacerbation uncontrolled vs controlled: 0.83 vs 0.59 p.001 ED visits:	

1: Gillette et al. (2016); 2: Rodriguez-Martinez et al. (2017); 3: Alexander et al. (2016); 4: Amirav et al. (1994); 5: Burkhart et al. (2000); 6: Carpenter et al. (2015); 7: Kamps et al. (2000); 8: Zivkovic et al. (2008); 9: Bourne (1996); 10: Capanoglu et al. (2015); 11: Carpenter et al. (2016); 12: Chen et al. (2002); 13: Foland et al. (2002); 14: Janssen et al. (2003); 15: Jones et al. (1995); 16: Levy et al. (2013); 17: Minai et al. (2004); 18: Munzenberger et al. (2007); 19: Sleath et al. (2011); 20: Turkeli et al. (2016); 21: Deerojanawong et al. (2009); 22: Walia et al. (2006); 23: Schmier et al. (2007); 24: Manriquez et al. (2015); 25: Reznik et al. (2013); 26: deGroot et al. (2014); 27: Duerden, et al. (2001); 28: Pedersen et al. (2010); 29: Price et al. (2013); 30: Morin, 2012

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								0.50 vs 0.17 p.001 Overnight hospital: 0.10 vs 0.03 p .04 Out of pocket cost (2005 dollars): $997 expenses & lost income 58% cost OOP medication Total wages/benefits /out of pocket 00lost: 1400 uncontrolled vs 600 controlled	
Manriquez et al J Bras Pneumol (2015) 41(5): 405-409	Assess IT ped/adult pt;dtm most common errors; compare results	none	Descript-tive cross sectional Regular appt; 1 week later IT reassess without further education	Chile March-May 2014 Aged 5-90 (pedi 5-18; adult 19-90) 270 total; 7 excluded co-morbidity;	IT errors	Viewed IT Inhaler use checklist for errors	Descript-ive stats % correct % error 2 groups evaluated by equivale-ence test	Correct IT: 73.4% pedi correct 9i.1% adult correct Incorrect IT: 26.6% pedi 90.6% adult Error:	Most of pediatric patient had better IT compared to adults- however, study did not delve into why they may have noted (education? Longer time of use with poorer IT?) Study did not look at IT after further education sessions- only 1 week after last office visit

1: Gillette et al. (2016); 2: Rodriguez-Martinez et al. (2017); 3: Alexander et al. (2016); 4: Amirav et al. (1994); 5: Burkhart et al. (2000); 6: Carpenter et al. (2015); 7: Kamps et al. (2000); 8: Zivkovic et al. (2008); 9: Bourne (1996); 10: Capanoglu et al. (2015); 11: Carpenter et al. (2016); 12: Chen et al. (2002); 13: Foland et al. (2002); 14: Janssen et al. (2003); 15: Jones et al. (1995); 16: Levy et al. (2013); 17: Minai et al. (2004); 18: Munzenberger et al. (2007); 19: Sleath et al. (2011); 20: Turkeli et al. (2016); 21: Deerojanawong et al. (2009); 22: Walia et al. (2006); 23: Schmier et al. (2007); 24: Manriquez et al. (2015); 25: Reznik et al. (2013); 26: deGroot et al. (2014); 27: Duerden, et al. (2001); 28: Pedersen et al. (2010); 29: Price et al. (2013); 30: Morin, 2012

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			After IT demo-given instruct-ion by team	physical/mental ailment 135 pedi 128 adult Regular asthma f/u; have MDI script; received IT teaching Exclusion: resp co-morbidity; physical ailment ↓ IT			P<0.05 significant	Most common pedi error: Fail hold breath 10 sec: 8.1% Fail continue inhale after actuation ihaler 6.1% Fail exhale before using inhaler: 3.7% Error adult: Fail exhale before using inhaler 53.1% Fail hold breath 10 sec 46% Fail 1 puff at a time 28%	
Reznik, et al, 2013, Clin Pediatrics, 53(3): 270-276	Study pediatric provider practices demo/assess IT; differences between res & attending; perceived	None	Level IV Cross-sectional survey Oct 2011-March 2012	Residents & attending MDs 3 pedi practices Bronx NY= 114 providers Residents:73 Attendings:40 NP: 1	Demo IT Teach IT Assess IT	Survey collection	Mean/SD categories Difference proportion Fisher test/ chi square	92/112 87% demo IT Attending use illustration: 9/37 (residents 3/55) 24% vs 6% p=.01 Demo IT if asthma not controlled:	Previous study by authors reported 85% patients incorrect IT despite previous education Authors noted use of community health worker as possible way to improve Limitations: Did not assess providers own knowledge of IT

1: Gillette et al. (2016); 2: Rodriguez-Martinez et al. (2017); 3: Alexander et al. (2016); 4: Amirav et al. (1994); 5: Burkhart et al. (2000); 6: Carpenter et al. (2015); 7: Kamps et al. (2000); 8: Zivkovic et al. (2008); 9: Bourne (1996); 10: Capanoglu et al. (2015); 11: Carpenter et al. (2016); 12: Chen et al. (2002); 13: Foland et al. (2002); 14: Janssen et al. (2003); 15: Jones et al. (1995); 16: Levy et al. (2013); 17: Minai et al. (2004); 18: Munzenberger et al. (2007); 19: Sleath et al. (2011); 20: Turkeli et al. (2016); 21: Deerojanawong et al. (2009); 22: Walia et al. (2006); 23: Schmier et al. (2007); 24: Manriquez et al. (2015); 25: Reznik et al. (2013); 26: deGroot et al. (2014); 27: Duerden, et al. (2001); 28: Pedersen et al. (2010); 29: Price et al. (2013); 30: Morin, 2012

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	barriers to education		Pedi res & attending Bronx 3 pedi practices as training sites 11 item ??: -demo IT -how/ when demo IT -assess IT - use IUC -barriers					Attending: 25/37 68% Resident: 27/57 47% P=.05 Pt not bring MDI: 98/114 86% None utilized IUC When assess IT: -every visit 10/75 13% Common barriers: -no MDI: 66% -lack of time 50% -↓ knowledge IUC 28% -↓ pt/family interest 1/41 attendings: 11/72 residents: 2.4% vs 15% Overcome barriers: -provide MDI n=55	-in inner city clinic- possibly not generalizable results

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								-provide training to providers n=13 -embedded educator -more clinic time -handouts	
deGroot et al, Acta Paed, (2014)104: 916-921.	Investigate causes uncontrolled asthma in referred patient	None	Level IV retro-spective chart review 1/2005-12/2009	Aged 5-17 referred to pulmonary specialty N=142 Netherlands	Asthma exacerbation: seeking care & rescue med Asthma severity: ACT IT: review every visit Adherence: every visit question of med taking Environmental triggers: in home review of asthma triggers Co-morbidities diagnosis listed	Vital signs; Daily meds Asthma exacerbation Asthma severity	Normal distribute by para-metric; non-normal distribute by non-para-metric metric	Only 4 patients met guidelines for true treatment resistant asthma; other 138 due to "shortcomings" asthma management Poor IT: 7.8% Nonadherence 37%	Chart review demonstrates multifactorial reasons for asthma treatment, compliance and severity IT a part of asthma control

