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The Effects of Implementing a Smartphone Application to Improve Asthma Self-Management in Adults

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THE EFFECTS OF IMPLEMENTING A SMARTPHONE APPLICATION TO IMPROVE ASTHMA SELF-MANAGEMENT IN ADULTS

by

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DEDICATION

This project is dedicated to all who are living with or who have died due to asthma. I hope that this project will draw attention to the importance of making asthma management a priority in the primary care setting.

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I would like to acknowledge my advisor, Dr. Zheng Li for her guidance and encouragement throughout this process. Thank you for sharing your knowledge and ideas with me. I would also like to thank Dr. Julie Koch, for her willingness to step and help me complete the final steps in my project. You have been so helpful and encouraging, and I am so grateful for your guidance. I would like to acknowledge my project site facilitator Lindsay Gordon, FNP, as well as Dr. Christina Huynh, for allowing me to work with their patients throughout the course of this project. It is clear how passionately you both care for your patients, and I strive to someday provide my patients with the same level of care and compassion that you do.

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ABSTRACT

Asthma is one of the most common chronic diseases, affecting 20.4 million adults in the United States (CDC, 2018). While asthma can generally be controlled, patients having an exacerbation may experience missed days of work and school, limitations in daily activities, decreased enjoyment of life, and decreased productivity at home, work, and school (Marcano-Belisario et al., 2013). Therefore, the purpose of this project was to improve patients' overall asthma control and asthma-related quality of life by encouraging self-management through patient education and the implementation of a mobile smartphone application. A total of 26 adult primary care patients with asthma participated in a focused asthma intervention: (a) a 30-minute one-on-one asthma education session utilizing a patient education guide and (b) the use of a mobile application for asthma management. Patients downloaded a free smartphone application, AsthmaMD®, and utilized the symptom tracker, medication reminders, and digital asthma action plan. The primary outcomes of the project included asthma control (ACT), asthma-related quality of life (AIS-6), and asthma literacy. Patients completed the ACT, AIS-6, and Asthma Literacy Questionnaire at their initial visit and again at four and eight weeks after the intervention. Statistical analysis was performed using repeated-measures ANOVA, and post-hoc analysis was conducted using protected *t*-tests. Upon completion of statistical analysis, a significant effect was found in both the ACT (F (2, 44) = 43.08, $p < .001$) and AIS-6 (F (2, 44) = 51.621, $p < .001$)**,** demonstrating a significant improvement in test scores from initial evaluation to 4-week follow-up, from 4-week follow-up to 8-week follow-up and from initial evaluation to 8-week follow-up. Analysis of the Asthma Literacy Questionnaire showed an increase in knowledge that was statistically significant in all areas of asthma education. Additionally, results suggested that all participants felt the mobile application was helpful for tracking asthma symptoms. Results of this evidence-based practice project can be used to help providers improve asthma self-management by promoting education, written or digital action plans, and the use of a mobile application for symptom tracking and medication reminders.

CHAPTER 1

INTRODUCTION

Background

Asthma is a heterogeneous disease with a variety of underlying disease processes, usually characterized by chronic airway inflammation (Global Initiative for Asthma [GINA], 2018). It is defined by the history of respiratory symptoms such as wheezing, shortness of breath, chest tightness and cough that vary in intensity over time, as well as airflow limitation (GINA, 2018). Variations in asthma symptoms can be triggered by exercise, allergen or irritant exposure, changes in weather, or viral upper respiratory infections (GINA, 2018). Symptoms of asthma may resolve spontaneously or may require the use of medications, and a patient's asthma can often be well controlled leaving them symptom-free for months at a time (GINA, 2018). However, when asthma is not well controlled, patients may experience exacerbations or flare-ups of symptoms, that may be life threatening and require emergency care (GINA, 2018). This can place a significant burden on patients, their families, the community, and the healthcare system as a whole. Therefore it is crucial that patients are able to recognize and address changes in their condition before the need for emergency care arises.

The scope of those affected by asthma is widespread. Asthma is a serious global health concern affecting all age groups, and its prevalence is increasing in many countries (GINA, 2018). It is one of the most common chronic diseases of both children and adults, affecting nearly one in every thirteen people in the United States (CDC, 2018). This amounts to 18.4 million adults over the age of eighteen with asthma, and 6.2 million children with asthma, for a staggering total of 24.6 million people in the United States living with the disease (CDC, 2018). As previously mentioned, though patients with asthma are able to manage symptoms through the use of daily maintenance medication, they often experience exacerbations of asthma symptoms requiring a change to normal maintenance therapy. If patients are not well equipped to manage them, worsening symptoms may become severe and require a higher level of care in

order to control (Gatheral et al., 2017). This can be physically and emotionally difficult for the patient, and may have financial implications as well.

Alarmingly, 46.9% of people currently living with asthma report having one or more asthma attacks every year, resulting in nearly two million emergency room visits, and seven million outpatient visits per year for asthma-related issues (CDC, 2018; Coffman, Cabana, Halpin & Yelin, 2008). In 2015 alone, approximately 1.7 million visits to the emergency room listed asthma as the primary diagnosis (CDC, 2017). While the cost of an emergency visit varies greatly depending on insurance coverage, one study found that in the United States patients seeking care in the emergency room would be charged an average of $1,502 (Want, Srebotniak, Brownell & Hsia, 2014). Those patients who are uninsured, low or fixed-income, or have high-deductible insurance plans are especially affected by these costs (Wang et al, 2014). These emergency room visits are largely preventable with proper asthma-related education, the use of appropriate medications, and implementation of an asthma action plan. As the prevalence of asthma continues to increase, asthma management must improve in order to keep patients from requiring emergency care for uncontrolled symptoms.

Acute exacerbations are just one component of asthma. Asthma is a long-term condition requiring regular visits to a primary care providers, maintenance medications, and frequent symptom monitoring, which places considerable pressure on patients and their families (Marcano-Belisario, Huckvale, Greenfield, Car & Gunn, 2013). While severe exacerbations may be infrequent, patients may experience mild asthma symptoms more regularly throughout their daily lives. These can include shortness of breath or wheezing with mild exertion or exercise, chest tightness, or limitations in activity. When not managed properly, even mild asthma symptoms can negatively affect patients' overall health, wellbeing and quality of life (Marcano-Belisario et al., 2013).

Additionally, patients suffering from uncontrolled asthma are more likely to have more missed days of work or school, exacerbations requiring increased visits to urgent care facilities

or emergency rooms, and experience limitations in daily activity. In order to reduce these adverse effects, patients must be accountable for their own care through self-management. The implementation of provider-led asthma education, coupled with improved self-management of symptoms could likely prevent many of these exacerbations. Evidence strongly supports the use of self-management in improving outcomes of chronic asthma (Pinnock & Thomas, 2014; U.S. Department of Health and Human Services [HHS], 2007).

The US Institute of Medicine defines self-management as "the tasks that individuals must undertake to live with one or more chronic conditions, including having the confidence to deal with medical management, role management, and emotional management of their condition" (Institute of Medicine [IOM], 2001). In patients with asthma, self-management includes being aware of symptoms as they emerge, recognizing an exacerbation before it worsens, tracking asthma symptoms in order to identify and avoid triggers, and adjusting medications according to an asthma action plan. By encouraging and educating patients on the importance of self-management, they are able to understand their condition, symptoms, and triggers, as well as feel confident in initiating their asthma action plan for medical management. This ability to self-manage allows patients to address deteriorating symptoms early, and correct them quickly, and potentially prevent the need for emergency care (Pinnock & Thomas, 2014).

The U.S. Department of Health and Human Services National Heart, Lung and Blood Institute (2007) Clinical Practice Guideline published by the recommends ongoing patient education, clinician follow-up, reinforcement and adherence strategies for improved control, as well as the use of asthma action plans, as strategies to improve patients' ability to self-manage their condition. The Global Initiative for Asthma (2018) also recommends the use of self-management through personalized asthma action plans and physician follow-up in order to manage asthma symptoms. Despite the strong evidence in support of self-management, most patients with asthma have not been provided with an asthma action plan or education about the importance of self-management (Pinnock & Thomas, 2014). Barriers to providing education on

self-management have been identified at multiple levels, including the provider, the patient, and the organization (Cloutier, 2016). Cited barriers include: the lack of familiarity of guidelines, unclear guidelines and recommendations, lack of outcome expectancy with providers not believing that guidelines would be effective, and most frequently mentioned was simply a lack of time during visits (Cloutier, 2016). Despite these barriers, self-management in the form of action plans and patient education must be provided to patients in order for them to better manage their asthma symptoms.

In addition to the self-management strategies mentioned above, emerging research supports the use of mobile apps and digital media as an element of improved asthma control (Hui et al., 2017). According to a study by the Pew Research Center (Smith, 2013), approximately 56% of all adults in the United States own a smartphone, and 34% own a tablet. These numbers are expected to increase yearly, as they have since their emergence on the market (Smith, 2013). While research on smart phones, digital media, and mobile apps is a newer concept, studies being published are demonstrating positive outcomes on asthma control and asthma-related quality of life resulting from the use of technology. In a Cochrane Systematic Review on the use of smartphones for asthma management, one study showed that the use of a smartphone app resulted in “better asthma-related quality of life and lung function, and reduced visits to the emergency department” (Marcano-Belisario et al., 2013, p.3). Another study found that monitoring and reminder technology through the use of mobile applications improved patient medication adherence and provide patients’ with information on managing symptoms without escalating therapy (Anderson, 2017).

The literature demonstrates the potential for utilizing technology in order to augment self-management skills for patients with asthma, but also addresses the need for additional studies. With the known support for self-management, a mobile application designed specifically for asthma symptom management is an added way for patients to track symptoms and activate their action plan in real-time, without needing to search for a symptom diary or an action plan

written on paper. The mobile app also allows patients to input their medications, enter reminder notifications for daily medications, and store symptom data in one location for review with their primary care provider. For many Americans, technology is a part of daily life, and if mobile technology could allow patients to integrate symptom tracking and digital asthma action plans into their daily routines, self-management could improve drastically.

Statement of the Problem

The number of emergency room and urgent care visits for patients with uncontrolled asthma is concerning. These visits demonstrate the lack of control over patients' asthma symptoms, and possibly the patients' inability to manage symptoms independently without requiring emergency care. While some asthma exacerbations require emergency care despite self-management by the patient, many exacerbations can be managed at home through the use of an asthma-action plan and proper education (Hui et al., 2017). However, despite the known benefits of self-management programs such as action plans, symptom tracking, and the use of mobile apps, implementation of these tools in clinical practice is still very poor (Ring et al., 2011).

One study found that less than 33% of patients who see a primary care physician regularly had received a personalized asthma action plan, and only 28% of patients reported receiving any written information about asthma (Partridge, Dal Negro & Olivieri, 2011). Additionally even when patients were given personalized action plans they were grossly underutilized, and a lack of education is likely to blame (Ring et al., 2007). One study found that even when action plans were initiated by the provider and given to the patient, more than 55% of patients reported adjusting their medication according to how they felt rather than on the guidance of the action plan, and 60% did not adjust their medications at all in response to changes in symptoms (Partridge, Dal Negro & Olivieri, 2011). This demonstrates that need for improved education on the value of the action plan and its role in managing symptoms.

Asthma action plans are intended to allow patients the autonomy to identify changes in their asthma status and adjust their asthma therapy as needed, under the guidance of a healthcare provider. The poor implementation and underutilization of action plans in the literature is troubling. There is a need for primary care providers to develop personalized action plans for patients, taking the time to provide adequate education on the importance of monitoring asthma symptoms and adjusting medications as appropriate and in accordance with the plan of care. Education is a key component in asthma management, as patients must be able to recognize the signs and symptoms of worsening asthma, and understand their medications and how they are to be used in accordance with their action plan. It is essential to emphasize the importance of adjusting medications are recommended by the provider and the action plan, based on symptoms, rather than using medications as the patient sees fit.

These self-management techniques for asthma management are crucial to patients gaining control over their asthma symptoms, and the underuse and underutilization of self-management techniques calls for the implementation of innovative techniques. As technology continues to evolve, new opportunities are emerging for improved symptom tracking and self-management, particularly through the use of smart phones and mobile applications. There is a need to improve the way that patients self-manage their asthma, as current evidence-based practice is not being implemented consistently in the clinical setting. This is ultimately causing an abundance of visits to emergency rooms and urgent care clinics, when patients may have been able to control their exacerbation at home.

Data from the Clinical Agency Supporting Need for the Project

The clinical site chosen for implementation of this project was a family practice office, staffed by one physician and one nurse practitioner, located in northwest Indiana. Indiana has an overall asthma prevalence of 10.2%, making it one of the top ten highest states for asthma prevalence (CDC, 2015) and further demonstrating the need for appropriate management and control. Since Indiana does have a fairly high prevalence of asthma, the office manages many

patients with mild to moderate asthma. On an average day, the clinic sees approximately three to five adult patients per day with a diagnosis of asthma. This can of course vary day-to-day, but the office does see many adult patients with asthma, and the providers in the office are the patients' primary prescribers of asthma medications, including oral medications, rescue inhalers, and daily maintenance medications.

Despite the evidence in organizational guidelines which overwhelmingly support the use of self-management, education and personalized asthma action plans, the providers in the office do not have any formal procedure for managing and educating their patients with asthma. There is no protocol in place for educating patients on their condition, no written information provided during visits, and no personalized action plans being created between providers and patients. Providers in the office cite lack of time as the primary reason for not providing this education to their patients. Another cited reason for not providing education and action plans is that providers often feel the majority of their patients with asthma are not newly diagnosed, and therefore are knowledgeable in regard to their condition and how aware of how to manage it. However, both the nurse practitioner and physician were aware of this gap in patient care, as well as the current practice guidelines recommendations, and they were open to implementing an evidence-based intervention that directly benefitted their patients.

Purpose of the Evidence-Based Practice Project

The overall purpose of this project was to improve patients' ability to self-manage their asthma symptoms, therefore improving their ability to treat symptoms early and appropriately, as well as improve their ability to track symptoms and identify possible triggers. This was accomplished using an educational intervention utilizing a patient education guide published by the CHEST foundation, titled "Living Well with Asthma," and included asthma literacy education, appropriate use of medications, the development of a digital asthma action plan, and the introduction of a mobile application (app) to track symptoms. The mobile app also featured a digital asthma action plan that patients were able to access at any time from their personal

mobile device. The digital action plan allowed the patient or healthcare provider to input the patient's prescribed rescue and maintenance medications and create an interactive action plan, which the patient were able to activate and follow when they begin to experience asthma symptoms.

After the implementation of this intervention, patients should have improved knowledge of their condition and how to manage it, as well as an understanding of the importance of well-controlled asthma. Patients will be able to understand the disease process of asthma and feel comfortable explaining it to someone else. They will feel more comfortable using their inhalers and nebulizer machines, and they will feel more confident in identifying asthma triggers. Through education and the implementation of both a digital asthma action plan, patients will therefore be more effective at tracking symptoms and recognizing changes in their condition and acting accordingly. Patients will become more familiar with the asthma action plan and how to follow it. This intervention will allow patients to feel empowered and confident in managing their condition, and therefore they will experience an improved quality of life.

This project was developed to implement an evidence-based intervention that includes asthma education, the development of an asthma action plan, and the implementation of a mobile application in an effort to improve asthma self-management. The PICOT question addressed was "How effective is an intervention that includes education and self-management using digital asthma action plans and symptom tracking via mobile application, compared to the current standard of practice in improving quality of life, asthma control, and asthma literacy over an eight-week period?"