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Duerden, et al, Dis Mgmt & Health Outcomes, 9(2)75-87.	Literature review IT Compliance AK	none	Lit Review Level VI	Database review	Lit review of IT; compliance, AK	Lit review of IT; compliance, AK	none	Poor IT: -82%incorrect -56% accuat6ed MDI too early/late -79% made errors on 8 point assessment -89% error inhalation MD/RN poor IT: -15%RN correct IT -28% MD correct IT Role of training IT: -communication correct IT and monitor IT -10% correct IT self-mgmt vs 51% with verbal/written education Provider education: -after 1-2 teaching seesion:	Poor IT assoc w/ poor AC Providers do not know how to use inhalers and benefit from education and repeat education

1: Gillette et al. (2016); 2: Rodriguez-Martinez et al. (2017); 3: Alexander et al. (2016); 4: Amirav et al. (1994); 5: Burkhart et al. (2000); 6: Carpenter et al. (2015); 7: Kamps et al. (2000); 8: Zivkovic et al. (2008); 9: Bourne (1996); 10: Capanoglu et al. (2015); 11: Carpenter et al. (2016); 12: Chen et al. (2002); 13: Foland et al. (2002); 14: Janssen et al. (2003); 15: Jones et al. (1995); 16: Levy et al. (2013); 17: Minai et al. (2004); 18: Munzenberger et al. (2007); 19: Sleath et al. (2011); 20: Turkeli et al. (2016); 21: Deerojanawong et al. (2009); 22: Walia et al. (2006); 23: Schmier et al. (2007); 24: Manriquez et al. (2015); 25: Reznik et al. (2013); 26: deGroot et al. (2014); 27: Duerden, et al. (2001); 28: Pedersen et al. (2010); 29: Price et al. (2013); 30: Morin, 2012

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								Pre 3/7/7 steps correct/post 6.3/7 step corect	
Pedersen, et al, Primary Care Resp J, 2010: 209-216	Expert review of ADMIT series & pediatric IT	None	Level VI Review of research ADMIT series	ADMIT series review				Inhaled med ↑ work at lung, ↓ time medication action, ↓ systemic effect Discussion of droplet deposition oral pharyx/esophagus: larger droplet size=↑ deposition. Child's airway=↑ deposition Common errors: Coordination breathing 50% school aged children ↓ benefit med d/t incorrect IT Spacers ↓ deposition in oral pharynx & esophagus (80% ↓ 30%); ↑ IT IT needs to be taught; teaching each visit	

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								After 3 instructions: 98% MDI correct IT; after 2 instructions 90% correct MDI IT Teaching each visit to ↓ knowledge loss of IT	
Price et al, Resp Med, 2013, 107: 37-46	Expert review of literature	None	Level VI Review of literature/ expert opinion	Review of 92 published papers regarding inhaler competence				-inhalers not used correctly 14-90% time VT & hand on together ↑ IT -multiple factors incorrect IT --device (multiple, used differently --patient: noncompliant, incorrect IT -- healthcare provider: does not know IT; does not teach IT	Patients do not have correct IT Necessary to include healthcare provider education for IT and to teach IT Each device own IT instructions Verbal plus hands on training reinforces IT

1: Gillette et al. (2016); 2: Rodriguez-Martinez et al. (2017); 3: Alexander et al. (2016); 4: Amirav et al. (1994); 5: Burkhart et al. (2000); 6: Carpenter et al. (2015); 7: Kamps et al. (2000); 8: Zivkovic et al. (2008); 9: Bourne (1996); 10: Capanoglu et al. (2015); 11: Carpenter et al. (2016); 12: Chen et al. (2002); 13: Foland et al. (2002); 14: Janssen et al. (2003); 15: Jones et al. (1995); 16: Levy et al. (2013); 17: Minai et al. (2004); 18: Munzenberger et al. (2007); 19: Sleath et al. (2011); 20: Turkeli et al. (2016); 21: Deerojanawong et al. (2009); 22: Walia et al. (2006); 23: Schmier et al. (2007); 24: Manriquez et al. (2015); 25: Reznik et al. (2013); 26: deGroot et al. (2014); 27: Duerden, et al. (2001); 28: Pedersen et al. (2010); 29: Price et al. (2013); 30: Morin, 2012

AC: asthma control; **ACT:** asthma control test; **AE:** asthma education; **AQLQ:** asthma quality of life questionnaire; **AS:** asthma severity; **AV:** after video; **BV:** before video; **CC:** completely confident; **DV:** dependent variable; **DX:** diagnosis; **FEV1:** forced expiratory volume 1 second; **ER:** emergency room; **FVC:** forced vital capacity; **GINA:** global initiative for asthma; **GT:** good inhaler technique; **HOH:** hard of hearing; **ICS:** inhaled corticosteroid; **IMPACT:** Improving the Management of Patients Asthma and COPD Treatment; **IT:** inhaler technique; **IV:** independent variable; **MDI:** metered dose inhaler; **NC:** no change; **NCC:** not completely confident; **NS:** no significance; **Obs:** observational; **PACT:** pediatric asthma clinic trial; **PE:** physical exam; **PIF:** peak inspiratory flow; **PFT:** pulmonary function test; **pop:** population; **PP:** parental perception **RCT:** randomized controlled study; **RT:** respiratory therapist; **RTC:** return to clinic; **SE:** self-efficacy; **VT:** verbal inhaler training; Δ change; **??:** questionnaire

Citation: first author	Purpose of Study	Conceptual Framework	Design/ Method	Sample/Setting	Major Variables Studied and Their Definitions	Measurement of Major Variables	Data Analysis	Study Findings	Appraisal of Worth to Practice Strength of the Evidence (i.e., level of evidence + quality [study strengths and weaknesses]) RECOMMENDATIONS
								Addition of healthcare provider IT education increase knowledge IT; how to teach IT	
Morin, R (2012).	Improve pediatric MDI IT	Orem	DNP scholarly project Pre/post test IT IT checklist Pt demon-strate IT -receive teaching -re-demon-strate IT	Pittsfield, MA Convenience sample 11 weeks N-118	IT Healthcare providers ↑ IT teaching	IT checklist Observation health care provider teaching amount	Descript-tive stats	111 teaching episodes DNP candidate 7 teaching episodes MD 11% IT correct to 100% correct post education; mean 2.3 improved steps	Same city as my DNP scholarly project. Not necessarily same socioeconomic DNP student higher engagement than clinic staff for teaching moments

1: Gillette et al. (2016); 2: Rodriguez-Martinez et al. (2017); 3: Alexander et al. (2016); 4: Amirav et al. (1994); 5: Burkhart et al. (2000); 6: Carpenter et al. (2015); 7: Kamps et al. (2000); 8: Zivkovic et al. (2008); 9: Bourne (1996); 10: Capanoglu et al. (2015); 11: Carpenter et al. (2016); 12: Chen et al. (2002); 13: Foland et al. (2002); 14: Janssen et al. (2003); 15: Jones et al. (1995); 16: Levy et al. (2013); 17: Minai et al. (2004); 18: Munzenberger et al. (2007); 19: Sleath et al. (2011); 20: Turkeli et al. (2016); 21: Deerojanawong et al. (2009); 22: Walia et al. (2006); 23: Schmier et al. (2007); 24: Manriquez et al. (2015); 25: Reznik et al. (2013); 26: deGroot et al. (2014); 27: Duerden, et al. (2001); 28: Pedersen et al. (2010); 29: Price et al. (2013); 30: Morin, 2012

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Levels of Evidence

Table AB2: Levels of Evidence

Level of Evidence	Type of Study	Number of Studies
I	Systematic Review	2
II	RCT	6
III	Cohort	1
IV	Observational/Descriptive/Prospective Cross Sectional/Retrospective Chart Review	18
VI	Literature Review	3
VII	DNP Scholarly Project	1

1: Gillette et al. (2016); 2: Rodriguez-Martinez et al. (2017); 3: Alexander et al. (2016); 4: Amirav et al. (1994); 5: Burkhart et al. (2000); 6: Carpenter et al. (2015); 7: Kamps et al. (2000); 8: Zivkovic et al. (2008); 9: Bourne (1996); 10: Capanoglu et al. (2015); 11: Carpenter et al. (2016); 12: Chen et al. (2002); 13: Foland et al. (2002); 14: Janssen et al. (2003); 15: Jones et al. (1995); 16: Levy et al. (2013); 17: Minai et al. (2004); 18: Munzenberger et al. (2007); 19: Sleath et al. (2011); 20: Turkeli et al. (2016); 21: Deerojanawong et al. (2009); 22: Walia et al. (2006); 23: Schmier et al. (2007); 24: Manriquez et al. (2015); 25: Reznik et al. (2013); 26: deGroot et al. (2014); 27: Duerden, et al. (2001); 28: Pedersen et al. (2010); 29: Price et al. (2013); 30: Morin, 2012

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Verbal inhaler technique/Hands on technique/Return Demonstration with outcomes Synthesis Table

Table AB3: Verbal Inhaler Technique/Hands on Technique/Return Demonstration with Outcomes Synthesis Table

Article	Video	Hands On Education	Verbal Education	Placebo Device	Return Demonstration	Outside clinic IT education	Inhaler Technique	Asthma Control	Asthma Knowledge	Medicine Compliance	Fear Asthma	Missed School	ER use
1		√	√		√		↑						
3		√	√		√		↑						
4		√	√		√		↑	↑					
5		√	√		√	√	↑	↑				↓	
6	√	√	√		√		↑					↓	
7		√	√		√		↑	↑					
8		√	√		√		↑	↑	↑		↑		
9		√	√		√		↑						
11	√	√	√		√		↑						
12		√	√		√		↑	↑	↑				
13		√	√		√		↑						
14		√	√		√		↑	↑					
16		√	√	√	√	√	↑	↑					
17		√	√		√	√	↑	↑					
18		√	√		√		↑	↑					
19		√	√		√		↑	↑	↑				
20		√	√		√		↑						
21		√	√		√		↑						
22		√	√		√		=						
24		√	√				↑						
30		√	√	√	√		↑						

1: Gillette et al. (2016); 2: Rodriguez-Martinez et al. (2017); 3: Alexander et al. (2016); 4: Amirav et al. (1994); 5: Burkhart et al. (2000); 6: Carpenter et al. (2015); 7: Kamps et al. (2000); 8: Zivkovic et al. (2008); 9: Bourne (1996); 10: Capanoglu et al. (2015); 11: Carpenter et al. (2016); 12: Chen et al. (2002); 13: Foland et al. (2002); 14: Janssen et al. (2003); 15: Jones et al. (1995); 16: Levy et al. (2013); 17: Minai et al. (2004); 18: Munzenberger et al. (2007); 19: Sleath et al. (2011); 20: Turkeli et al. (2016); 21: Deerojanawong et al. (2009); 22: Walia et al. (2006); 23: Schmier et al. (2007); 24: Manriquez et al. (2015); 25: Reznik et al. (2013); 26: deGroot et al. (2014); 27: Duerden, et al. (2001); 28: Pedersen et al. (2010); 29: Price et al. (2013); 30: Morin, 2012

AC: asthma control; **ACT:** asthma control test; **AE:** asthma education; **AQLQ:** asthma quality of life questionnaire; **AS:** asthma severity; **AV:** after video; **BV:** before video; **CC:** completely confident; **DV:** dependent variable; **DX:** diagnosis; **FEV1:** forced expiratory volume 1 second; **ER:** emergency room; **FVC:** forced vital capacity; **GINA:** global initiative for asthma; **GT:** good inhaler technique; **HOH:** hard of hearing; **ICS:** inhaled corticosteroid; **IMPACT:** Improving the Management of Patients Asthma and COPD Treatment; **IT:** inhaler technique; **IV:** independent variable; **MDI:** metered dose inhaler; **NC:** no change; **NCC:** not completely confident; **NS:** no significance; **Obs:** observational; **PACT:** pediatric asthma clinic trial; **PE:** physical exam; **PIF:** peak inspiratory flow; **PFT:** pulmonary function test; **pop:** population; **PP:** parental perception **RCT:** randomized controlled study; **RT:** respiratory therapist; **RTC:** return to clinic; **SE:** self-efficacy; **VT:** verbal inhaler training; Δ change; **??:** questionnaire

Collaborative Team Synthesis Table

Table AB4: Collaborative Team Synthesis Table

Article	Collaborative Effort
7	Respiratory Therapy
13	Pharmacy
17	Respiratory Therapy

1: Gillette et al. (2016); 2: Rodriguez-Martinez et al. (2017); 3: Alexander et al. (2016); 4: Amirav et al. (1994); 5: Burkhart et al. (2000); 6: Carpenter et al. (2015); 7: Kamps et al. (2000); 8: Zivkovic et al. (2008); 9: Bourne (1996); 10: Capanoglu et al. (2015); 11: Carpenter et al. (2016); 12: Chen et al. (2002); 13: Foland et al. (2002); 14: Janssen et al. (2003); 15: Jones et al. (1995); 16: Levy et al. (2013); 17: Minai et al. (2004); 18: Munzenberger et al. (2007); 19: Sleath et al. (2011); 20: Turkeli et al. (2016); 21: Deerojanawong et al. (2009); 22: Walia et al. (2006); 23: Schmier et al. (2007); 24: Manriquez et al. (2015); 25: Reznik et al. (2013); 26: deGroot et al. (2014); 27: Duerden, et al. (2001); 28: Pedersen et al. (2010); 29: Price et al. (2013); 30: Morin, 2012

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Length of Intervention and Sustainability Synthesis Table