Significance of the EBP Project

This evidence-based practice project is needed because more Americans than ever before have asthma, making it one of this country's most common and costly diseases. According to the Asthma and Allergy Foundation of America (AAFA)(2018), from 2001 to 2011, the number of people with asthma increased by 28 percent. This increase in asthma prevalence

also means an increase in the cost of asthma care. In 2007, the cost of asthma care in the United States reached $56 billion dollars (AAFA, 2018). The cost of asthma care includes both direct costs, such as medications and hospital visits, and indirect costs, such as missed workdays and productivity (AAFA, 2018). While both contribute to the cost of asthma care, direct costs make up the overwhelming majority, nearly $50.1 billion, the largest portion of which is hospital stays (AAFA, 2018). A study by Barnett and Numagambetov (2007) estimated that the direct cost of asthma is approximately $3,259 per person per year. This is a significant cost, and it includes not only the costs of medication and hospital stays but also days missed from work leading to lost wages (Barnett & Numagambetov, 2007).

Aside from the burdens caused by the cost of asthma, patients with asthma may experience more missed days from work and school, limitations in physical activity, and decreased quality of life (Gatheral et al., 2017). Adults who were employed and had one or more asthma attacks during the previous 12 months missed 14.2 million days of work due to asthma exacerbations (CDC, 2013). Those with asthma are also at increased risk of asthma-related death. Approximately ten Americans die daily due to asthma, and in 2015 there were 3,615 deaths listing asthma as the primary cause (CDC, 2018a). Many of these deaths were avoidable with proper treatment and care.

The objective of this project was to improve asthma self-management in the primary care setting through the use of education, asthma action plans, and the use of a mobile application in accordance with current practice guidelines. The goal of the intervention was to improve patients overall education about their disease, as well as improve asthma control and asthma-related quality of life. This in turn, can reduce the cost of asthma care to both the patient and the healthcare system, missed days from work and school, and asthma-related deaths.

CHAPTER 2

THEORETICAL FRAMEWORK, EBP MODEL, AND REVIEW OF LITERATURE

Melnyk and Fineout-Overholt (2015) defined evidence-based practice (EBP) as "a paradigm and lifelong problem-solving approach to clinical decision making that involves the conscientious use of the best available evidence with one's own clinical expertise and patient values and preferences to improve outcomes for individuals, groups, communities and systems" (p. 604). Essentially, EBP involves seeking the highest level of evidence available, and using that evidence, as well as the expertise of the healthcare provider, to develop a strategy to implement a change in clinical practice. Evidence-based practice is crucial in health care in order to provide the highest quality of healthcare with the best patient outcomes at the lowest possible cost (Melnyk and Fineout-Overholt, 2015). EBP ensures that clinical practice is reflective of current research and literature. This need to implement the highest level of evidence in clinical practice was the driving force for the development of this project.

Both a theoretical framework and an evidence-based practice model, in addition to a thorough review of recent literature, must guide the implementation of EBP. This project utilized the Self-Care Deficit Nursing Theory by Dorothea Orem and the Stetler Model, as the tools to guide this change in practice. An exhaustive search of the literature was conducted in order to find the most relevant and highest quality sources. This chapter will discuss the theoretical framework and evidence-based practice model used to guide this project, including their application to development and implementation and their strengths and limitations. A detailed review of pertinent literature is also included.

Theoretical Framework

Nursing theories provide an organized framework of concepts designed to guide the practice of nursing (George, 2011). These theories are developed in order to explain and describe nursing care, guide the practice of nursing, and provide a foundation for clinical decision-making. Nursing theories affect clinical practice on a daily basis, and they are often

used as the foundation that guides nurse-patient interactions. Nursing theories help nurses to think critically, improve patient care and outcomes, and improve nurse-patient relationships. It is through nursing theories, like the Self-Care Deficit Nursing Theory, that new knowledge and data can be obtained (George, 2011). The following section will discuss the Self-Care Deficit Nursing Theory and how it was used to guide the development and implementation of this EBP project.

Overview of Theoretical Framework

The Self-Care Deficit Nursing Theory was developed by Dorothea Orem in 1959, and has been revised several times since, with the last edition of her book published in 2001. Dorothea Orem's Self-Care Deficit Nursing Theory, her general theory, included three interrelated theories: the theory of self-care, the theory of self-care deficit, and the theory of nursing systems (George, 2011). The basis of Orem's theory is that "nursing has as its special concern man's need for self-care action and the provision and maintenance of it on a continuous basis in order to sustain life and health, recover from disease and injury, and cope with its effects" (Orem, 2001, p.22). In essence, self-care is necessary in order to promote health, and if that is not maintained then nursing must intervene. In order to understand Orem's theory, it is crucial to define some of the key concepts, including the concepts of self-care, self-care agency, basic conditioning factors, and therapeutic self-care demand as they pertain to the theory (George, 2011). The concepts make up the foundation for the Self-Care Deficit Nursing Theory.

The first of Orem's three theories is the theory of self-care, which is essential in defining the concept of self-care. *Self-care* is defined as the "performance or practice of activities that individuals initiate and perform on their own behalf to maintain life, health, and well-being" (Orem, 2001, p.43). *Self-care requisite* is the term used to describe reasons why self-care activities occur, and include universal, developmental, and health deviation self-care. Universal self-care activities are often thought of as the basis of self-care, including maintaining sufficient

intake of air, water, and food, maintaining the process of elimination, maintaining balance between sleep and rest, and prevention of hazard to human well being. These are often referred to as activities of daily living. Developmental self-care requisites are the second category of self-care requisites. They include activities related to growth and development, such as adjusting to a new job or physical changes to the body associated with aging (Orem, 2001). Developmental self-care requisites are generally influenced by changes occurring throughout life cycle stages and may be positive or negative in nature (Orem, 2001, p. 48).

Orem also discusses self-care in the healthcare setting, called health deviation self-care requisites. Within the healthcare setting there are specific self-care activities that are essential in order to maintain optimal health. These activities include things like seeking medical assistance, being aware of and attending to medical conditions, effectively carrying out medically prescribed diagnostic and therapeutic procedures, being aware of and managing the effects of medical care measures, and learning to live with the effects of treatment measures in such a way that it promotes continued personal development (Orem, 2001, p. 235). While universal self-care and development self-care are essential components to maintaining overall health, self-care within the healthcare setting served as the basis for the theory's use in the implementation of this project.

Self-care agency is another critical component of the Self-Care Deficit Nursing Theory. This term simply describes the patient's ability and capability to engage in self-care behaviors (Orem, 2001). A patient's ability to engage in self-care is determined by basic conditioning factors. Basic conditioning factors are things like age, gender, developmental state, state of health, health care system, family support, environmental factors, and availability and accessibility of resources (Orem, 2001). Generally, patients are able to care for themselves, but in cases were patients are very old or very young, have developmental or cognitive delays, are in poor state of health or do not have resources available, they may require assistance in

performing self-care activities. *Therapeutic self-care demand* is the term used to describe the total of care activities needed to meet a person's requirement for self-care (Orem, 2001).

These concepts are importance in understanding the second of Orem's theories, the theory of self-care deficit, which states, "when therapeutic self-care demand exceeds self-care agency, a self-care deficit exists and nursing is needed" (George, 2011, p.115). Essentially, when the patient's total care needed is greater than the patient's ability to care for himself, nursing is needed. Basic conditioning factors, such as age, health status or developmental state, are important to consider because these factors impact the way that patients are able to care for themselves. The theory of self-care deficit is the basic element of Orem's general theory, the Self-Care Deficit Nursing Theory, because it explains the need for nursing care.

The theory of self-care deficit is essential to the general theory because it delineates when nursing care is need. When patients, or their caregivers in the case of dependents, are unable to meet the self-care demand and provide continuous effective self-care, nursing must intervene (George, 2011). Nursing care may be provided if the capacity to provide care is less than the identified self-care demand, or if a deficit is predicted for the future such as in the case of major surgery or procedure such as chemotherapy (Orem, 2001). Nursing may be required when patients have new diagnoses and need help to process and cope with these changes, or when education is needed on new medication regimes or specialized care (Orem, 2001). Anytime a self-care deficit is present there is a need for nursing to assist.

Orem (2001, p. 56) identifies the five ways that nurses may help use to help, including: acting for and doing for others, guiding others, supporting another, providing an environment promoting personal development in relation to meet future demands and teaching another. The nurse may use one or all of these methods to provide patients the assistance they need to promote self-care. Orem defines the activities that nurses perform in order to provide nursing care, a few of which include maintaining nurse-patient relationships, coordinating nursing care,

responding to patient needs, coordinating care with other healthcare disciplines, and discharging patients when the regain their ability to care for themselves (Orem, 2001, p.19).

The third theory that comprises Orem's Self-Care Deficit Nursing Theory is the theory of nursing systems, which outlines how the patient's needs will be met by the nurse, the patient, or both (George, 2011, p. 118). This theory identifies three classifications of nursing systems to meet the self-care requisites of the patient. These systems are the wholly compensatory system, the partly compensatory system, and the supportive-educative system (Orem, 2001). The wholly compensatory system is represented when the patient is unable to carry out self-care activities and is therefore fully dependent on others (Orem, 2001). The partly compensatory system is represented in a situation where the patient and nurse are both active participants in the patient's care (Orem, 2001). In the supportive-education system, the patient is fully capable of meeting their self-care needs, but requires help with decision-making and gaining knowledge or skills. In the supportive-education system the nurse acts primarily as a consultant or educator (Orem, 2001). These systems define the roles of the nurse and the patient, and one or more of these systems may be used with a single patient over a period of time.

In order to implement her theory, Orem proposes a three-step nursing process. The first step includes nursing diagnosis and prescription. The nurse will acquire data about the patients' self-care agency and therapeutic self-care demand, and determine why nursing is needed (Orem, 2001, p. 310). The second step involves designing a nursing system and planning for delivery of care (Orem, 2001). This includes choosing effective ways to help the patient and then planning a method to move from designing the nursing system to implementing the production of the system (Orem, 2001). The third and final step is the production and management of the nursing system. During this phase, the nurse and patient work together to meet unmet self-care demands and help the patient work toward developing self-care agency

(Orem, 2001). The nursing process is constantly evaluated and modified to meet the needs of the patient.

In summary Dorothea Orem's Self-Care Deficit Nursing Theory is composed of three interrelated theories of self-care, self-care deficit, and nursing systems (George, 2011). The six central concepts of self-care were discussed within these theories include self-care agency, therapeutic self-care demand, self-care deficit, nursing agency, and nursing system, and the concept of basic conditioning factors. The overall premise of the theory is that when self-care demands are greater than the patient's self-care abilities nursing is required. The nurse assesses the situation, develops a plan of care and nursing system to meet the needs of the patient, and implements and evaluates the system over time. As discussed in the previous chapter, self-management and care is a crucial component of asthma management. The Self-Care Deficit Nursing Theory can be used as the framework to guide the development and implementation of a self-care focused asthma intervention.

Application of Theoretical Framework to EBP Project

Recent systematic reviews have confirmed that there are major benefits associated with effective asthma self-management education, however the implementation of self-management education is rare in the clinical setting (Pinnock & Thomas, 2015). Self-management for patients with asthma has been shown to include education, personalized asthma action plans, and routine follow-up with a provider, and newer research is supporting the use of digital technology as a self-management tool (Pinnock & Thomas, 2015). While it is understood that all clinicians should be providing their patients with the education and tools needed in order to understand and manage their condition, studies have demonstrated that self-care practices among asthma patients are not adequate (Altay & Cavusoglu, 2013). Much of current research has been focused on the most effective way to promote self-care and self-management with asthma patients in an effort to improve morbidity and mortality (Pinnock & Thomas, 2015). Ultimately the goal of self-management is to improve the self-care deficit faced by patients with asthma.

The goals of asthma self-management align well with Orem's Self-Care Deficit Nursing Theory, which states that when the patient's therapeutic self-care demand exceeds self-care agency, a self-care deficit exists and nursing is needed (Orem, 2001). There is a demonstrated self-care deficit among asthma patients that is likely by fault of both the patient and the provider. As discussed in the previous chapter, there is a lack of asthma control throughout the country, leading to increased exacerbations, missed work and school days, and increased morbidity and mortality (Gatheral et al., 2017). The Self-Care Deficit Nursing Theory can be applied to guide this project in developing an evidence-based intervention to improve asthma self-management.

The first step in Orem's nursing process is "Diagnosis and Prescription" (Orem, 2001). This phase involved analyzing and interpreting the situation to determine why nursing care was needed (Orem, 2001). A thorough review of the literature determined that self-management is severely lacking among asthma patients, and that the self-care demand of asthma care was exceeding patients' self-care agency or ability to care for themselves. Therefore self-care activities such as seeking medical assistance, being aware of and attending to medical conditions, and effectively carrying out medically prescribed diagnostic and therapeutic procedures were not being performed (Orem, 2001, p. 235). The literature was reviewed to determine where self-care is lacking, and how it could be improved. Once a clear need for improved self-care was demonstrated in the literature, a need for nursing care was established.

The second step in Orem' nursing process is to "Design a nursing system and plan for delivery" (Orem, 2001). This phase involved designing an effective and efficient system of nursing that will best suit the needs of the patient (George, 2011). Therefore after determining a need for nursing intervention, the next step was developing a plan for implementation of nursing care that would best help patients meet self-care goals. This involved meeting with key stakeholders, developing an appropriate intervention, and establishing desired outcomes. In developing a plan for delivery, a nursing system was also created. As previously discussed,

Orem's nursing systems theory described three nursing systems: wholly compensatory system, the partly compensatory system, and the supportive-educative system (Orem, 2001).

The nursing system used for this project was a supportive-educative system. In this system the nurse functions primarily as a teacher or consultant, which was the case with this project (Orem, 2001). Patients in the primary care setting with a diagnosis of asthma are fully capable of meeting their self-care needs, but may require help with education, guidance or skills in order to effectively self-manage their symptoms (Orem, 2001). For example the patient may be fully capable of using a metered dose inhaler independently, but he may require assistance and education of proper technique in order to do so. The supportive-educative system is fitting for patients who are physically and mentally capable, but they require assistance in learning how to meet therapeutic self-care needs. It is appropriate for the primary care office setting, and will suit the needs of the patient.

The third and final step of Orem's theory is the "Production and management of nursing systems" (Orem, 2001). During this phase, the nursing system is created through the nurse's interaction with the patient. The nurse's actions strive to meet the unmet self-care demands and help the patient develop improved self-care agency (Orem, 2001, p.322). The goal of this phase is to help patient's learn to self-manage their asthma symptoms, therefore improving their self-care agency until it exceeds their self-care demand and removes the self-care deficit. Orem suggests achieving this through guiding, directing and supporting patients, stimulating patients' interest in self-care, assisting patients to monitor themselves to determine if self-care is effective, and promoting daily living routines that support the integration of self-care (Orem, 2001, p. 322-323).

Orem's Self-Care Deficit Nursing Theory, with its three interrelated theories and proposed nursing process, were extremely helpful in the development of this project. The self-care deficits identified by patients with asthma found in the literature clearly demonstrated a need for this project, and the nursing process allowed for the creation and management of the

nursing system in which the project was completed. The Self-Care Deficit Nursing Theory provided a blueprint for the development of this project, as it pertains to nursing, as well as for evaluation of its overall effectiveness.

Strengths and Limitations of Theoretical Framework for EBP Project

Orem's theory provides nurses with a way to identify when a self-care deficit exists and when there is a need for nursing care. It has been in use for many years, and it has been revised and improved upon several times, making it one of the most widely used nursing theories to date (George, 2011). Though its unique way of looking at nursing was very helpful in the development of this DNP project, the theory is not without limitations. The following section will discuss some of the strengths and limitations of the Self-Care Deficit Theory both generally and as it applies to this evidence-based practice project.