Table AB5: Length of Intervention and Sustainability Synthesis Table

Article	Length of Intervention	Sustainability measured
1	15 months	Not measured
3	5 weeks	Not measured
4	4 months	Not measured
5	4 weeks	Not measured
6	4 weeks	Not measured
7	3 months	Not measured
8	12 months	Not measured
9	4 months	Not measured
10	4 weeks	Not measured
11	4 weeks	Not measured
12	Not stated	Not measured
13	4 months	Not measured
16	3 years	3 years
17	4 weeks	Continuation of PACT study
18	3 years	Not measured
19	3 months	Not measured
20	2 months	Not measured
21	12 months	Not measured
22	Not measured	Not measured
24	2 months	Not measured
30	11 weeks	Not measured

1: Gillette et al. (2016); 2: Rodriguez-Martinez et al. (2017); 3: Alexander et al. (2016); 4: Amirav et al. (1994); 5: Burkhart et al. (2000); 6: Carpenter et al. (2015); 7: Kamps et al. (2000); 8: Zivkovic et al. (2008); 9: Bourne (1996); 10: Capanoglu et al. (2015); 11: Carpenter et al. (2016); 12: Chen et al. (2002); 13: Foland et al. (2002); 14: Janssen et al. (2003); 15: Jones et al. (1995); 16: Levy et al. (2013); 17: Minai et al. (2004); 18: Munzenberger et al. (2007); 19: Sleath et al. (2011); 20: Turkeli et al. (2016); 21: Deerojanawong et al. (2009); 22: Walia et al. (2006); 23: Schmier et al. (2007); 24: Manriquez et al. (2015); 25: Reznik et al. (2013); 26: deGroot et al. (2014); 27: Duerden, et al. (2001); 28: Pedersen et al. (2010); 29: Price et al. (2013); 30: Morin, 2012

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Provider Knowledge of Inhaler Technique

Table AB6: Provider Knowledge of Inhaler Technique Synthesis Table

Article	Provider Knew How to Use/Teach Inhaler Technique
2	NO
3	NO
7	NO
13	NO
19	NO
23	NO
25	NO

1: Gillette et al. (2016); 2: Rodriguez-Martinez et al. (2017); 3: Alexander et al. (2016); 4: Amirav et al. (1994); 5: Burkhart et al. (2000); 6: Carpenter et al. (2015); 7: Kamps et al. (2000); 8: Zivkovic et al. (2008); 9: Bourne (1996); 10: Capanoglu et al. (2015); 11: Carpenter et al. (2016); 12: Chen et al. (2002); 13: Foland et al. (2002); 14: Janssen et al. (2003); 15: Jones et al. (1995); 16: Levy et al. (2013); 17: Minai et al. (2004); 18: Munzenberger et al. (2007); 19: Sleath et al. (2011); 20: Turkeli et al. (2016); 21: Deerojanawong et al. (2009); 22: Walia et al. (2006); 23: Schmier et al. (2007); 24: Manriquez et al. (2015); 25: Reznik et al. (2013); 26: deGroot et al. (2014); 27: Duerden, et al. (2001); 28: Pedersen et al. (2010); 29: Price et al. (2013); 30: Morin, 2012

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Tools Utilized During Implementation

Table AB7: Tools Utilized During Implementation Synthesis Table

Article	Asthma Control Test	Inhaler Use Checklist	Asthma Quality of Life	Asthma Action Plan	Spirometry	Education
1						√
2	√	√	√	√	√	
4	√	√		√		
6	√	√		√		√
7		√				√
8		√				√
9		√				
10	√					
11		√				√
12		√				
13		√		√	√	√
14		√				
16		√			√	
17		√		√	√	√
19	√	√				
20	√					
21		√				
22		√				
26		√				
30		√				

1: Gillette et al. (2016); 2: Rodriguez-Martinez et al. (2017); 3: Alexander et al. (2016); 4: Amirav et al. (1994); 5: Burkhart et al. (2000); 6: Carpenter et al. (2015); 7: Kamps et al. (2000); 8: Zivkovic et al. (2008); 9: Bourne (1996); 10: Capanoglu et al. (2015); 11: Carpenter et al. (2016); 12: Chen et al. (2002); 13: Foland et al. (2002); 14: Janssen et al. (2003); 15: Jones et al. (1995); 16: Levy et al. (2013); 17: Minai et al. (2004); 18: Munzenberger et al. (2007); 19: Sleath et al. (2011); 20: Turkeli et al. (2016); 21: Deerojanawong et al. (2009); 22: Walia et al. (2006); 23: Schmier et al. (2007); 24: Manriquez et al. (2015); 25: Reznik et al. (2013); 26: deGroot et al. (2014); 27: Duerden, et al. (2001); 28: Pedersen et al. (2010); 29: Price et al. (2013); 30: Morin, 2012

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Correct Inhaler Technique Steps

Table AB8: Correct Inhaler Technique Steps Synthesis Table

Article	Remove Cap	Shake Inhaler/Insert into Spacer	Exhale Completely	Place Mouthpiece in mouth in-between lips	Press canister Down Once	Breathe in Slowly & Completely; hold breath 10 seconds	Exhale Gently	Wait 30 seconds before next dose
3		√				√		
6		√	√			√		
7		√		√				
9		√	√			√	√	
10		√				√		
13			√			√		√
14		√				√		
19		√				√		
20		√	√					
22	√	√	√	√				
24						√		

1: Gillette et al. (2016); 2: Rodriguez-Martinez et al. (2017); 3: Alexander et al. (2016); 4: Amirav et al. (1994); 5: Burkhart et al. (2000); 6: Carpenter et al. (2015); 7: Kamps et al. (2000); 8: Zivkovic et al. (2008); 9: Bourne (1996); 10: Capanoglu et al. (2015); 11: Carpenter et al. (2016); 12: Chen et al. (2002); 13: Foland et al. (2002); 14: Janssen et al. (2003); 15: Jones et al. (1995); 16: Levy et al. (2013); 17: Minai et al. (2004); 18: Munzenberger et al. (2007); 19: Sleath et al. (2011); 20: Turkeli et al. (2016); 21: Deerojanawong et al. (2009); 22: Walia et al. (2006); 23: Schmier et al. (2007); 24: Manriquez et al. (2015); 25: Reznik et al. (2013); 26: deGroot et al. (2014); 27: Duerden, et al. (2001); 28: Pedersen et al. (2010); 29: Price et al. (2013); 30: Morin, 2012

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Appendix C: Chapter 3

Table AC1: Full Implementation Plan

Intervention	Evidence Support	Who	Where	How
Pre-Implementation Steps				
EBP instruction to staff	Clinic staff must know difference between research and EBP and how EBP drives change (Melnyk, B & Fineout-Overholt, E, 2015)	PD BPA MDs BPA NPs BPA nursing BPA MAs	CHP-BPA library	• Face to face discussion • Powerpoint of EBP basics • Clinical Scholar EBP model • Education provided by PD to clinic staff • To discuss each step of EBP; relate to practice • PDF handouts created for each step in EBP model • Allowed for time for questions/answers
Brainstorming session with nursing and providers	Brainstorming is a quality improvement marker (American Society of Quality: Brainstorming, 2017)	PD BPA MDs BPA NPs BPA nursing BPA MAs Hadley	CHP-BPA library	• Face to face discussion • Whiteboard • Journal for notes during discussions by PD
Respiratory Therapy teaching inhaler technique PD; then teaching to providers/nursing	[7,13,17]	PD BPA NPs BPA nursing Respiratory therapy	CHP-BPA library	• PD met with RT for inhaler training • • PD met with each nurse individually to train for both inhaler technique and well as inhaler technique checklist[2,4,6,7-9,11-14,16-17,19,21-22,26,30]
• Obtain Asthma Action Plan (AAP)	[1-31]	PD	CHP-BPA PD home Asthma coalition	• Acquired from State of Massachusetts and American Lung[2,4,6,13,17] • Placed into asthma packets kept in PD office