Strengths. Orem's theory of nursing overall has many strengths. It provides a comprehensive base for nursing practice and is applicable in many settings including education, clinical practice, administration and research (George, 2011). It can be used by all levels of nursing from beginning practitioner to an advanced clinician (George, 2011). The theory clearly delineates when there is a need for nursing care; in this case when specific knowledge and techniques are needed in order to maintain self-care (Orem, 2001). Orem clearly outlines the three theories that compose her general theory, describing them individually as well as how they fit together as one. Orem also defines all of the terms used within the theories including self-care agency, therapeutic self-care demand, self-care deficit, nursing agency, and nursing system, and the concept of basic conditioning factors. Additionally, descriptions of the various nursing systems are provided in a way that is easily understood (George, 2011). This theory has been revised many times and continues to evolve, and though Dorothea Orem passed away in 2007, its impact is international (George, 2011).

This theoretical framework was a wonderful fit for this project. There is a need in the literature to address the self-care deficit present in asthma care and management, and Orem's

theory provides guidance on how to identify and address this. Orem's theory clearly identifies how to determine that a self-care deficit exists, and provides the necessary steps to create a plan, design a nursing system, and implement and manage the intervention. This aligned well with this EBP project, which had the same goals to identify a clinical problem, develop an intervention to change practice, and evaluate the outcomes. Her self-care approach is contemporary with the concepts of health promotion and health maintenance. Overall it is a well-developed, time-tested model that can be used to improve patient adherence and outcomes.

Limitations. Though Orem provides descriptions of the terms used within her theory, the multitude of terms can be overwhelming to the reader initially. The overall language used within the theory is somewhat complex, and may be difficult to understand for novice students or non-native English speakers. Other limitation is that health is often viewed as dynamic and ever changing, while Orem's model implies three static conditions of health (George, 2011). George (2011) noted that when determining a patient's placement within a system, a major determinant is the patient's capacity for physical movement without any concern for emotional needs. This may be a limitation to the overall theory as not all patients are limited only by physical constraints or illness. Often the reason patients are unable to perform self-care is due to mental illness or emotional state. A final limitation is that in contrast to models like Nola Pender's Health Promotion Model, Orem's theory is focused only on the illness state. However since the population of interest for this project is patients with asthma, this was not necessarily a limitation.

Evidence-based Practice Model

There are many interventions in healthcare that have been shown to have a positive impact on patient outcomes as well as cost savings for the healthcare system, yet are still not being implemented in the clinical setting **(**Melnyk & Fineout-Overholt, 2015). The reason for this is multifactorial. In part, healthcare providers may not be aware of these studies and therefore

are not aware that a change in practice is needed. It may be that the clinician is faced with organizational barriers such as lack of interest, motivation, cost, or lack of supportive leadership that prevent the implementation of EBP (Melnyk & Fineout-Overholt, 2015). It may be that there is individual and/or organizational resistance to change.

The task of changing clinical practice is daunting and difficult, with many complex factors involved. As a result, evidence-based practice models, such as the Stetler Model, have been developed to systematically guide the implementation of EBP (Melnyk & Fineout-Overholt, 2015). The following section will discuss the Stetler Model and its use in guiding the design, planning and implementation of this evidence-based practice project.

Overview of EBP Model

In the 1970's, the Conduct and Utilization of Research in Nursing (CURN) project was one of the earliest attempts to increase the use of research among nurses (Schmidt & Brown, 2015). This project attempted to move nurses away from doing things "because we've always done it this way" and encouraged them to strive towards becoming a more research-based profession (Schmidt & Brown, 2015). The CURN project moved nursing from relying on customs and opinions to searching for the best evidence and actively seeking the best way to apply it in clinical practice (Schmidt & Brown, 2015). While the CURN project provided insight as to how and why it was important to embrace research in the clinical setting, it lacked the inclusion of a process detailing how to integrate research into practice (Schmidt & Brown, 2015). The Stetler Model was developed to further advance nurses' ability to integrate EBP into practice.

The Stetler/Marram Model for research utilization was first developed in 1976 in order to fill this void in the application of research findings into clinical practice (Stetler & Marram, 1976). The model has been modified several times over the years, always with critical thinking and use of research at the core, and has now come to be known as simply the Stetler Model (Melnyk & Fineout-Overholt, 2015). The Stetler Model aims to provide practitioners with step-by-step instructions for integrating research into practice, and it is useful to help nurses deliver safe

patient care. The model's most recent revision in 2001 also provided updates that facilitated the implementation of evidence-based practice (Melnyk & Fineout-Overholt, 2015).

Overall, the Stetler Model provides steps to assess and use research findings to facilitate the implementation of evidence-based practice in the clinical setting (Melnyk & Fineout-Overholt, 2015). The model begins with identifying a need to make a change, discusses the steps to implement the change, and finally addresses the need for evaluation and future research. Five steps make up the model, including preparation, validation, comparative evaluation/decision making, translation/application, and evaluation (Stetler, 2001). Each of these steps is crucial in applying best practice in the clinical setting, and was used to guide the process of implementing this EBP project. The following section will discuss each step of the Stetler model in detail.

Phase I: Preparation. The preparation phase of the Stetler Model "encourages nurses to be clear about purpose, the context, and the sources of any research evidence" (Schmidt & Brown, 2015, p.441). During this phase, nurses identify the need to make a change and start the process of determining its feasibility. This involves identifying internal and external barriers/influences, identifying key stakeholders, determining measurable outcomes, and searching, sorting and selecting sources of research evidence (Schmidt & Brown, 2015; Stetler, 2001). Nurses want to affirm the nature, degree and priority of the problem and focus on high priority issues (Stetler, 2001). Once the preparation phase has identified a clinical problem, nurses must validate if there is sufficient evidence to support the need to make a change.

Phase II: Validation. The validation phase involves critically analyzing the evidence to determine if it is sufficient and credible to warrant a change in practice (Schmidt & Brown, 2015). During the validation phase, nurses must perform a thorough review of the literature, and determine the quality of the evidence (Schmidt & Brown, 2015). Nurses will critique systematic reviews, rate the level of quality of each evidence source and create an evidence table, determine clinical significance, and eliminate non-credible sources (Stetler, 2001). It is at this

phase that nurses will determine if there is enough high-quality evidence to proceed. If there is no evidence or the evidence is not sufficient and credible, the process ends here (Stetler, 2001).

Phase III: Comparative Evaluation/Decision Making. During the third phase, nurses engage in "labeling, condensing, organizing, and attributing meaning to the assembled evidence" (Schmidt & Brown, 2015, p. 444). The nurse must determine if the evidence is relevant to the clinical problem, population and environment. If so, the evidence collected in the validation phase is evaluated using appraisal tools and grouped according to level of evidence. Pertinent findings are synthesized in order to determine their cumulative results. Nurses evaluate the degree and nature of criteria such as risk, resources and readiness, make a decision whether/what to use and judge the strength of decision. Evidence collected is sorted into classified as (a) not use, (b) to use now, or (c) to consider future use (Stetler, 2001). At this point, the nurse is able to decide whether to use the evidence to guide practice (Stetler, 2001).

Phase IV: Translation/Application. The fourth phase is focused on applying research into the practice setting. This phase is difficult because change, particularly in the healthcare field, is often met with hesitance and resistance. The nurse must consider barriers to change and how to address them. She must also consider how the evidence will be communicated, disseminated and applied in the clinical practice setting (Schmidt & Brown, 2015). During this phase, the process of making a change is developed. Factors such as who will implement the change and what resources will be needed are important. Is adequate financial backing available to support this change? If a nurse will be responsible for implementation will she be compensated? Will the staff respond positively to her? The nurse also must determine how the success of the program will be measured (Schmidt & Brown, 2015).

Phase V: Evaluation. The final phase of the Stetler Model nurses evaluate the outcomes of the practice change and measure its success. Evaluation may be formal or informal, and may be individual or at an organizational level (Stetler, 2001). The evaluation phase assesses the new changes in practice, ensuring goals are met, and monitors for any

adverse effects (Melnyk & Fineout-Overholt, 2015). During this phase, the nurse or the management of the larger organization can determine if change can be expanded into other clinical areas. While the evaluation phase concludes the EBP cycle, as the findings are applied, new gaps in the literature are identified thus beginning a new cycle.

Application of EBP Model to EBP Project

Once a need for asthma self-management in order to improve patient's control and quality of life was established, the process of EBP began. The Stetler Model was used as a guide in the process of designing and planning for the implementation of this EBP project. Each of the five steps, including preparation, validation, comparative evaluation/decision making, translation/application, and evaluation were applied to the project (Stetler, 2001).

During the preparation phase, evidence was collected from the clinical site as well as from the literature identifying a need for change in the clinical setting. A brief review of current evidence showed that 46.9% of people currently living with asthma report having one or more asthma attacks every year, and with nearly 24.6 million people diagnosed with asthma in the United States these numbers identify a need for improved symptom management (CDC, 2018; Coffman, Cabana, Halpin & Yelin, 2008). The purpose of the project was made clear: to examine the literature for the best way to improve asthma management and implement it within the primary care setting. The project manager also spoke with key stakeholders, administrators and healthcare providers to determine the feasibility of implementing a change in practice, as well as provider willingness to implement and continue the intervention after the completion of the project. At the end of phase one, a clinical problem was identified, and a literature search was initiated to search for relevant evidence.

Once the literature search was begun, the validation phase involves appraising the evidence to determine if there is sufficient credible evidence to support a change. During this phase, an exhaustive search of the literature was conducted, and the evidence organized according to level and quality. The comparative evaluation/decision making phase involved

labeling, condensing, organizing, and attributing meaning to the assembled evidence" (Schmidt & Brown, 2015, p. 444). The level of evidence was determined using the Melnyk and Fineout-Overholt "Hierarchy of evidence for intervention questions" also known as the pyramid of evidence (Melnyk and Fineout-Overholt, 2015, p.92). This pyramid determined the level of evidence and therefore the strength of the findings. The quality of the studies was appraised using the John Hopkins Evidence-Based Practice (JHNEBP) tool, which will be discussed at length in a later section (Dearholt & Dang, 2014). The comparative evaluation/decision-making phase demonstrated sufficient evidence to support a change in practice, as well as enough high-quality evidence to proceed with the implementation of the project.

Phase IV involves converting evidence into a plan for bringing about change that is both a fit in the clinical setting, feasible, and aligns with available resources. Once it was determined that asthma self-management through the use of education, action plans, and mobile technology was the best way to improve asthma control, the project manager met with staff at the project site to determine the feasibility of an intervention. A plan was developed to implement this change, including consideration of who will be responsible for communicating, disseminating and applying the evidence (Schmidt & Brown, 2015). Consideration was made to the amount of disruption to office flow, the need for assistance from office staff, the time commitment involved, in order to reduce resistance to change. Once the intervention was designed, the final stage involved the evaluation of the effectiveness of the project.

The evaluation process involved careful analysis of all aspects of the intervention, including asthma control, asthma-related quality of life, and asthma literacy. Evaluation was also done to evaluate patient's opinion and usage of the smartphone mobile app. There was an ongoing process of evaluation, and changes to the intervention were made accordingly. The final evaluation determined the success of the intervention, as well as its ability to meet the goal of improved asthma self-management. Throughout the planning, development, implementation and evaluation of the EBP project, the Stetler Model served as the foundation of the process.

Strengths and Limitations of EBP Model for EBP Project

There are many strengths of the Stetler Model. The model was originally developed in 1976, and since its development has had regular updates to reflect changes in the nursing practice and its emphasis on the importance of evidence-based practice. The steps of the model promote critical thinking and conscious decision-making at every phase. The five steps logically follow the progression of the research/nursing process, and each phase has the opportunity to re-evaluate the process and stop the process if there is not sufficient support. The model encourages ongoing evaluation and promotes further research. The model does focus more on the process of individual change rather than organizational change.

As mentioned above, one of the limitations of the Stetler Model is its emphasis on individual practitioner-led change, rather than change at an organizational level. The model emphasizes that all recommendations are applied at the skilled practitioner level to individual patients or staff (Melnyk & Fineout-Overholt, 2015). Therefore, interventions may be implemented differently depending on the skill level of the practitioner. Additionally, the Stetler Model has grown in complexity with each revision in order to provide more details and guidance to practitioners. While this is with good intention the model has become increasingly complicated to follow for novice practitioners, and the two step model may be overwhelming for some (Melnyk & Fineout-Overholt, 2015)

Literature Search

Sources Examined for Relevant Evidence

An exhaustive search of the literature was performed in order to find the most effective way to improve asthma management. Articles that were included in this project were found after a search of multiple databases was conducted including CINAHL, PubMed, Joanna Briggs Institute EBP database, National Guideline Clearinghouse, Cochrane Library, MEDLINE, and citation chasing. Terms from the PICOT question were included in the searches, as well as terms such as “self-management” and “asthma control,” until a “best search” was reached.

The following search terms and Boolean operators were found to be the most relevant search: “asthma” AND (“manage*” OR “self manage*” OR “action plan”) AND (“adhere*” OR “compliance”). Mesh headings were used in applicable databases for the heading “asthma” as both a major and minor heading. Within the National Guideline Clearinghouse and Joanna Briggs Institute, searches were performed for simply “asthma” due to the smaller number of sources within the databases. Search limiters included Scholarly (Peer Reviewed) Journals; Published Date: 2013 to present; and published in the English language. A five-year search limiter was imposed because high-level evidence such as the Global Initiative for Asthma (2018) and Cochrane Systematic Reviews have published all-encompassing reports from 2016 to present. One article from 2011 was included due to the specific focus on the use of mobile technology, and its lack of inclusion in the sources listed above. Additionally, the US Department of Health and Human Services, National Heart, Lung, and Blood Institute’s *Guidelines for the diagnosis and management of asthma* was included, though it has not been updated since 2007, because of its frequent reference in the literature.

Inclusion criteria included articles that were focused specifically on patients’ self-management abilities within the primary care/outpatient setting. These included studies that discussed asthma action plans, asthma education, and the use of mobile technology to improve asthma control. These studies primarily measured asthma control, asthma-related quality of life, and asthma literacy as their outcomes. Studies were excluded that occurred in the emergency department or inpatient setting. Studies were also excluded that evaluated medication regimes and focused on pharmaceutical asthma management, as the primary focus of this project was improving patients’ ability to manage their condition independently. A detailed discussion of the literature search process is discussed below.

A search of Joanna Briggs Institute using the keywords “asthma management” yielded 27 results. Twenty results were reviewed for inclusion, and two were chosen for inclusion. Next a search was conducted in the National Guideline Clearinghouse. Due to the smaller number of

sources within this website, a search was done for simply “asthma,” which yielded 20 result. Eight sources were relevant and reviewed, and one guideline was chosen for inclusion. A search of CINAHL using both major and minor headings, and the terms (“manage*” OR “self manage*” OR “action plan”) AND (“adhere*” OR “compliance”), produced 120 results, thirty-eight of which were reviewed and one systematic review was ultimately chosen from CINAHL for review and critical appraisal. The same search was done within MEDLINE and produced 393 results, of which twenty-six abstracts were read. Ultimately one randomized controlled trial was selected. The Cochrane library was searched using terms “asthma AND management” resulting in 108 reviews. Sixteen were reviewed and appraised, and two were chosen for inclusion.

Two additional sources were included in the literature review. These included the US Department of Health and Human Services, National Heart, Lung, and Blood Institute *Guidelines for the diagnosis and management of asthma* (HHS, 2007) and the Global Initiative for Asthma: Global strategy for asthma management and prevention (GINA, 2018). Both of these sources are used as a foundation for asthma care and guidelines, and they are referenced frequently in the literature. In total 668 sources were identified, 110 were reviewed, and 9 were included. A summary of the literature search results is presented below in Table 2.1.

Table 2.1

Literature Search Results

Database	Yielded	Duplicates	Reviewed	Accepted
CINAHL	120	6	38	1
MEDLINE	393	18	26	1
National Guideline Clearinghouse (NGC)	20	0	8	1
Joanna Briggs Institute (JBI)	27	0	20	2
Cochrane Library	108	0	16	2
Citation Chasing	0	0	2	2
Total	668	24	110	9

Levels of Evidence

The search for best evidence must include critical appraisal of the level of evidence collected. The sources for this EBP project were evaluated and categorized using the “Hierarchy of Evidence for Intervention/Treatment Questions” also known as “Pyramid of Evidence” (Melnyk & Fineout-Overholt, 2011) This hierarchy of evidence provides information as to the level of evidence included in the study and how it can be applied in order to answer the PICOT question. For an evidence-based practice intervention, systematic reviews and meta-analysis will be the most beneficial as they are considered the strongest level of evidence to guide clinical practice.