Intervention	Evidence Support	Who	Where	How
• Obtain Asthma Control Test (ACT) form • Obtain pediatric quality of life (QOL) form • Obtain Inhaler Use checklist form • Construct verification forms (ER/urgent care utilization, missed school days/work days, AAP completion)			American Lung Association	• Placed in unit protocol handbook in Carol's office
QI/QA assessement • PDSA • 8 dimensions Review barriers/facilitators	QI/QA processes improve EBP AHRQ: PDSA, 2017 IHI: PDSA 2017 Reed & Carol, 2015 ASQ: 8 dimensions 2017	PD BPA MDs BPA NPs BPA nursing BPA MAs Hadley	CHP-BPA library	• Face: face meeting • Whiteboard • Journaling by PD • Education by PD to nursing and provider staff regarding QI/QA process (verbal and written) • Notebook kept in library for further comments, thoughts, reflections from staff- encouragement for staff to utilize notebook
First Visit Implementation				
First Vist: • ACT • Pediatric QOL	[1-31]	BPA MDs BPA NPs	Entire BPA clinic	Face to face patient time • Inhaler Technique

Intervention	Evidence Support	Who	Where	How
• Inhaler technique eval • Inhaler use checklist • Inhaler technique education • Competition AAP • Asthma education handout • Review of ER utilization • Review of missed school/work • Schedule 3 month follow up visit		BPA nursing BPA MAs Hadley Front Desk		Patient inhaler technique evaluated by nurses and recorded on Inhaler Use Checklist. Occured after provider visit. • AAP filled out by provider • All forms filled out otherwise by family/patients • All forms brought back to PD desk (ownership: self-efficacy for treatment; perception of health, perception of abilities) [1-31] • Inhaler technique hands-on and verbal education provided by nursing to patients • Occured after provider visit. Education discussed and reviewed per protocol checklist (ownership: self-efficacy for treatment; perception of health, perception of abilities) [1-31] • ACT, QOL forms filled out by patient/family before patient visit Forms placed into project protocol binder (ownership: self-efficacy, wellness, perception of health, perception of abilities)[1-31] • ER/urgent care utilization and missed school days form reviewed by MA before visit Patient filled out reported form

Intervention	Evidence Support	Who	Where	How
				Staff review Meditech reports Form was given to provider for review then placed into project binder (ownership: wellness equates to all areas of life- including school and socialization and activities of daily living)[1-31] • AAP completion AAP was given to provider for completion at time of patient visit AAP copied and scanned into EMR Verification form placed into project binder (ownership: self-efficacy, responsibility, wellness) [1-31] • Three month follow up visit tickler alert filed (Ownership: self-efficacy, responsibility)
Subsequent Asthma Visit Implementation Plan				
• ACT • Pediatric QOL • Inhaler technique eval • Inhaler use checklist • Inhaler technique education	[1-31]	BPA MDs BPA NPs BPA nursing BPA MAs Hadley Front Desk	Entire BPA clinic	• Face to face patient time • Outcome metrics as described in outcome metric protocol • Inhaler Technique Patient inhaler technique evaluated by nurses and recorded on Inhaler Use Checklist after provider visit Inhaler Use placed into project binder

Intervention	Evidence Support	Who	Where	How
• Review AAP: new plan completed if new medications • Review of ER utilization • Review of missed school/work (ownership: wellness equates to all areas of life- including school and socialization and activities of daily living) • Schedule 3-month f/u				(ownership: self-efficacy for treatment; perception of health, perception of abilities) [1-26] • Inhaler technique hands-on and verbal education provided by nursing to patients after provider visit Education discussed and reviewed per protocol checklist (ownership: self-efficacy for treatment; perception of health, perception of abilities) [1-31] • ACT, QOL forms filled out by patient/family before patient visit Forms labeled and given to provider for review Forms placed into project protocol binder (ownership: self-efficacy, wellness, perception of health, perception of abilities) [1-31] • ER/urgent care utilization and missed school days form before patient visit Patient filled out reported form Staff review of Meditech reports Form was given to provider for review then placed into project binder (ownership: wellness equates to all areas of life- including school and socialization and activities of daily living) [1-31]

Intervention	Evidence Support	Who	Where	How
				• AAP completion AAP was given to provider for completion at time of patient visit AAP copied and scanned into Athena EMR Verification form placed into project binder (ownership: self-efficacy, responsibility, wellness) [1-31] • Three months follow up visit tickler alert filed (Ownership: self-efficacy, responsibility)
Monthly QI/QA Assessment Plan				
• PDSA • 8-dimension • Barriers • Facilitators Sustainability Financial Tracking	QI/QA processes improve EBP AHRQ: PDSA, 2017 IHI: PDSA 2017 Reed & Carol, 2015 ASQ: 8 dimensions 2017	BPA MDs BPA NPs BPA nursing BPA MAs Hadley Front Desk	CHP-BPA library	• Face face meeting • Whiteboard • Journaling by GMN • Notebook kept in library for project comments, suggestions for improvement • Review of QI/QA measures • Discuss successes and barriers • Sustainability discussion- how to keep project moving forward; move into other CHP practices

Implementation Plan: developed through the Clinical Scholar EBP model

Table AC2: Progress Markers for Implementation of DNP Scholarly Program

Date	**Progress Marker**	**Evidence**	**Who?**	**What?**	**Where?**	**When?**	**How?**	**Final Outcome**
11/1/17	IRB decision		CHP GMN	IRB	CHP	11/1/17	Face to face discussion	No IRB required for protocol implementation
11/6/17	CHP approval		CHP GMN	Approval	CHP		Form signature	Verbal given for project implementation; formal meeting to be held April 2018. Received approval to implement
11/6/17	Clinic discussion project		GMN Shalan	Discussion of roll out of project	Shalan office BPA	11/6/17	Face to face discussion	Clinic approval: was an ongoing process. Final clinic approval discussed; not all providers agreeable to proceed (7/18)
11/13/17	Contact with respiratory therapist (RT)	9,13,16	GMN	RT to assist with training/ Education of inhaler technique	CHP-BPA	11/13/17	Email contact	Cory from RT was contacted. Have met with CMO- will require CORI background check, confidentiality and possible further steps for her. I met with her and lead nurse at BMC and discussed IT 6/18. She was not

Date	Progress Marker	Evidence	Who?	What?	Where?	When?	How?	Final Outcome
								EBP minded. I contacted Fallon ACO for RT support; not able to arrange in time of implementation
11/13/17	Contact with Roberta Gale, NP: head of ER at BMC		GMN Roberta Gale	Internal data for why ER utilized; how many ER visits occur	CHP-BPA	11/13/17	Email contact rgale1@ bhs1.org	Appt arranged 12/4/17; canceled by Gale. Require reschedule. 4/18:Ultimately decided by PD and CMO not to procede. To obtain data from Meditech
12/4/17	Contact with Joan Roy nursing director Pittsfield Public Schools	1-26	GMN Nursing director	Discuss project; discuss if absenteeism data can be shared or if need IRB (ownership: wellness equates to all areas of life- including school and socialization and activities of daily living)	CHP-BPA		Email contact jroy@ Pittsfield. Net 413-499-9535 x2144	4/18: Decision made to not move forward; would require an IRB. Future work with school consid
12/26/17	Acquire ACT, QOL, AAP,	1-26	GMN Review Lamm,	Patient completed (ethically to hear their voice)	PDF creation of packets	12/26/17	PDF creation	Completed 6/18:

Date	Progress Marker	Evidence	Who?	What?	Where?	When?	How?	Final Outcome
	inhaler use checklist, create patient packets		Shalan and nursing	Inhaler checklist-metric form Patient packets: all metric forms	Contact asthma coalition for AAP, ACT, QOL, inhaler use		Phone and email contact with agencies	ACT: acquired from Merck; no copyright required QOL: acquired from Dr. Copyright not allow for import into EMR or publication to EPIP AAP: acquired from state of MA Inhaler use checklist: 8 inhaler steps with yes/no validation typed onto single paper ER/urgent care and missed school days form: form typed by PD for clinic use All packets created by PD
1/8/2018	Meeting Shalan, Lamm, nursing,		GMN Shalan Lamm Nursing	Discuss patient flow, appointments Tickler alarm	CHP-BPA	1/8/18	Face to face discussion	complete: complete with discussion and with any change in project plan

Date	Progress Marker	Evidence	Who?	What?	Where?	When?	How?	Final Outcome
	office manager		Hadley					tickler alarm to be discussed discussions continued each month; ending in 6/18 for pre-implemenation
1/8/2018	Internal data discussion		GMN Shalan Lamm How to acquire internal data CHP-BPA		CHP-BPA	1/8/18	Face to face discussion	4/18: EMR not able to have viable asthma patient report. Nursing gave PD partial list of asthma patients. PD adding to every day Will have to hand count asthma patients for project
1/22/18	Provider/ Nursing progress meeting		BPA MDs BPA NPs BPA nursing Hadley	Discussion of progress of project; begin discussion of QI/QA, sustainable project	CHP-BPA library	1/22/18	Face to face discussion	Monthly meetings held April-August 2018 regarding implementation
1/30/18	RT training with providers/ nursing	9,13,16	BPA MDs BPA NPs BPA nursing	Evidence has shown providers require IT	CHP-BPA library and	1/30/18	Face to face discussion	6/18: met with RT; will not be ethical to move forward

Date	Progress Marker	Evidence	Who?	What?	Where?	When?	How?	Final Outcome
			RT	training as well. First RT meeting	provider offices		Schedule as needed to meet with all provider Nursing	since EBP not embraced. PD had inhaler training then met with each nurse and taught. Providers did not attend trainings
4/1/2018	Information fliers sent to patients Posters placed in waiting room and patient rooms		GMN Hadley Front Desk	Patient and families to become familiar with new asthma care format in office	CHP-BPA Info sent to family homes	4/1/18	Written info Poster info	7/18: Met with CMO to discuss. One general introduction to asthma care form written and added to each asthma packet. At this time no formal posters printed
4/9/2018	Meeting with Dr EFO for UT Tyler sign off		PD EFO	Official univeristy/advisor sign off of project	Zoom session	4/9/18	Zoom	Received approval to implement from Dr EFO and UT Tyler after 6/18 intensives in Tyler
4/16/2018	Meeting with providers at CHP-BPA		PD NPs and MDs	To discuss project in detail and how will affect schedules and providers	CHP-BPA	Week of 4/16	In person	7/18, 8/18: Met with each provider individually for final implemtation. Each provider

Date	Progress Marker	Evidence	Who?	What?	Where?	When?	How?	Final Outcome
								voiced concerns. 1 provider opted out of program; 1 provider only allowed well care visits
7/5/2018	Launch of project	1-26	All of BPA	Launch of EBP project at BPA Start of metric collection QI/QA	CHP-BPA	7/5/2018	Clinic-based	Project launded 7/5/2018 with final day 10/19/2018 data collection
7/5/2018	Provider/ Nursing/ Front desk Meeting		BPA MDs BPA NPs BPA nursing BPA MAs Hadley Front desk	Status review of week 1 of roll out Barriers Facilitators First QI/QA eval	CHP-BPA library	7/5/2018	Face to face discussion	Weekly meetings with nursing and MAs: discussed successes/failures. Occurred throughout project
11/1/18	Provider/ Nursing meeting		BPA MDs BPA NPs BPA nursing BPA MAs Hadley Front desk	Debrief of project Barriers Facilitators QI/QA How to keep sustain care	CHP-BPA library	11/1/18	Face to face discussion	Debriefing regarding implementation occurred with full team. Start of data review and dissemnation process began
11/1/18	Metric analysis of project outcomes		GMN Shalan Lamm	Start of analysis of metrics, outcomes, QI/QA	CHP-library	11/1/18	Face to face discussion	Face to face discussion occurred; zoom meeting with Dr Lamm and Dr EFO

Date	Progress Marker	Evidence	Who?	What?	Where?	When?	How?	Final Outcome
								11/8/18 for discussion of project
7/2018-5/2019	Disseminate project		GMN Lamm Shalan UT Tyler faculty	Metric analysis Scholarly write up of project Send for publication National conference	GMN home GMN BPA		Face to face discussion Phone Email US Mail Attend national confer-ence: podium and poster present	Presented poster presentation (up to implementation) at Doctors of Nursing Practice Conference, Palm Springs, Sept 2018 Ownership of Adolescent Ashtma Health: A Concept Analysis: Published Nursing Forum December 2018 Abstract Submitted for EPIP presentation at Sigma Theta Tau Nov 2019 conference Post presentation; written manuscript to be published

Appendix D: Forms

THE UNIVERSITY OF TEXAS AT TYLER COLLEGE OF NURSING AND HEALTH SCIENCES

SCHOOL OF NURSING – DOCTOR OF NURSING PRACTICE PROGRAM. DNP MENTOR AGREEMENT

I have reviewed the mentor guidelines. I can provide the student with advanced experiences that meet the DNP Scholarly Project (EPIP) goals as agreed upon by the student, the faculty mentor, and me. I understand that there will be no remuneration for this service. I will facilitate and review the student's learning activities and will submit the required evaluations to the DNP Program.

I Everett Lamm, MD, FAAP agree
to serve as a (name of mentor)

mentor for the DNP student Gina Nickels-Nelson

(name of student)

from _____ to _____ (beginning date of mentorship) (anticipated end of mentorship)

OR

I agree to mentor for the following semesters: All Semesters ☐ X

OR

Specifically: _____Fall _____Spring _____Summer I

May UTTYLER disclose your contact information for future students seeking mentors?