The pyramid of evidence has seven levels. As mentioned above the highest level, Level I, includes systematic reviews and meta-analysis of relevant randomized controlled trials, and

evidence-based practice guidelines composed of both systematic reviews and meta-analysis (Melnyk & Fineout-Overholt, 2011). Level I evidence is the most desirable when designing an intervention or guiding a treatment plan. Level II contains evidence from well-designed randomized controlled trials. Level III is evidence from well-designed controlled trials without randomization. Level IV is evidence from well-designed case-control and cohort studies. Level V is evidence from systematic reviews of descriptive and qualitative studies. Level VI is evidence from single descriptive or qualitative studies, and finally Level VII is evidence from the opinion of authorities and/or reports of expert committees (Melnyk & Fineout-Overholt, 2011). Only sources deemed to be level one and two were included in this EBP project.

Appraisal of Relevant Evidence

In addition to appraising the level of evidence, the quality of evidence was also appraised using the John's Hopkins Evidence Based Practice: Research Evidence Appraisal Tool (Dearholt & Dang, 2014). The sources included were given a rating of high (A), good (B), or low quality or major flaws (C)(Table 2.2). A rating of (A) high quality evidence was applied to articles that were consistent, had generalizable results, a sufficient sample size, adequate control, definitive conclusions, and made consistent recommendations based on a comprehensive review of the literature (Dearholt & Dang, 2014). Evidence considered good quality (B) included studies with reasonably consistent results, sufficient sample size for the study design; some control, and fairly definitive conclusions; reasonably consistent recommendations based on fairly comprehensive literature review (Dearholt & Dang, 2014). Evidence considered low quality or major flaws is given a (C) rating. These studies have little evidence with inconsistent results, insufficient sample side for the study design, and do not allow for conclusions to be drawn (Dearholt & Dang, 2014). There were no articles included in this EBP project that were low quality or included major flaws (C). Table 2.2 below provides information on the levels of evidence and quality appraisal of literature included in this review.

Table 2.2

Level and Quality of Evidence

Level	Included	Quality	Study Design
Level I	7	A, A	JBI Evidence Summaries (2)
		A	NGC Guidelines (1)
		B, B, A	Systematic Reviews (3)
		A, B	Organizational Guidelines (2)
Level II	1	A	Randomized Controlled Trial (1)
Level III	0	0	0
Level IV	0	0	0
Level V	0	0	0

Level I: Joanna Briggs Institute. Eight of the nine sources included in the literature review are Level I evidence, meaning they are systematic reviews or evidence-based practice guidelines developed from systematic reviews. The evidence presented in this section includes: two Joanna Briggs Institute (JBI) Evidence Summaries, one guideline from the National Guideline Clearinghouse (NGC), three systematic reviews, the US Department of Health and Human Services, National Heart, Lung, and Blood Institute *Guidelines for the diagnosis and management of asthma* (HHS, 2007), and the Global Initiative for Asthma: Global strategy for asthma management and prevention (GINA, 2018).

The first JBI evidence summary focused on the role of education in asthma self-management and (Gupta, 2016) answered the question “What is the best available evidence regarding the effectiveness of self-management education in patients with asthma?” The

evidence summary is based on a structured search of the literature which included a Cochrane Review of 36 randomized controlled trials (RCTs) involving 45 papers and 6,090 participants, and a second Cochrane Review of 15 RCTs including 19 papers and 2,460 participants (Gupta, 2016). The summary found level one evidence in support of self-management education for adults, as it significantly improved health outcomes (reduced hospitalizations, emergency visits, days lost from work, episodes of nocturnal asthma, and improved quality of life) when compared to usual care, which was typically little to no education (Gupta, 2016). Additionally, self-monitoring, regular review of treatment and asthma symptoms by a healthcare provider, and the use of an asthma action plan were the key to the success of an asthma education program (Gupta, 2016). Based on the information collected from the Cochrane reviews listed above, the author of the evidence summary concluded that self-management education for adults with asthma should involve "self-monitoring, regular medical review, and an individual written or verbal asthma action plan." This evidence summary was rated high quality (A), due to its sufficient sample size and definitive conclusions.

The second evidence summary from JBI asked the clinical question "What educational strategies effectively promote improved knowledge, health and adherence in children and adults with asthma?" (Mann, 2017). This evidence summary is based on a structured search of the literature and included evidence from: two evidence-based guidelines, five RCTs, a Cochrane systematic review of 12 studies involving 2.342 participants, a systematic review including six studies, a Cochrane systematic review with 20 studies and 81,746 participants, and a systematic review of 33 studies (Mann, 2017). One randomized controlled trial within the evidence summary found that self-management can provide beneficial outcomes and reduce emergency department visits, and a second systematic review found that interventions such as skills training, education, and relapse prevention can reduce the use of urgent care facilities among patients with asthma (Blakemore, et al., 2015; Mancuso, et al., 2011)

Based on the evidence from the systematic reviews and RCTs included in the evidence summary, recommendations for best practice were made. Recommendations included tailoring education to each patient using an educational assessment, assessment of asthma (control, severity and quality of life), adjustment of basic treatment, adjustment of action plan, and control of the patient's environment (avoiding triggers or quitting smoking)(Mann, 2017). This evidence summary, as well as the one discussed above, supports the use of education as a tool to improve asthma self-management, thus the inclusion of education as an outcome of the project. This body of evidence was determined to be high quality (A) as well.

Level I: National Guideline Clearinghouse. The Registered Nurses' Association of Ontario (RNAO) published a guideline titled "Adult asthma care: promotion control of asthma." The objectives of the guideline include: to provide nurses and other healthcare providers with evidence-based recommendations of foundational asthma care for adults with asthma, to assist nurses and other healthcare providers help persons with asthma achieve asthma control; thereby minimizing and ideally preventing morbidity and mortality and improving quality of life, and to enhance the quality of nurses' practice pertaining to the assessment and management of adult asthma, ultimately improving clinical and health outcomes through the use of EBP (RNAO, 2017). This publication provided guidelines for asthma assessment, planning, treatment implementation, evaluation and education, as well as guidelines for organizational and policy change related to asthma management (RNAO, 2017).

The guideline development team searched eight databases for guidelines, randomized controlled trials and systematic reviews published between May 2006 and December 2015. Once articles were retrieved, a team of master's prepared nurses independently assessed the eligibility of studies according to exclusion and inclusion criteria (RNAO, 2017). Six guidelines and 88 studies, including RCTs and systematic reviews, were ultimately included in the development of the guideline (RNAO, 2017).

The guideline includes major practice recommendations which include: identifying factors that affect the complexity of asthma management such as age, sex/gender and smoking habits, develop an individualized asthma action plan that addresses asthma education as an essential component of care, and support self-management by collaborating with the patient to develop and review a documented asthma action plan (RNAO, 2017). Patients with uncontrolled asthma should be assessed at every encounter in order to assess any current exacerbations and identify any contributing factors that can be improved as well as develop an individualized, person-centered asthma education plan that addresses learning needs, culture concerns, health literacy and empowerment (RNAO, 2017). Asthma education programs should be multifaceted and reinforce evidence-based asthma care (RNAO, 2017). Providers should incorporate self-management support with adults with uncontrolled asthma through the use of action plans, telehealth or home visits (RNAO, 2017). The guidelines also provide the level of evidence associated with each of the practice recommendations, allowing the reader to determine the strength of he evidence behind the recommendation (RNAO, 2017). This guideline is high quality (A) because it has a sufficient sample size, definitive conclusions and makes recommendations based on a review of the literature.

Level I: Cochrane Library. One of the major components in this EBP project involves the use of a mobile application to assist with symptom tracking and the implementation of a digital asthma action plan. A Cochrane systematic review by Marcano-Belisario, et al., (2013) was conducted with the objective to assess the effectiveness, cost-effectiveness and feasibility of using smartphone and tablet apps to facilitate the self-management of individuals with asthma. The authors included RCTs that compared self-management interventions for patients with clinician diagnosed asthma delivered via smartphone apps to self-management interventions delivered via traditional methods (on paper)(Marcano-Belisario, et al, 2013). The results included two RCTs with a total of 408 participants (Marcano-Belisario, 2013).

The two studies were somewhat different in nature and therefore a meta-analysis was not performed. One study allowed participants to keep daily entries of their asthma symptoms, asthma medication usage, and peak flow readings on their mobile phone, and they were given corresponding recommendations (Marcano-Belisario, 2013). The second study had participants record the same readings twice daily and they received immediate feedback in the form of a three-color traffic light to indicate their level of asthma control (Marcano-Belisario, 2013). Though different, both studies measured asthma symptom scores, asthma-related quality of life, unscheduled visits to the emergency department, and frequency of hospital admissions (Marcano-Belisario, 2013).

One study found that the use of a smartphone app for the delivery of an asthma self-management app had no statistically significant effect on asthma symptom scores (mean difference (MD) 0.01, 95% confidence interval (CI) -0.23 to 0.25), asthma-related quality of life (MD of mean scores 0.02, 95% CI -0.35 to 0.39), unscheduled visits to the emergency department (OR 7.20, 95% CI 0.37 to 140.76), or frequency of hospital admissions (OR 3.07, 95% CI 0.32 to 29.83) (Marcano-Belisario, 2013). The other study, however, found that the use of a smartphone app did result in high asthma-related quality of life at 6-month follow up (MD 5.50, 95% CI 1.48 to 9.52 for the physical component score of the SF-12 questionnaire; MD 6.00, 95% CI 2.51 to 9.49 for the mental component score of the SF-12 questionnaire), improved lung function at four (MD 27.80, 95% CI 4.51 to 51.09), five (MD 31.40, 95% CI 8.51 to 54.29) and six month (MD 39.20, 95% CI 16.58 to 61.82), and reduced visits to the emergency department due to asthma-related complications (Marcano-Belisario, 2013).

The current evidence from the two studies within this systematic review is not sufficient to advise clinical practitioners with regard to the use of smartphone applications for asthma management (Marcano-Belisario, 2013). Due to the considerable difference in the two studies included, authors were unable to obtain conclusive answers about the benefits of a mobile application. While further research is needed, one study did show that the use of a smartphone

app can result in better asthma-related quality of life and lung function, and reduced visits to the emergency department (Marcano-Belisario, 2013). However, the other study failed to show any significant improvement. This systematic review would be considered good quality (B), since the study was unable to produce definitive, generalizable results. The study did have a sufficient sample size, some control, and a comprehensive literature review (Marcano-Belisario, 2013).

The second Cochrane Library systematic review included in the literature search examines the role of written asthma action plans in asthma self-management (Gatheral et al., 2017) As previously discussed, the aim of asthma care is to empower patients, or their parents, to take control of his or her own condition through encouraging self-management (Gatheral et al., 2017). A personalized asthma action plan is a written plan designed to help patients maintain asthma control and/or regain control after an exacerbation (Gatheral et al., 2017). The study by Gatheral et al (2017) analyzed fifteen studies described in 27 articles, regarding the effectiveness of personalized asthma action plan. These 15 studies randomized a total of 3,062 participants. The authors included parallel randomized controlled trials, both blinded and unblended, that evaluate written action plans in adults with asthma (Gatheral et al., 2017).

The studies included compared the use of an action plan alone versus no action plan, and an action plan plus education versus education alone (Gatheral et al., 2017). The primary outcomes were the number of participants reporting at least one exacerbation requiring an emergency department visit or hospitalization and asthma symptom scores using a validated scale (Gatheral et al., 2017). Secondary outcomes were quality of life measured on a validated scale, number of participants reporting at least one exacerbation requiring the use of corticosteroids, respiratory function, and days lost from work or school (Gatheral et al., 2017).

The results found that there was no clear benefit or harm associated with action plans in terms of the number of patients requiring an emergency department visit or hospitalization for acute exacerbation (OR 0.75, 95% CI) 0.5 to 1.24; 1385 participants; five studies; low-quality evidence), change from baseline in asthma symptoms (mean difference (MD) -0.16, 95% CI -

0.25 to - 0.07; 141 participants; one study; low-quality evidence) or the number of serious adverse events, including death (OR 3.26, 95% CI 0.33 to 32.21; 125 participants; one study; very low-quality evidence). Data revealed a statistically significant improvement in quality of life scores for those utilizing an action plan compared with no action plan (MD 0.18, 95% CI 0.05 to 0.30; 441 participants; three studies; low-quality evidence). In one study, asthma action plans were associated with significantly fewer days lost from work or study (MD -6.20, 95% CI -7.32 to - 5.08; 74 participants; low-quality evidence) (Gatheral et al., 2017). Overall, the quality of the evidence in this study was moderate and therefore the appraisal rating is good (B).

Level I: CINAHL Systematic Review: A systematic review by Hui et al. (2017) looked at the use of smart phone/mobile applications in asthma management. The aim of this systematic review was to identify which information and communication technology features implemented in mobile apps to support asthma self-management are associated with adoption, adherence to usage, and clinical effectiveness (Hui et al., 2017). Therefore, this article assessed the clinical effectiveness of available mobile applications, characterized the features of the interventions and associated outcomes, and assessed the adoption and adherence to usage (Hui et al., 2017). The purpose of this study was to "identify which information and communication technology features implemented in mobile apps to support asthma self-management are associated with adoption, adherence to usage, and clinical effectiveness" (Hui et al., 2017, p. 619).

Authors of this review systematically searched 9 databases, scanned reference lists, and undertook manual searches for studies from January 2000 to April 2016 (Hui et al., 2017). The review included randomized controlled trials and quasi-experimental studies with adult participants (Hui et al., 2017**).** All eligible papers were assessed for quality, and the authors extracted data on the features included, health-related outcomes (asthma control, exacerbation rate), process/intermediate outcomes (adherence to monitoring or treatment, self-efficacy), and

level of adoption of and adherence to use of technology. Meta-analysis and narrative synthesis were used (Hui et al., 2017**)**

The systematic review included 12 RCTs employing a range of technologies. A meta-analysis (*n* = 3) showed improved asthma control (MD -0.25 [95% CI, -0.37 to -0.12]). The studies incorporated 10 features grouped into 7 categories, including: education, monitoring/electronic diary, action plans, medication reminders/prompts, facilitating professional support, raising patient awareness of asthma control, and decision support for professionals. The most successful interventions included multiple features, but effects on health-related outcomes were inconsistent. A meta-analysis of data from 3 trials showed improved asthma control, though overall the clinical effectiveness of apps, typically incorporating multiple features, varied. Further studies are needed to identify the features that are associated with adoption of and adherence to use of the mobile app and those that improve health outcomes (Hui et al., 2017). This systematic review met the criteria for high quality (A).

Level I: Global Initiative for Asthma. In 1993, the National Heart, Lung, and Blood Institute collaborated with the World Health Organization to convene a workshop that led to a Workshop Report titled Global Strategy for Asthma Management and Prevention. This led to the establishment of the Global Initiative for Asthma (GINA), a network of individuals, organizations, and public health officials coming together to disseminate information about the care of patients with asthma, and to provide a mechanism to translate scientific evidence into improved asthma care. The GINA report “Global Strategy for Asthma Management and Prevention” has been updated annually since 2002. The GINA report was recently updated in 2018, and includes evidence collected via a rolling PubMed search over the last eighteen months using filters established by the committee (GINA, 2018). The GINA guidelines are mentioned frequently within the literature, and are therefore important to include within the literature search.

GINA guidelines state that the essential components of effective guided asthma self-management include: self-monitoring of symptoms and/or peak flow, a written asthma action

plan to show how to recognize and respond to worsening asthma, and regular review of asthma control, treatment and skills by a health care provider (GINA, 2018). Self-management education that includes these components dramatically reduces asthma morbidity in both adults and children (GINA, 2018). Benefits include a one-third to two-thirds reduction in asthma-related hospitalizations, emergency department visits and unscheduled doctor or clinic visits, missed work/school days, and nocturnal wakening (GINA, 2018). It has been estimated that the implementation of a self-management program in 20 patients prevents one hospitalization, and successful completion of such a program by 8 patients prevents one emergency department visit (GINA, 2018). Less intensive interventions that involve self-management education but not a written action plan are less effective and information alone is ineffective (GINA, 2018).

A systematic meta-review of 270 RCTs on supported self- management for asthma confirmed that it reduces unscheduled healthcare use, improves asthma control, is applicable to a wide range of target groups and clinical settings, and does not increase health care costs (GINA, 2018). The GINA guidelines are high quality evidence (A). The guidelines were developed after an extensive literature search, produced generalizable results, included a sufficient sample size, drew definitive conclusions, and made consistent recommendations based on a comprehensive review of the literature. These guidelines are used in the clinical setting to guide current practice.

Level I: National Heart, Lung, and Blood Institute (NHLBI). The US Department of Health and Human Services, National Heart, Lung, and Blood Institute's *Guidelines for the diagnosis and management of asthma: Expert panel report 3,* though now ten years old, is a valuable piece of evidence when discussing asthma management (HHS, 2007).

An expert panel commissioned by the National Asthma Education and Prevention Program (NAEPP), and coordinated by the National Heart, Lung, and Blood Institute (NHLBI) of the National Institutes of Health developed this guideline. Using the previous guidelines, developed in 1997 and 2004, as the framework, the expert panel organized the literature review

and final guidelines report around four essential components of asthma care, namely: assessment and monitoring, patient education, control of factors contributing to asthma severity, and pharmacologic treatment. Subtopics were developed for each of these four broad categories. The literature review process for this guideline was exhaustive. In three cycles over an 18-month period the total number of titles screened by reviewers was 15,444 (HHS, 2007). The number of abstracts and articles reviewed for all three cycles was 4,747. Of these abstracts, 2,122 were advanced for full-text review, which resulted in 1,654 articles serving as a bibliography of references used to update the guidelines, available on the NHLBI Web site (HHS, 2007).

While the NHLBI guidelines are extremely lengthy (over 400 pages) and somewhat overwhelming to sort through, they provide valuable evidence regarding asthma self-management. The effectiveness of written asthma action plans has been addressed in several systematic reviews and in five individual studies within the guidelines. A systematic review of 36 RCTs showed that self-management education that included self-monitoring by either peak flow or symptoms, coupled with regular medical review and a written asthma action plan, reduced hospitalizations, urgent care visits, ED visits, work absences, and nocturnal asthma in adults (HHS, 2007). The self-management action plan significantly improved self- perceived asthma control, confidence (self-efficacy) for self-management, and self-treatment and self-management behavior during an asthma exacerbation.

Another RCT provided education for all patients during ED visits for asthma exacerbations and randomly assigned patients to three study arms: no written plan, a symptom-based written plan, and a peak flow-based written plan. Over the 6-month follow-up period, all groups improved their asthma control, but patients who received a peak flow-based written plan had significantly (p = .002) fewer urgent care visits (5 for 46 patients) compared with patients who received a symptom-based plan (45 visits for 48 patients) or no written plan (55 visits for 48 patients). A case-control study by compared patients who died from exacerbation of asthma

with controls who had severe asthma exacerbations successfully treated in the ED. After adjustment for demographic, psychosocial, and disease severity factors, having a written asthma action plan at the time of the exacerbation was significantly associated with a 70 percent reduction in the risk of death (*RR* = .29 [.09, .93]). Although the results of these studies are mixed, they suggest that the use of written plans may help patients improve control of their asthma, particularly in preventing or managing asthma exacerbations (HHS, 2007). While the NHLBI guidelines meet the criteria for high quality evidence, their lack of update over the last ten years, and therefore lack of inclusion of technology aspects reduces their appraisal to good quality (B).

Level Two. The final source of evidence included in the literature review is a randomized controlled trial that was designed with the goal of determining whether web-based technologies can improve asthma self-management (Ahmed, et al., 2016). My Asthma Portal (MAP) is a web-based self-management support system that couples evidence-based behavioral change components (self-monitoring of symptoms, physical activity, and medication adherence) with real-time monitoring, feedback, and support from a nurse case manager (Ahmed et al., 2016). The aim of this study was to compare the impact of access to a Web-based asthma self-management patient portal linked to a case-management system (MAP) over 6 months compared with usual care on asthma control and quality of life (Ahmed et al., 2016).

A total of 100 patients were included in this RCT, 49 individuals were randomized to MAP and 51 to usual care. Patients were eligible if they were between 18 and 69 years old, had a physician diagnosis of asthma, were prescribed at least one controlled medication, classified as having poor asthma control at the time of recruitment, had access to the internet, reported smoking < 20 years, and were fluent in English or French (Ahmed et al., 2016). Compared with usual care, participants in the intervention group reported significantly higher asthma quality of life (mean change 0.61, 95% CI 0.03 to 1.19), and the change in asthma quality of life for the intervention group between baseline and 3 months (mean change 0.66, 95% CI 0.35 to 0.98)

was not seen in the control group. No significant differences in asthma quality of life were found between the intervention and control groups at 6 (mean change 0.46, 95% CI -0.12 to 1.05) and 9 months (mean change 0.39, 95% CI -0.2 to 0.98). This study supported the use of MAP to enhance asthma quality of life (Ahmed et al., 2016). Implementation of MAP beyond 6 months with tailored protocols for monitoring symptoms and health behaviors as individuals' knowledge and self-management skills improve may result in long-term gains in asthma control. This study was high quality (A) because it made definitive conclusions, and though small, was generalizable to the larger population. Table 2.3 below provides a detailed summary of all evidence included in this project

Table 2.3

Evidence Summary

Citation	Purpose	Design & Intervention	Sample	Results	Level and Quality
Ahmed, S., Ernst, P., Bartlett, S. J., Valois, M., Zaihra, T., Paré, G., & Tamblyn, R. (2016). The effectiveness of web-based asthma self-management system, my asthma portal (MAP): A Pilot Randomized Controlled Trial. *Journal Of Medical Internet Research*, *18*(12), 313.	The aim of this study was to compare the impact of access to a Web-based asthma self-management patient portal linked to a case-management system (MAP) over 6 months compared with usual care on asthma control and quality of life	Randomized controlled trial	A total of 100 patients were included in the study. 49 individuals were randomized to MAP and 51 to usual care.	Participants in the intervention group reported significantly higher asthma quality of life (mean change 0.61, 95% CI 0.03 to 1.19), and the change in asthma quality of life for the intervention group between baseline and 3 months (mean change 0.66, 95% CI 0.35 to 0.98) was not seen in the control group. No significant differences in asthma quality of life were found between the intervention and control groups at 6 (mean change 0.46, 95% CI -0.12 to 1.05) and 9 months (mean change 0.39, 95% CI -0.2 to 0.98). This study supported the use of MAP to enhance asthma quality of life.	Level II, A
Gatheral T.L, Rushton, A., Evans, D.J.W., Mulvaney, C.A. Halcovitch, N.R., Whiteley, G., Eccles, F.J.R., & Spencer, S. (2017). Personalized asthma action plans for adults with asthma. Cochrane Database of Systematic Reviews, 4. doi: 10.1002/14651858.CD011859.pub2.	To evaluate the effectiveness or action plans used alone or in combination with education, for patient-reported outcomes, resource use and safety among adult patients	Cochrane Library systematic review	Analyzed fifteen studies described in 27 articles, regarding the effectiveness of personalized asthma action plan. These 15 studies randomized a total of 3,062 participants. The authors included parallel randomized controlled trials,	The results found that there was no clear benefit or harm associated with action plans in terms of the number of patients requiring an emergency department visit or hospitalization for acute exacerbation (odds ratio (OR) 0.75, 95% CI) 0.5 to 1.24; 1385 participants; five studies; low-quality evidence), change from baseline in asthma symptoms (mean difference (MD) -0.16, 95% CI -0.25 to - 0.07; 141 participants; one study; low-quality evidence) or the number of serious adverse events, including death (OR 3.26, 95% CI 0.33 to 32.21; 125 participants; one study; very low-quality evidence). Data revealed a statistically	Level I, B

			both blinded and unblended, that evaluate written action plans in adults with asthma	significant improvement in quality of life scores for those utilizing an action plan compared with no action plan (MD 0.18, 95% CI 0.05 to 0.30; 441 participants; three studies; low-quality evidence). In one study, asthma action plans were associated with significantly fewer days lost from work or study (MD -6.20, 95% CI -7.32 to - 5.08; 74 participants; low-quality evidence)	
Global Initiative for Asthma. (2018). Global strategy for asthma management and prevention. Retrieved from: www.ginasthma.org	Updated to reflect new evidence about asthma and its treatment, and also integrate evidence into strategies that would be both clinically relevant and feasible for implementation into busy clinical practice, and present recommendations in a user friendly way with extensive use of summary tables and flow-charts	Organizational Guideline (Systematic review)	The literature searches for 'clinical trial' publication types and meta-analyses identified a total of 424 publications, of which 324 were screened out for relevance and/or quality. The remaining 100 publications were reviewed by at least two committee members, and 61 were subsequently discussed at a face-to- face meeting (35 'clinical trials' and 26 meta-analyses).	The 2018 update of the Global Strategy for Asthma Management and Prevention incorporates new scientific information about asthma based on a review of recent scientific literature by an international panel of experts on the GINA Science Committee. This comprehensive and practical resource about one of the most common chronic lung diseases worldwide contains extensive citations from the scientific literature and forms the basis for other GINA documents and programs.	Level I, A
Gupta, A. (2016). Evidence Summary. Asthma: Self Management Education	To answer the question: "what is the best available evidence regarding	JBI Evidence Summary	Cochrane Review of 36 randomized controlled trials (RCTs) involving 45	Best practice recommendation: self-management education for adults with asthma should involve "self-monitoring, regular medical review, and an individual written or verbal	Level I, A

(Adults). The Joanna Briggs Institute.	the effectiveness of self-management education in patients with asthma?"		papers and 6,090 participants Cochrane Review of 15 RCTs including 19 papers and 2,460 participants	asthma action plan."	
Hui, C.Y., Walton, R., McKinstry, B., Jackson, T., Parker, R., Pinnock. (2017). The use of mobile applications to support self-management for people with asthma: a systematic review of controlled studies to identify features associated with clinical effectiveness and adherence. Journal Of The American Medical Informatics Association, *24(3), 619-632*. doi:10.1093/jamia/ocw143	The aim of this systematic review was to identify which information and communication technology features implemented in mobile apps to support asthma self-management are associated with adoption, adherence to usage, and clinical effectiveness	Systematic review of randomized controlled trials (RCTs) and quasi-experimental studies with adults Of the twelve Interventions, three were mobile phone apps, four were web applications, three SMS, one electronic inhaler reminder system connected with web application, and one used a customized asthma	The numbers of participants ranged from 16-300, and were recruited from primary/secondary care with mild/moderate asthma. Most studies included teenagers/adults, 6 interventions required owning a mobile phone	A meta-analysis (n=3) showed improved asthma control (mean different -0.25 (95% CI -0.37 to -0.12). Studies incorporated 10 features grouped into 7 categories (education, monitoring/diary, action plans medication/prompts, facilitating professional support, raising patient awareness of asthma, and decision support for professional). The most successful interventions included multiple features	Level I, A

		monitoring system			
Mann, E. (2017). Evidence Summary. Asthma: Therapeutic Education. Joanna Briggs Institute.	To answer the question "What educational strategies effectively promote improved knowledge, health and adherence in children and adults with asthma?"	JBI Evidence Summary	Two evidence-based guidelines, five RCTs, a Cochrane systematic review of 12 studies involving 2.342 participants, a systematic review including six studies, a Cochrane systematic review with 20 studies and 81,746 participants, and a systematic review of 33 studies	Best practice recommendation: included tailoring education to each patient using an educational assessment, assessment of asthma (control, severity and quality of life), adjustment of basic treatment, adjustment of action plan, and control of the patient's environment (avoiding triggers or quitting smoking)	Level I, A
Marcano-Belisario, J.S., Huckvale K., Greenfield, G., Car, & J., Gunn, L.H. (2013). Smartphone and tablet self-management apps for asthma. *Cochrane Database of Systematic Reviews*, 11. doi: 10.1002/14651858.CD010013.pub2	To assess the effectiveness, cost-effectiveness and feasibility of using smartphone and tablet apps to facilitate the self-management of individuals with asthma.	Cochrane Library systematic review Liu (2011) evaluated the effect of an interactive mobile phone-based asthma self-management system, which allowed patients to	408 participants with poorly controlled asthma based on criteria from the American Thoracic Society or the Asthma Control Questionnaire, from two randomized controlled trials 120 adults patients greater than18 years old (Liu, 2011)	One study found no statistically significant effect on asthma symptom scores (mean difference (MD) 0.01, 95% confidence interval (CI) -0.23 to 0.25), asthma-related quality of life (MD of mean scores 0.02, 95% CI -0.35 to 0.39), unscheduled visits to the ED (OR 7.20, 95% CI 0.37 to 140.76), or frequency of hospital admissions (OR 3.07, 95% CI 0.32 to 29.83) The other study found that the use of a smartphone app did result in high asthma-related quality of life at 6-month follow up (MD 5.50, 95% CI 1.48 to 9.52 for the physical component score of the SF-12 questionnaire; MD 6.00, 95% CI 2.51 to 9.49 for the mental	Level I, A

		keep daily entries of symptoms, mediations, and peak flow readings. In Ryan (2012) intervention group participants were asked to record asthma symptoms twice daily, as well as asthma medication use and peak flow readings using a smartphone app.	208 patients greater than 12 years old (Ryan, 2012)	component score of the SF-12 questionnaire), improved lung function at four (MD 27.80, 95% CI 4.51 to 51.09), five (MD 31.40, 95% CI 8.51 to 54.29) and six month (MD 39.20, 95% CI 16.58 to 61.82), and reduced visits to the emergency department due to asthma-related complications.	
Registered Nurses' Association of Ontario. (2017). Adults asthma care: promoting control of asthma, second edition. Retrieved from https://www.ahrq.gov/gam/index.html	To provide nurses and other healthcare providers with evidence-based recommendations of foundational asthma care for adults with asthma To assist nurses and other healthcare providers help persons with asthma achieve asthma control; thereby	National Guideline Clearinghouse guideline	Six guidelines and 88 studies, including RCTs and systematic reviews, were ultimately included in the development	Provided guidelines for asthma assessment, planning, treatment implementation, evaluation and education, as well as guidelines for organizational and policy change related to asthma management.	Level I, A

	minimizing and ideally preventing morbidity and mortality and improving quality of life. To enhance the quality of nurses' practice pertaining to the assessment and management of adult asthma, ultimately improving clinical and health outcomes through the use of EBP.				
US Department of Health and Human Services, National Heart, Lung, and Blood Institute. (2007). Guidelines for the diagnosis and management of asthma: Expert panel report 3. Retrieved from https://www.nhlbi.nih.gov/sites/default/files/media/docs/asthgdln_1.pdf	Reflects the latest scientific advances in asthma drawn from a systematic review of the published medical literature by an NAEPP-convened expert panel. It describes a range of generally accepted best-practice approaches for making clinical decisions about asthma care.	Organizational Guideline (Systematic review)	In three cycles over an 18-month period the total number of titles screened by reviewers was 15,444 (NHLBI, 2007). The number of abstracts and articles reviewed for all three cycles was 4,747. Of these abstracts, 2,122 were advanced for full-text review, which resulted in 1,654.	Guideline provides extensive recommendations for practice based on exhaustive search of the literature and current professional recommendations (Various studies discussed above).	Level I, B

Construction of Evidence-based Practice

Synthesis of Critically Appraised Literature

A thorough review of the literature provided an in-depth look at the number of patients suffering from uncontrolled asthma symptoms, and the negative impact that uncontrolled asthma has on both overall health and asthma-related quality of life. The recurring themes throughout the literature all discuss the importance of self-management as way to improve asthma control and quality of life. The exhaustive literature search done by GINA to produce their yearly guideline update states that the essential components of effective guided asthma self-management include self-monitoring of symptoms and/or peak flow, a written asthma action plan to show how to recognize and respond to worsening asthma, and regular review of asthma control, treatment and skills by a health care provider (GINA, 2018). Common themes found in the literature review discussed above were similar. Recently, technology has been studied in the research is order to evaluate the potential role and effectiveness of using smartphone applications as a component of self-management (Marcano-Belisario, 2013). The majority of interventions agreed on the importance of one or all of these components of asthma management, and all of them have shown to be beneficial in managing asthma.