_____yes or

X _____no

Everett Lamm, MD

Mentor Signature _____ Date 9/5/2017

For office use only:

Reviewed by_____Date _____

Approved as a DNP mentor_____yes_____no

COLLEGE OF NURSING AND HEALTH SCIENCES

SCHOOL OF NURSING – DOCTOR OF NURSING PRACTICE PROGRAM

Mentor Biographical Data

(Please note that an updated resume or curriculum vitae may be submitted as an alternate to the completion of this section)

Name:_____Everett Lamm, MD, FAAP_____ Current Agency__Com

munity Health Programs, Inc._____ Position or Title:

Chief Medical Officer_____

Office Address:__444 Stockbridge Road, Great Barrington, MA 01230__

(street)

_____

(city) (state) (zip)

Office phone with area code 413-528-9311 x 1143

Fax number_____

Email (personal or office) ____elamm@chpberkshires.org_____

Alternate email _____

Preferred Method of Contact:_____Phone __X__Email

Type of position you currently hold_Chief Medical Officer_____ Designated

rural health site? __X__yes_____no

Designated health professional shortage area? __X__yes_____no

Designated medically underserved area? _____ X

yes no

Education

Undergraduate Degree

1. University of Pennsylvania, Philadelphia, PA, BA/'92
(Name of institution) (City/State) (Degree/Year)

2. Harvard University, Cambridge, MA, Post-Baccalaureate Premedical Studies/'93 (Name of institution) (City/State) (Degree/Year)

Graduate Degree

1. University of Vermont College of Medicine, Burlington, VT, MD/'99 (Name of institution) (City/State) (Degree/Year)

Postgraduate Specialty Training

1. University of Vermont College of Medicine, Burlington, VT, Pediatric Residency Program 1999-2002

(Name of institution) (City/State) (Degree/Year)

2. (Name of institution) (City/State) (Degree/Year)

License Information (*Must provide State verification/proof of licensure and certification when applicable)

Professional License Number/State 269024/Massachusetts Board Certification: X yes no

Certifying Board (if applicable):

1. American Board of Pediatrics Date 2003

2. Date

Employment Last Five Years (most recent first)

Employer City/State Dates

1. Community Health Programs, Inc. Great Barrington, MA 9/2016-Present 2. Core Physicians, LLC, Exeter, NH 8/2009-8/2016

3.

4.

Student Signature: *Gina M Nickels-Nelson*

Date submitted: 9-6-2017

Form AD1: Memorandum of Understanding: Industry Mentor Agreement

*/

CHP Berkshire Pediatrics is introducing a new asthma care program for your child/teen. Your child's health, especially caring for asthma, is extremely important to us. So, over the next few months we will begin implementing additional care measures at our office that you will notice.

At your visits, there will be new paperwork we are requesting you to fill out regarding how asthma is affecting your life at home. Asthma not only causes breathing issues, but can also cause your child to miss school and for you to miss work. By filling out these questions, we will better be able to address these issues.

We are also going to have your child show us how they use their inhaler at home. Please bring your medication and spacer to the office for each visit. Even though most people believe they use their medication correctly, unfortunately only about 40% of patients use their inhaler appropriately. This is usually as a result of not getting the proper training when the diagnosis is made. If your child is not using their medication correctly, then they are not getting the medication to their lungs to help manage their asthma effectively.

These are the first steps to improving your child's care. We look forward to seeing you and your child in our office every 6 (six) months to make sure your child is doing well and not suffering as a result of having asthma.

Form AD2: Patient Introduction Letter to Project

Patient's Name:_____ Today's Date:_____

Asthma Control Test™ (ACT) is:

- A quick test that provides a numerical score to assess asthma control.
- Recognized by the National Institutes of Health (NIH) in its 2007 asthma guidelines.[1]
- Clinically validated against spirometry and specialist assessment.[2]

PATIENTS:

1. Answer each question and write the answer number in the box to the right of each question.
2. Add your answers and write your total score in the TOTAL box shown below.
3. Discuss your results with your doctor.

									SCORE
1. In the past **4 weeks**, how much of the time did your **asthma** keep you from getting as much done at work, school or at home?	All of the time	1	Most of the time	2	Some of the time	3	A little of the time	4	None of the time 5	
2. During the past **4 weeks**, how often have you had shortness of breath?	More than once a day	1	Once a day	2	3 to 6 times a week	3	Once or twice a week	4	Not at all 5	
3. During the past **4 weeks**, how often did your **asthma** symptoms (wheezing, coughing, shortness of breath, chest tightness or pain) wake you up at night or earlier than usual in the morning?	4 or more nights a week	1	2 or 3 nights a week	2	Once a week	3	Once or twice	4	Not at all 5	
4. During the past **4 weeks**, how often have you used your rescue inhaler or nebulizer medication (such as albuterol)?	3 or more times per day	1	1 or 2 times per day	2	2 or 3 times per week	3	Once a week or less	4	Not at all 5	
5. How would you rate your **asthma** control during the **past 4 weeks**?	Not controlled at all	1	Poorly controlled	2	Somewhat controlled	3	Well controlled	4	Completely controlled 5	
									TOTAL	

If your score is 19 or less, your asthma may not be under control.