Self-monitoring can be done using either a written asthma journal or via smartphone app. New evidence is emerging that demonstrates potential benefits of using mobile technology to improve symptom management (Marcano-Belisario, 2013). This is a new area of research, and likely will be a topic for future research. It has been recommended by several evidence summaries (Gupta, 2016) and guidelines (GINA, 2018; HHS, 2007) that asthma action plans are an essential component of asthma self-management, but the idea that this action plan may be digital, rather than written on paper, is a newer concept. Since the role of technology is asthma is fairly new, it is important to consider the future implications for incorporating technology into asthma management. Therefore, this project evaluated the effectiveness of using a smartphone app, and a digital action plan in place of a written one, as a component of self-management.

Overall, the evidence concludes that the key to successful self-monitoring includes asthma-based education, regular review of treatment and asthma symptoms by a healthcare provider, and the use of an asthma action plan (Gupta, 2016). Smartphone applications may be beneficial in aiding in symptom tracking, as well as improve the use of the asthma action plan due to the convenience (Marcano-Belisario, 2013). While most of the literature agreed on the best ways to promote and encourage asthma self-management, the fact remains that these things are not being done with patients and it is resulting in uncontrolled symptoms requiring excessive use of urgent cares and emergency rooms.

Best Practice Model Recommendation

The best practice model recommendation developed for this EBP project was created based on a thorough review and appraisal of the highest, most relevant evidence available. Based on the evidence, the project manager spoke with the clinical site staff in order to develop an appropriate way to introduce asthma-related EBP into the clinical setting. From this conversation, an intervention was developed that incorporated each aspect of asthma self-management including asthma education, symptom tracking, and a digital asthma action plan. The project manager will provide one-on-one asthma-focused education with the patient following their regularly scheduled office visits, discussing medications, allergy triggers, proper inhaler usage, and overall understanding of asthma. She will then introduce a free mobile smartphone app that will allow patients to track and record symptoms, set up reminders for maintenance medications, and input their daily and rescue medications in order to create a digital asthma action plan similar to a written action plan. The project manager will encourage patients to track their symptoms at least once daily, utilize their digital action plan when needed, and use the smartphone application to have focused conversations with their healthcare providers about any potential problems with their asthma control. This will ideally improve patient's overall asthma control, asthma-related quality of life, and asthma literacy. This

intervention can therefore help to address the lack of self-management that is resulting in so many asthma exacerbations and urgent care visits.

How the Best Practice Model will Answer the Clinical Question

The PICOT question addressed was “How effective is an intervention that includes education and self-management using digital asthma action plans and symptom tracking via mobile application, compared to the current standard of practice in improving quality of life and asthma control over an eight week period?” The best practice model will evaluate if this multifaceted asthma self-management intervention can improve patients overall asthma control, asthma-related quality of life, and asthma literacy when compared to the current standard of care (no education or action plans). By introducing education, action plans, proper inhaler technique, and asthma symptom tracking, patients can feel in control of managing their asthma and be less likely to require treatment in a higher level of care. Using the Stetler Model to assess and evaluate the intervention throughout the process will ensure that the EBP process is being followed. By measuring each of these outcomes pre/post intervention, the results will ideally demonstrate positive outcomes and therefore the need for a change in practice within the clinical setting based on the intervention developed.

CHAPTER 3

IMPLEMENTATION OF PRACTICE CHANGE

In order to improve asthma self-management and control among patients, an intervention was designed by the project manager in collaboration with clinical site management and healthcare providers. The intervention was multifaceted and consisted of two components. The first component included a 30-minute one-on-one asthma education session utilizing a patient education guide published by the CHEST foundation, titled “Living Well with Asthma.” This education guide was provided to the patient at no cost, and addressed the following topics: describing the disease-process of asthma and how it impacts the body; identifying asthma triggers and solutions; following an asthma action plan, understanding asthma medications, inhalers and peak flow meters; and determining what to do during an asthma attack. The goal of the education guide was to help patients understand how to control and/or reduce asthma symptoms in order to reduce asthma’s effects on day-to-day living. The project manager reviewed the booklet with the patient at length, promoting discussion and review of any questions the patient may have.

The second portion of the intervention included the introduction and download of a free mobile smartphone application, AsthmaMD®, which can be used for both asthma self-management and the use of a digital asthma action plan. Detailed information and images of mobile application screens are provided (Appendix A). Patients were instructed on the features of the mobile application, including symptom tracking, medication reminders, and a personalized digital asthma action plan for use in the event of worsening asthma symptoms. The goal of this EBP intervention was to implement an educational session coupled with the use of a mobile smartphone application in order to improve asthma management within the selected population.

Three primary outcomes were measured: asthma control, asthma-related quality of life, and asthma literacy. The clinical site used for implementation of this project did not have any formal education program or handouts for patients with asthma. Clinicians at the site did not

have any type of structured discussion of symptom tracking, nor did they create action plans for their patients with asthma. Therefore, a secondary objective of this project was to implement an intervention that clinicians within the office could continue to utilize with their patients after the completion of this project. Additionally, at the completion of the eight-week intervention, a survey was completed by the patient to measure how many times the mobile application was used, and whether the patient thought this was a beneficial component to asthma management. This secondary outcome measure allowed the project manager to evaluate the utility of using a mobile application in future clinical practice.

Participants and Setting

Implementation of the project occurred at a family practice office located in Porter County, Indiana. This office is part of a larger health care organization that has several area hospitals and outpatient facilities. In addition to the family practice office, the building also contains outpatient services such as laboratory, imaging, and physical therapy. The practice employs two full-time providers, one physician and one nurse practitioner. The physician is a board-certified Doctor of Osteopathic Medicine, with seven years of experience specializing in family medicine. The nurse practitioner in the office is a board-certified family nurse practitioner with three years of experience working in the primary care setting. The nurse practitioner is a Doctor of Nursing Practice (DNP). The two have worked together in collaboration for three years in the family practice setting.

The providers in the office serve as the primary care providers to the patients that they see, and they manage a variety of both acute and chronic health conditions. On average, the providers each see approximately 13-20 patients per day, for a combined total of 26-40 patients in the office per day when both providers are present (Mondays, Tuesdays, and Thursdays). The nurse practitioner and physician each work four days per week, therefore at least one provider is present in the office Monday-Friday from approximately 8am to 5pm. Providers alternate days off on Wednesdays and Fridays, therefore there is only one provider present in

the office on those days. The providers have a shared office space, with shared front desk and clinical support staff. The office space contains five examination rooms, two of which are used by each provider. One examination room holds the refrigerator containing vaccinations and is therefore not used for patient visits. This room contained ample space for the project manager to conduct the intervention and was always available for use. There was always a designated education room to conduct the intervention, and the completion of the project did not impede the flow of patients in the office.

Patients are shared between the two providers, with the physician seeing each patient a minimum of once per year for a wellness visit. While patients may prefer to see either the NP or the physician, all patients in the office are able to see either provider. Many patients alternate between the providers, depending on who is available when they need to be seen. The physician and NP have a shared personal office, with both desks being in the same room. Therefore, there is open discussion and dialogue about patient care and treatment plans between the two providers. Electronic charts are shared between providers.

The providers in the office manage patients of all ages, including children immediately after birth. Children, however, were excluded from this project because they are generally referred to a pediatric asthma specialist for diagnosis and treatment of asthma. The pediatric asthma specialist also provides education and action plans; thus, the providers in the office are not directly responsible for managing pediatric asthma.

Therefore, the participants in this project were adult patients over 18 years of age. Since patients are shared between the NP and physician, there was no restriction on which patients could participate. The intervention is based on evidence that supports the importance of clinic-based education (HHS, 2007) as well as evidence that the use of mobile apps is effective in improving asthma self-management (Marcano-Belisario et al., 2013). In order to be considered for participation, patients had to have a diagnosis of asthma, and have been prescribed medication for asthma within the last 12 months. Participants were asked about their asthma

diagnosis and whether it was recent, whether they were currently using any medications for asthma, and whether they felt like they had ongoing issues with asthma. This clarification was made in order to prevent the inclusion of patients who may have been either erroneously diagnosed with asthma many years ago or as a child, or who do not currently utilize any form of asthma treatment. Patients who have asthma listed as a diagnosis in their medical charts, but denied ever being diagnosed with asthma were excluded and encouraged to have further discussion with their primary care provider. Additional inclusion criteria included English speaking and in possession of and able to use a smartphone. Exclusion criteria included pregnant women and those diagnosed with dementia or significant cognitive impairment that would prevent the patient from accurately tracking symptoms or independently managing their health conditions.

Outcomes

Three primary outcomes were measured throughout the course of this EBP project. These include patient-reported asthma control, patient-reported asthma-related quality of life, and patient-reported asthma literacy. Each of these outcomes was targeted by the intervention. Surveys measuring each of these outcomes were given to patients prior to intervention, again at four weeks post-intervention and one final time at eight weeks post-intervention. Each of these outcomes will be discussed in detail in the following sections. Additionally, one secondary outcome was measured as well. At the completion of the eight-week follow-up, patients will be asked three questions in order to evaluate their perception of the benefit of the mobile app (Appendix B), including if the mobile application was helpful, if they will continue to use it, and how many times per week they accessed the app. This is not a direct outcome of the intervention and therefore not considered a primary outcome, however patients use of the mobile application is important in determining future clinical implications.

Asthma control was measured using the Asthma Control Test (ACT). The ACT is a self-administered questionnaire that asks five questions about patients' overall control of their

asthma symptoms. Each question has five possible options, rated on a Likert Scale with the responses ranging from one (reflecting poor control) to five (reflecting good control) points each. Questions address the amount of time that asthma hinders daily productivity, how often patients experience shortness of breath, how often patients experience nocturnal symptoms or interference with sleep, how often rescue inhalers or nebulizers are required and an overall rating of asthma control. Scores range from 5 to 25, with a score of 19 of less indicating that the patient may have uncontrolled asthma. The recall period for this questionnaire is four weeks.

Asthma-related quality of life was measured using the Asthma Impact Survey (AIS-6). The AIS-6 is a brief 6-item asthma-specific quality of life instrument intended to measure the impact asthma has on the patient's life. This instrument measures how much and how often asthma interferes with or limits participation in daily activities, and it also measures feelings of frustration related to asthma. An example of one of the questions in the survey is "In the past 4 weeks, how much did your asthma limit your usual activities or enjoyment of everyday life?" The five response categories range from "not at all" to "extremely." Two items assess how often asthma has left the patient frustrated or tired. Three items assess the functional aspect of asthma by asking how often the patient has limited physical activity, socialization, or work. This survey is approved for patients 18 years and old, and also utilizes a four week recall period.

The literature supports the use of education to help improve asthma management (HHS 2007). Based on Orem's Self Care Theory, patients who are knowledgeable about their disease process and management steps should be able to provide appropriate self-care. The goal of the final phase of the Self Care Theory is to meet the unmet self-care demands and help the patient develop improved self-care agency (Orem, 2001). This project met that goal by helping patients learn to self-manage their asthma symptoms, therefore improving their self-care agency until it exceeds their self-care demand and removes the self-care deficit. Orem suggests achieving this through guiding, directing and supporting patients, stimulating patients' interest in self-care, assisting patients to monitor themselves to determine if self-care is effective, and promoting

daily living routines that support the integration of self-care (Orem, 2001). In order to accomplish this, patients participated in an educational intervention related to asthma and its impact on the body, in order to fully understand the importance of self-management and proper asthma control.

To address the direct impact of the educational component of the EBP project, the third and final primary outcome measured was asthma literacy (Appendix C). This was measured using four items developed by the project manager, in order to evaluate the effectiveness of the educational portion of the intervention. The responses were presented on a Likert Scale from "0- no confidence" to 3- high confidence" and stated:

1. I know what asthma is and could explain it to someone else.
    0- No confidence
    1- Slight confidence
    2- Moderate confidence
    3- High confidence
2. I know how to use my metered dose inhaler and nebulizer machine (if applicable).
3. I know what triggers my asthma symptoms.
4. I know what do when I start to experience asthma symptoms.

The patient completed this literacy survey immediately prior to the intervention. It was then reviewed by the project manager and used to help guide the educational session of the intervention. The survey was completed again, along with the other two outcome measures, four-weeks and eight-weeks after the completion of the intervention

Additionally, one secondary outcome was measured. This secondary outcome measure will allow the project manager to evaluate whether patients used the mobile application, if patients felt that the application was beneficial in improving their asthma self-management, and if patients would continue to use the mobile application in the future. While this outcome is not a

direct measure of the success of the intervention, it is important in order to evaluate if improved asthma outcomes were directly related to mobile application usage. This information can be used to make recommendations for future research as well as to guide future clinical practice guidelines and recommendations for asthma self-management strategies.

Evaluation of Mobile Application Use

1. Do you feel that the mobile application was helpful in keeping track of your asthma symptoms??
    a. Yes
    b. No
    c. Unsure
2. Do you think you will continue to utilize the mobile application in the future to manage your asthma symptoms?
    a. Yes
    b. No
    c. Unsure
3. How many times per week did you log your symptoms on the mobile application?
    a. 0-2 times per week
    b. 3-5 times per week
    c. 6-7 times per week

This survey will be completed only once, in conjunction with the eight-week post-intervention follow-up surveys. Patients will receive this survey in their folder along with the ACT, AIS-6 and Asthma Literacy Survey, with instruction to only complete once at the completion of the intervention.

Intervention

The intervention was based on evidence that supports the importance of clinic-based education (HHS, 2007), as well as evidence that demonstrated the effectiveness of using mobile apps for asthma self-management (Marcano-Belisario et al., 2013). Patients were identified by the project manager, as well as by the office staff. During patient's regularly scheduled office visits, they were asked by the medical assistant performing their triage and vitals, "Do you have asthma?" and if yes, "We have a Valparaiso University doctoral student doing a project about asthma, would she be able to come in and ask you a few questions to see if it's something you are interested in?"

Patients who stated that they have asthma and were willing to talk with the project manager were then approached by the project manager, in the privacy of the exam room, and asked if they would be willing to move to another room to discuss the EBP project. Of note, the project manager was often present with the provider at these visits, in the role of the DNP student, and therefore asked patients herself if they were interested in learning more about the EBP project. If there was not a patient appointment following the current appointment, patients remained in the same examination room to complete the intervention. If space is needed, the patient and project manager moved to the designated patient education room.

After the provider concluded their visit, the patients who were interested in learning more about the EBP project were moved to an unoccupied exam room if needed, as discussed above. They then met with the project manager who presented the script outlining the premise of the project. Inclusion and exclusion criteria were discussed. Participants who met the criteria and were willing to move forward with the intervention were then educated on the potential risks and benefits, given the opportunity to ask any questions they may have and presented with the informed consent form. Once patients completed the informed consent, the project managerpresented the participant with the several surveys to complete including the demographic form (Appendix D), ACT, AIS-6 and Asthma Literacy Questionnaire, which

combined contain 20 total questions. The project manager provided instructions on the completion of the surveys, and asked if the patient required any assistance to complete them. If the patient needed assistance reading the questions or clarification about multiple-choice answers, guidance was given. The project manager then stepped out of the room to allow the patients privacy and concentration while completing the surveys. Completion of the three short surveys and the demographic form was time-tested and took no more than five minutes to complete.

The first component of the intervention included a 30-minute one-on-one asthma education session utilizing a patient education guide published by the CHEST foundation, titled "Living Well with Asthma." This education guide was provided to the patient at no cost, and the content included topics such as: the disease-process of asthma and how it impacts the body, asthma triggers and solutions, following an asthma action plan, understanding asthma medications, inhalers and peak flow meters, and what to do in case of asthma attack. The goal of the education guide was to help patients to understand how to control and/or reduce asthma symptoms in order to reduce asthma's effects on day-to-day living. Each page of the booklet was reviewed with the patient. In addition to reviewing each page in the "Living Well with Asthma" booklet, patients were also encouraged to ask any questions they may have regarding the management of their asthma. The time spent on this portion of the intervention varied based on the patient's overall understanding of asthma. Some patients took 10-15 minutes to feel confident in their understanding of asthma, while others took 30-45 minutes to ask questions and report a satisfactory level of understanding.

The second component of the intervention included the use of a mobile application for asthma management. Patients downloaded a free smartphone application, AsthmaMD®, onto their mobile phone. The project manager assisted the patient is entering their personal data such as height, weight and age, as well as inputting their maintenance and rescue medications as applicable. From this information, a digital asthma action plan was created by the mobile

application. Patients were instructed on entering symptoms into the symptom tracker, setting up medication reminders, and following their asthma action plans if symptoms arise. Patients were instructed to log into the app and record their symptoms once per day. This included entering symptoms if they experienced any, or lack of symptoms if they didn't, into the symptom tracker, tracking if they took asthma medications, and setting medication reminders if needed. The mobile application was reviewed with the patients until they reported feeling confident in their ability to log in and enter data independently. They were encouraged to call the project manager if they had any difficulty with using the application. The intervention took approximately 15 minutes per patient, with significant variance depending on the patient's level of competency utilizing a smartphone app. On average, the intervention took a total of 50 minutes when combined with introduction, informed consent, survey completion, educational session, and download and instruction of the mobile application, though many patients completed the intervention in considerably less time.

Follow-up occurred at four and eight-weeks post-intervention, at which time the ACT, AIS-6 and asthma literacy survey were repeated. The project had a rolling entry date with each patient being followed at four and eight-weeks after the initial intervention. Four-week intervals were an appropriate follow-up window as this is the recall period for both the ACT and AIS-6. The options for patients regarding follow-up were as follows. If patients were seen again in the office at both four and eight-weeks post-intervention for scheduled follow-up with their provider, project follow-up occurred at those visits. Patients also had the option of completing follow-up surveys over the phone or via text message. Since determining when the patient will return to the office was difficult to determine at the time of intervention, all patients received two copies of each of the surveys (ACT, AIS-6 and literacy survey) as well as one copy of the Evaluation of Mobile Application Use form in the folder included with the "Living Well with Asthma" booklet.

If patients were seen in the office at four and eight week intervals, the project manager met with patients in the examination room to discuss any concerns they may have regarding the

app. Patients were asked to bring their mobile phone with them to any visit in order to review any questions and assess mobile application usage. The project manager then had the patient complete the surveys at the time of the visit and hand them to her directly. Patients were asked to bring their own surveys, however if they did not remember to bring them the project manager gave them additional surveys. Extra copies were kept in the providers' office in the event that a patient returned for a scheduled visit when the project manager was not present at the clinical site. In those cases, the provider collected the surveys and kept them in a locked file cabinet in the office until the project manager was able to collect them.

Patients not following up with a provider were given the option to follow up with the project manager in person at the office. This visit was with the project manager only and therefore not associated with any charge for an office visit. For those who preferred to complete the follow-up surveys via phone call or text message, the project manager obtained preferred contact information and set a tentative date for a phone call or text message to occur. The project manager initiated contact with her cell phone, and patients were given contact information for the project manager's cell phone in case of any questions or concerns throughout the course of the project. At the time of that phone call or text message, patients completed their surveys included in the folder, and discussed the results will the project manager who then filled in the corresponding answers on a written survey. The patient's preferred method of follow-up was determined at the time of initial intervention. All data collected was entered into de-identified data sheets, which contained demographic information, initial survey results, and follow-up survey results (Appendix E).

Planning

The Stetler Model was used to guide the development of this project. The first steps in planning of this EBP project began with a discussion with the nurse practitioner and physician at the clinical site about potential project ideas. It was identified that there was a need for improved asthma management through structured asthma education and promotion of self-management

in the office. There was discussion about the types of interventions that might be successful, and once a thorough review of the literature was conducted by the project manager it was decided to implement a project using both asthma education, and a smartphone application for digital action plans and symptom tracking. Approval was obtained from the nurse practitioner, physician and the office manager to proceed with designing the project. Front-desk registration staff members and two medical assistants were also included in the development of the project. Their input was used to develop an appropriately planned invention that would fit within the current office workflow with minimal disruption to day-to-day operations. This conversation was helpful in determining the most effective way to recruit patients, what space to use for the intervention, and how to best contact patients for follow-up visits/phone calls. Medical assistants were also instructed on what to ask patients when rooming them in order to assist the project manager with recruitment of participants.

Data

Measures

The measures used for data collection included the ACT, AIS-6 and as asthma literacy questionnaire. While the ACT and AIS-6 have established validity and reliability, the asthma literacy questionnaire and survey evaluating the use of the mobile application, created specifically by the project manager for the evaluation of this educational intervention, do not. Details of each of the outcome measures are discussed below.

Asthma Control test. Overall validity has been demonstrated in more independent study population samples for the ACT than for any other instrument that measures asthma control outcomes (Clouthier et al., 2012). Schatz et al. (2006) evaluated the reliability and validity of the ACT in a longitudinal study of asthmatic patients new to the care of an asthma specialist. Schatz et al. found that internal consistency reliability of the ACT was 0.85 (baseline) and 0.79 (follow-up). Test-retest reliability was 0.77. Criterion validity was demonstrated by significant correlations between baseline ACT scores and baseline specialists'

ratings of asthma control ($r = 0.52$, $p < .001$)(Schatz et al., 2006). Discriminant validity was demonstrated; with significant ($p < .001$) differences in mean ACT scores across patients differing in asthma control, pulmonary function, and treatment recommendation (Schatz et al., 2006). Responsiveness of the ACT to changes in asthma control and lung function was demonstrated with significant correlations between changes in ACT scores and changes in specialists' ratings ($r = 0.44$, $p < .001$). An ACT score of 19 or less provided optimum balance of sensitivity (71%) and specificity (71%) for detecting uncontrolled asthma (Schatz et al., 2006). This demonstrated that the ACT is a reliable, valid tool that is responsive to changes in asthma control over time, and is therefore an appropriate tool to use for this EBP project.

Asthma Impact Survey. Schatz et al. (2007) also conducted a study to provide validation for the AIS-6, a tool used to evaluate asthma-related quality of life. Authors compared the AIS-6 to other tools used to measure quality of life including the mini-Asthma Quality of Life Questionnaire (AQLQ) and the Asthma Therapy Assessment Questionnaire (ATAQ). The researchers found that AIS-6 scores were significantly related to female sex, educational level, income, smoking, body mass index (BMI), COPD, steroid use, and hospitalization history. The AIS-6 score significantly correlated ($r = - .84$, $p < .0001$) with the AQLQ total score and loaded on the three factors (activity, symptoms, and concern/bother) reflected by the survey information and on which the AQLQ also loaded. Significant but somewhat smaller correlations were found between the AIS-6 and the ATAQ ($r = .70$, $p < .0001$) and the AOMS ($r = 0.55$, $p < .0001$).

Strengths of the AIS-6 include its rigorous methodological development, high internal consistency reliability, modest to substantial correlations with other asthma outcome measures and its ease of use in the clinical setting (Wilson et al., 2012). Overall the study supported the validity of the AIS-6 as an asthma-specific quality of life tool. The proven validity and reliability of the AIS-6, along with its 4-week recall window that coordinates with the ACT recall window, made the AIS-6 an appropriate tool to measure asthma-related quality of life for this project.

Collection

As participants were recruited for participation, their name, date of birth and medical record number were obtained. This allowed the project manager to access demographic information such as gender, age and race, about the patient independently for the sake of time. The project manager was able to collect this information using a designated login for the electronic health record provided to her as a student in the clinical setting. Each participant was assigned a coordinating number starting from 1, to identify them through the remainder of the project. This information was kept on a master list, which was stored on a password-protected computer in a location separate from the locked briefcase containing patient data. Therefore, no personal identifying information was associated with the actual questionnaires, only the patients assigned number listed in the upper left-hand corner. All documents, survey data and completed questionnaires were stored in a combination-locked briefcase accessible only by the project manager, which was kept in the provider's office when not with the project manager. This office is locked at the conclusion of the day and it is not in a patient-accessible area. When data was taken out of the office the project manager, who kept the information in a combination-locked briefcase inside her private home, was responsible for transporting it.

Management and Analysis

The initial surveys, ACT, AIS-6 and Asthma Literacy Survey, were completed the same day the patient agreed to participate in the EBP project and subsequently received the educational session and intervention with the smartphone application. This data was all de-identified as described above. Solely the project manager compared pre and post-intervention data, and all personal patient information was kept confidential. Only group data and trends were included in the final project report. The data was analyzed using SPSS at the completion of the project.

Protection of Human Subjects

There was ample consideration for the rights of human subjects throughout this project. First, the project manager completed training by the National Institutes of Health on the

protection of human subjects participating in research. Second, permission to complete this project was obtained from both Valparaiso University Institutional Review Board (IRB) and the IRB of the hospital organization affiliated with the clinic at which the project was completed. Patients were aware that participation within the study was voluntary. Risks and benefits were discussed in detail and informed consent was obtained prior to the start of the intervention. Patients were told that they had the right to cease participation and leave the study at any time without fear of repercussion. Participants were aware that leaving the study would not affect their relationship with this office or with their healthcare provider.

All confidential information was kept in a locked briefcase accessible only to the project manager. The briefcase was kept either with the project manager, in the providers office which is not accessible to patients, or in the project manager's private home. All demographic forms and surveys were marked with de-identifying numbers for the privacy of participants. The master document linking the participants' names and addresses with the numbers associated with their surveys and forms was kept on the project manager's personal password protected computer, along with aggregate data. The laptop was transported to and from the project site with the project manager and also kept in the provider's office, inaccessible to patients. All materials were kept in the project managers locked briefcase for a period of three years and at that time will be discarded in the locked patient health information shredder. All data collected was reported and disseminated only in aggregate form.

CHAPTER 4

FINDINGS

The PICOT question of this EBP project asked “How effective is an intervention that includes education and self-management using digital asthma action plans and symptom tracking via mobile application, compared to the current standard of practice in improving quality of life, asthma control, and asthma literacy over an eight week period?” The overall purpose of this project was to improve patients’ ability to self-manage their asthma symptoms, therefore improving their ability to treat symptoms early and appropriately, as well as improve their ability to track symptoms and identify possible triggers. This was accomplished by implementing an intervention that was multifaceted and consisted of two components. The first component included a 30-minute one-on-one asthma education session utilizing a patient education guide published by the CHEST foundation, titled “Living Well with Asthma.” The second portion of the intervention included the introduction and download of a free mobile smartphone application, AsthmaMD®, which was used for both asthma self-management and the use of a digital asthma action plan. The intervention occurred at a primary care office in northwest Indiana.

Three primary outcomes were measured throughout the course of this EBP project. These include asthma control using the Asthma Control Test (ACT), asthma-related quality of life using the Asthma Impact Survey (AIS-6) and asthma literacy using a questionnaire designed by the project manager. One secondary outcome was measured in order to evaluate patient’s use of the mobile application, and it asked whether patients used the mobile application, if patients felt that the application was beneficial in improving their asthma self-management, and if patients would continue to use the mobile application in the future. The tool was titled “Evaluation of Mobile Application Use” and was designed by the project manager specifically for use in this EBP project. Each of these outcomes was crucial to the evaluation of the overall effectiveness of this EBP project. Characteristics of the participants as well as analysis of the

data for each of these outcomes were analyzed using SPSS statistical software, version 25.0, and are reported in the following chapter.

Participants

Sample size

This project utilized a “within group repeated measures design,” whereas the same group of participants was evaluated at the initial time of intervention, four weeks after intervention, and again eight weeks after intervention. Participants were recruited at a primary care office as described in chapter 3, and all patients meeting inclusion criteria were eligible to participate. This included adult patients over 18 years of age, with a diagnosis of asthma, who have been prescribed medication for asthma within the last 12 months. Asthma diagnosis was determined by patient self-report, as discussed in the previous chapter. Additional inclusion criteria included English speaking and in possession of and able to use a smartphone. Exclusion criteria included pregnant women and those diagnosed with dementia or significant cognitive impairment that would prevent the patient from accurately tracking symptoms or independently managing their health conditions. As the project manager held the sole responsibility of implementing the intervention, patients had to be in the office for a visit on days when the project manager was present.

In total, twenty-six adult patients with asthma participated in this EBP project. Of the 26 participants that completed the initial surveys and intervention, all 26 completed the 4-week follow-up surveys, and 23 of the 26 completed both the 4 and 8-week follow-up surveys. Patients were recruited from October 4, 2018 through December 31, 2018, and each patient underwent both the educational intervention and the download and instruction on use of the mobile smartphone application. Follow-up visits, phone calls, and text messages were made from November 4, 2018 through February 5, 2019 in order to collect longitudinal data of the outcomes.

Characteristics

Demographic information was collected on all participants, including age, gender, race, marital status, income and education level. Patients were also asked the number of years that they have been diagnosed with asthma. The characteristics of the participants are displayed below in Table 4.1. Though three participants did not complete the final survey, the characteristics of these participants were analyzed and did not differ on any particular variable.

Of the 26 participants, patients' ages ranged from 20-54 with the mean age in the mid-thirties (M= 37.04, SD = 3.45). The patients that participated in the study consisted of 19 females (73.1%) and 7 males (26.9%) (Figure 4.1). Four options were provided for patients to choose their race and included "White, Black or African American, Hispanic or Latino or Other." Of the 26 participants, 20 (76.9%) selected "White," 3 (11.5%) selected "Black or African American," and 3 (11.5%) selected "Hispanic or Latino" (Figure 4.2). There were not any patients that selected "Other." Data on marital status was also collected, with 15 participants (57.7%) selecting "Married," 8 participants (30.8%) selecting "Single," and 3 participants (11.5%) selecting "Divorced" (Figure 4.3). Patient's income level varied greatly with 2 participants (7.7%) making 24,999 or less, 8 participants (30.8%) making $25,000-$49,999, 10 participants (38.5%) making $50,000-$74,999, 5 participants (19.2%) making $75,000-$99,999, and 1 participant (3.8%) making $100,000- $124,900 (Figure 4.4). Patients were asked to describe their education level. Three patients (11.5%) achieved a high school diploma or GED, 6 participants (23.1%) obtained some college, but no degree, 4 participants (15.4%) obtained an Associate's degree, 12 participants (46.2%) obtained a Bachelor's degree, and 1 participant (3.8%) obtained a Master's degree. The last demographic variable that was collected was the number of years patients had been diagnosed with asthma. The mean number of years with asthma was 24.54 (*SD* = 9.01).