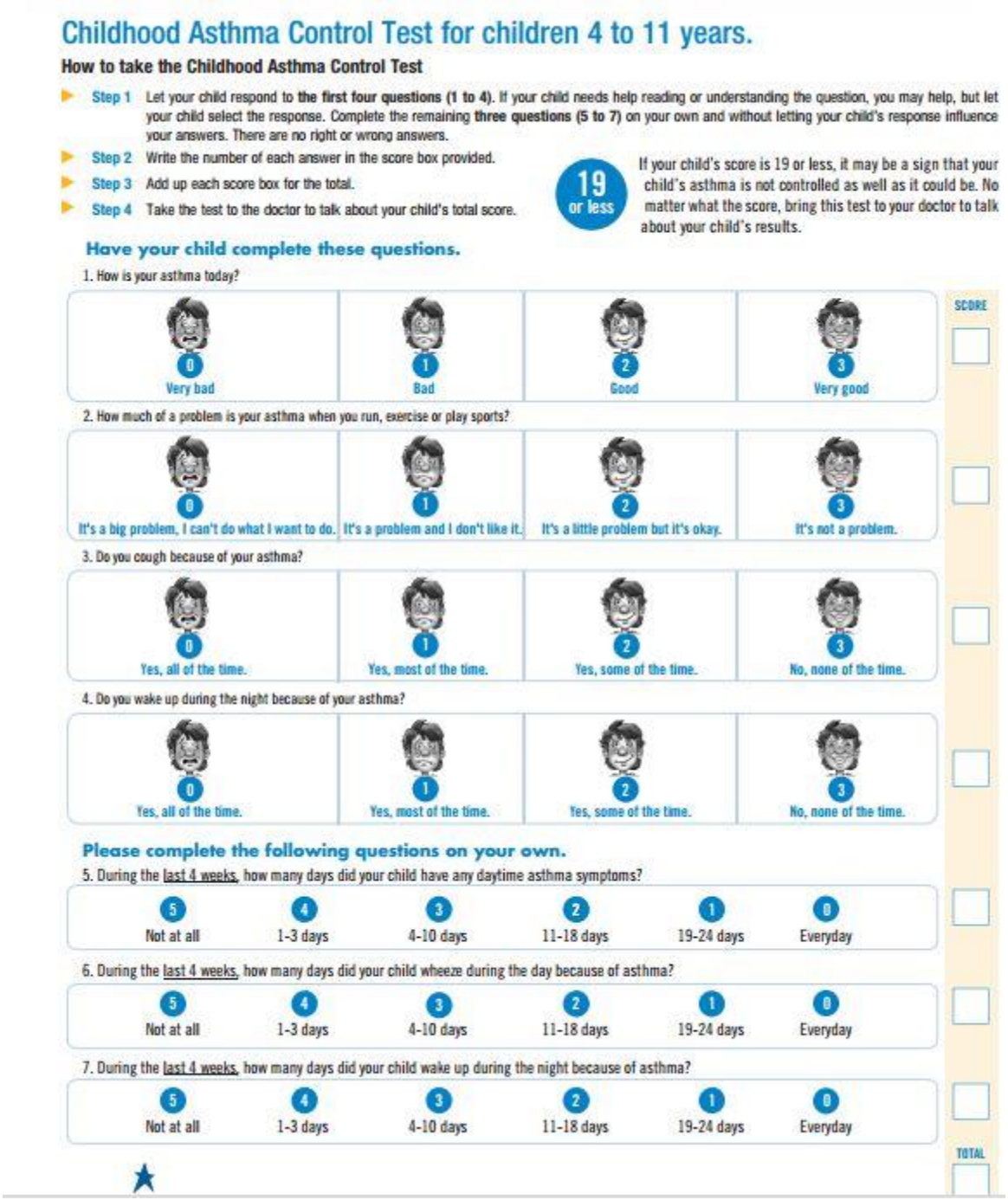
The Asthma Control Test is for people with asthma 12 years and older.

HEALTHCARE PROVIDER:

- Include the ACT score in your patient's chart to track asthma control.

References: 1. US Department of Health and Human Services, National Institutes of Health, National Heart, Lung and Blood Institute. *Expert Panel Report 3: Guidelines for the Diagnosis and Management of Asthma (EPR-3 2007).* NIH Item No. 08-4051. http://www.nhlbi.nih.gov/guidelines/asthma/asthgdln.htm. Accessed September 10, 2007. **2.** Nathan RA et al. *J Allergy Clin Immunol.* 2004;113:59-65.

Form AD3: Asthma Control Test



Childhood Asthma Control Test for children 4 to 11 years.

How to take the Childhood Asthma Control Test

- **Step 1** Let your child respond to **the first four questions (1 to 4).** If your child needs help reading or understanding the question, you may help, but let your child select the response. Complete the remaining **three questions (5 to 7)** on your own and without letting your child's response influence your answers. There are no right or wrong answers.
- **Step 2** Write the number of each answer in the score box provided.
- **Step 3** Add up each score box for the total.
- **Step 4** Take the test to the doctor to talk about your child's total score.

19 or less If your child's score is 19 or less, it may be a sign that your child's asthma is not controlled as well as it could be. No matter what the score, bring this test to your doctor to talk about your child's results.

Have your child complete these questions.

1. How is your asthma today?

0	1	2	3	SCORE
Very bad	Bad	Good	Very good	

2. How much of a problem is your asthma when you run, exercise or play sports?

0	1	2	3	
It's a big problem, I can't do what I want to do.	It's a problem and I don't like it.	It's a little problem but it's okay.	It's not a problem.	

3. Do you cough because of your asthma?

0	1	2	3	
Yes, all of the time.	Yes, most of the time.	Yes, some of the time.	No, none of the time.	

4. Do you wake up during the night because of your asthma?

0	1	2	3	
Yes, all of the time.	Yes, most of the time.	Yes, some of the time.	No, none of the time.	

Please complete the following questions on your own.

5. During the last 4 weeks, how many days did your child have any daytime asthma symptoms?

5	4	3	2	1	0	
Not at all	1-3 days	4-10 days	11-18 days	19-24 days	Everyday	

6. During the last 4 weeks, how many days did your child wheeze during the day because of asthma?

5	4	3	2	1	0	
Not at all	1-3 days	4-10 days	11-18 days	19-24 days	Everyday	

7. During the last 4 weeks, how many days did your child wake up during the night because of asthma?

5	4	3	2	1	0	
Not at all	1-3 days	4-10 days	11-18 days	19-24 days	Everyday	

TOTAL

Form AD4: Asthma Control Test

ASTHMA ACTION PLAN

Asthma and Allergy Foundation of America
aafa.org

Name:	Date:
Doctor:	Medical Record #:
Doctor's Phone #: Day	Night/Weekend
Emergency Contact:	
Doctor's Signature:	

The colors of a traffic light will help you use your asthma medicines.

GREEN means Go Zone!
Use preventive medicine.

YELLOW means Caution Zone!
Add quick-relief medicine.

RED means Danger Zone!
Get help from a doctor.

Personal Best Peak Flow: _____

GO — Use these daily preventive anti-inflammatory medicines:

You have *all* of these:
- Breathing is good
- No cough or wheeze
- Sleep through the night
- Can work & play

Peak flow: from _____ to _____

MEDICINE	HOW MUCH	HOW OFTEN/WHEN
For asthma with exercise, take:		

CAUTION — Continue with green zone medicine and add:

You have *any* of these:
- First signs of a cold
- Exposure to known trigger
- Cough
- Mild wheeze
- Tight chest
- Coughing at night

Peak flow: from _____ to _____

MEDICINE	HOW MUCH	HOW OFTEN/ WHEN
CALL YOUR PRIMARY CARE PROVIDER.		

DANGER — Take these medicines and call your doctor now.

Your asthma is getting worse fast:
- Medicine is not helping
- Breathing is hard & fast
- Nose opens wide
- Ribs show
- Can't talk well

Peak flow: reading below _____

MEDICINE	HOW MUCH	HOW OFTEN/WHEN

GET HELP FROM A DOCTOR NOW! Do not be afraid of causing a fuss. Your doctor will want to see you right away. It's important! If you cannot contact your doctor, go directly to the emergency room. DO NOT WAIT. Make an appointment with your primary care provider within two days of an ER visit or hospitalization.

Form AD5: Asthma Action Plan

MDI Inhaler Use Checklist Evaluation Form

Name of Patient:

Date of Evaluation:

Evaluator:

MDI Step	Score	Pre-Education Score	Post Education Score
Remove Cap	1		
Shake inhaler/place into spacer	1		
Exhale completely	1		
Place mouthpiece in mouth between lips	1		
Press canister down once	1		
Inhale slowly and deeply; hold breath 10 seconds	1		
Breathe out gently	1		
Wait 30 seconds before next dose	1		

Form AD6: Inhaler Technique Checklist