Table 4.1 Characteristics of the Participants (N = 26)

Characteristics	*Initial n (%)*
Gender	
Male	7 (26.9%)
Female	19 (73.1%)
Race/ethnicity	
Non-Hispanic White	20 (76.9%)
Non-Hispanic Black	3 (11.5%)
Hispanic or Latino	3 (11.5%)
Marital Status	
Married	15 (57.7%)
Single	8 (30.8%)
Divorced	3 (11.5%
Income	
$24,999 or less	2 (7.7%)
$25,000-$49,999	8 (30.8%)
$50,000-$74,999	10 (38.5%)
$75,000-$99,999	5 (19.2%)
$100,000-$124,999	1 (3.8%)
Education level	
High school diploma or GED	3 (11.5%)
Some college, no degree	6 (23.1%)
Associate’s degree	4 (15.4%)
Bachelor’s degree	12 (46.2%)
Master’s degree	1 (3.8%)

Figure 4. 1 Gender

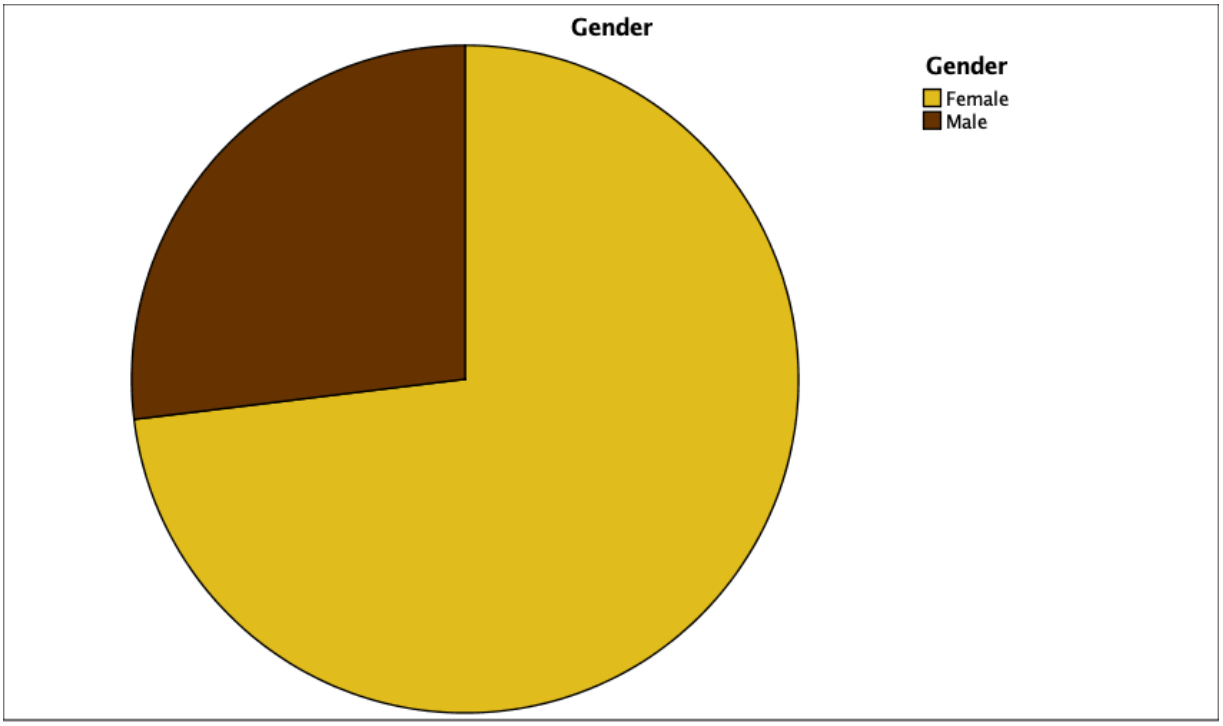


Figure 4.2 Race

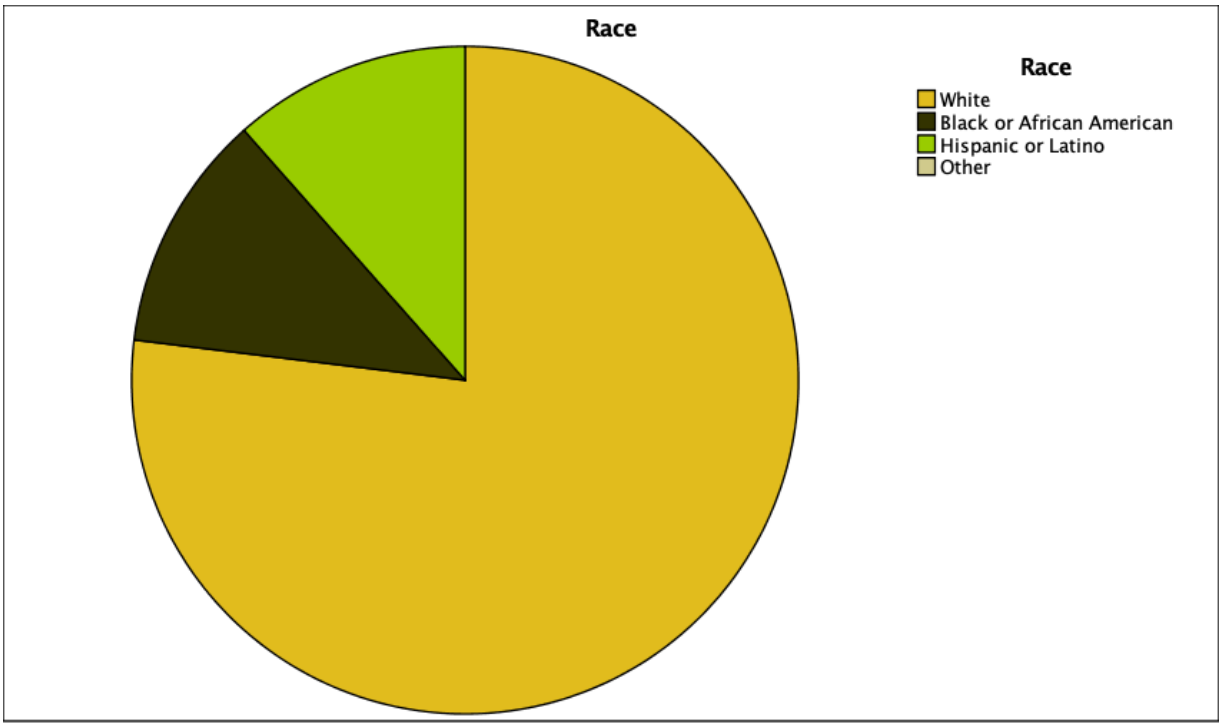


Figure 4.3 Marital Status

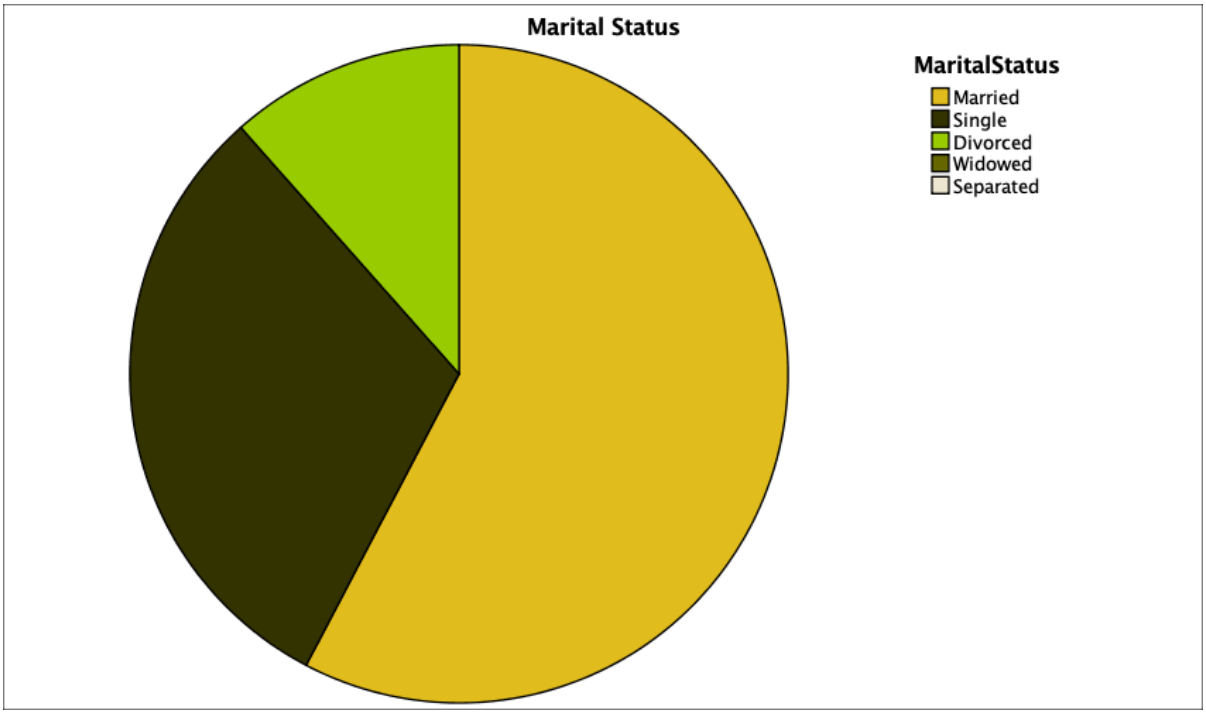


Figure 4.4 Income Level

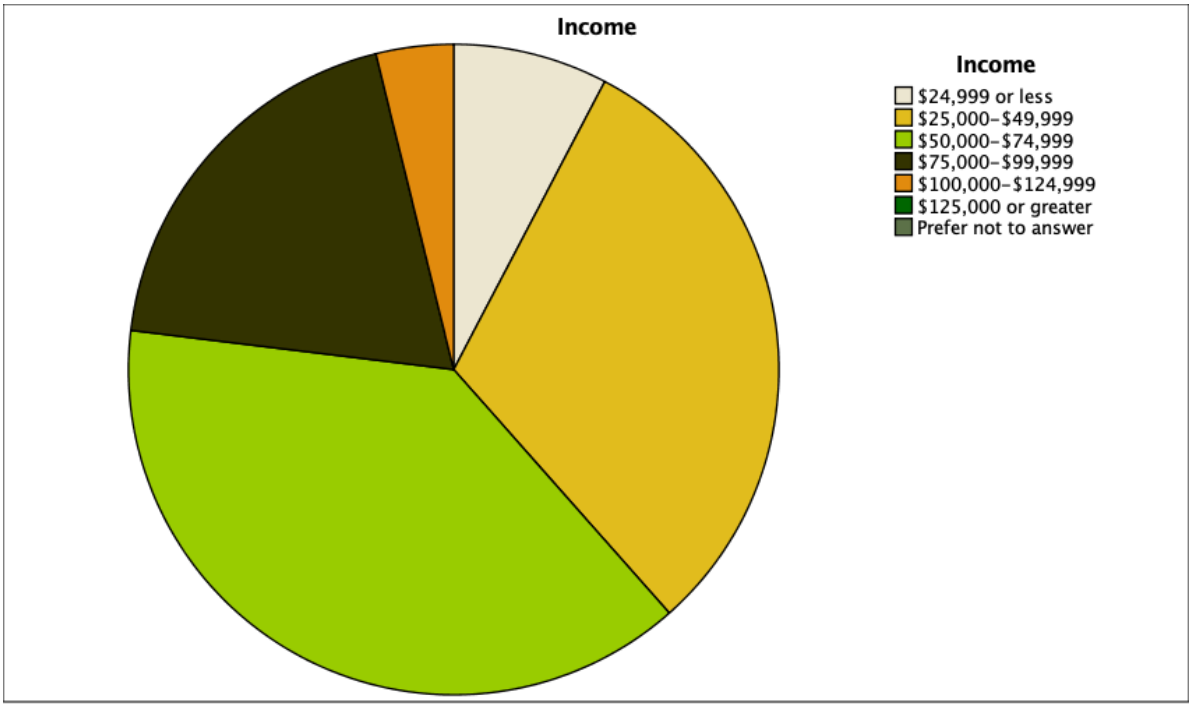
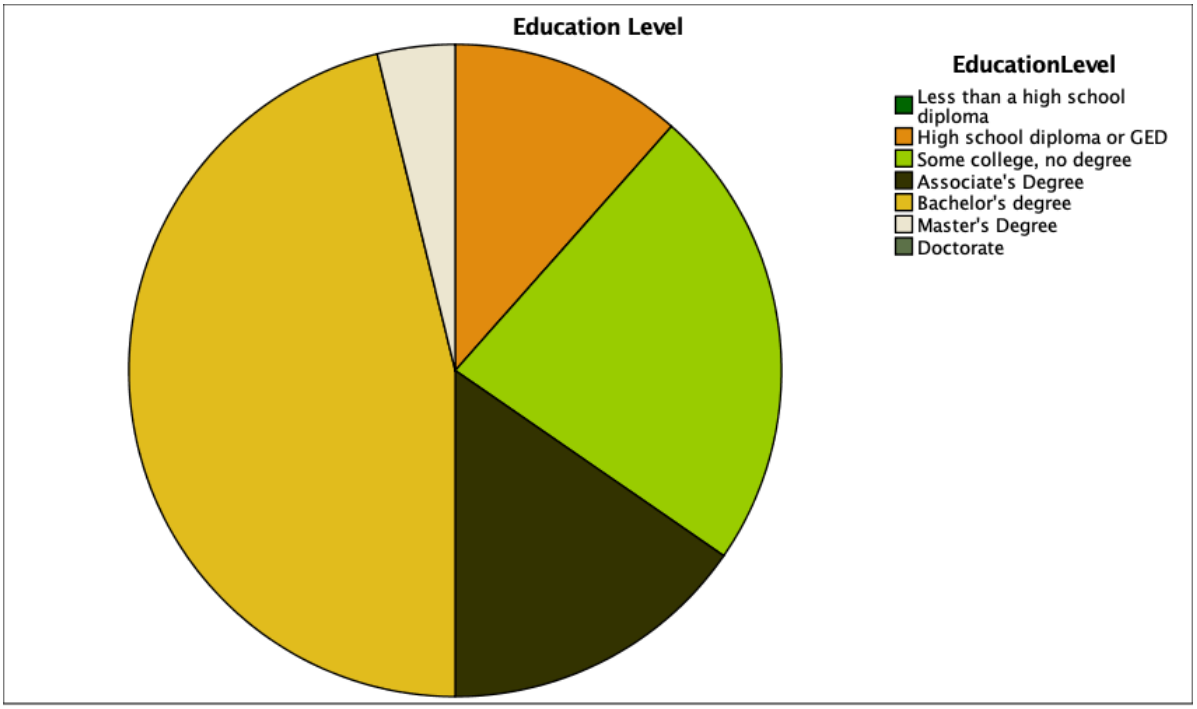


Figure 4.5 Education Level



Changes in Outcomes

Statistical Analysis

In order to assess for changes in outcomes in this EBP project, a repeated-measures analysis of variance (ANOVA) was performed on each of the three primary outcomes. This test extends the basic ANOVA procedure to a within-subject independent variable (when participants provide more than one level of an independent variable)(Cronk, 2018). The repeated-measures ANOVA functions like a paired t-test when more than two levels are being compared (Cronk, 2018). This is an appropriate test to perform in order to determine if there were statistical difference in ACT and AIS-6 scores, and asthma literacy across three data collection points.

Asthma Control Test (ACT). A one-way repeated measure ANOVA was calculated comparing the ACT total score of participants at three different times: Pre-intervention, 4-week

post-intervention, and 8-week post intervention. A significant effect was found (F (2, 44) = 43.08, $p < .001$). Follow-up protected t tests revealed that ACT scores increased significantly (all $p < .001$) from the initial (pre-intervention) test (M = 18.88, SD = 3.871) to the test at 4-week post intervention (M = 21.00, SD = 2.561), from 4-week post-intervention (M = 21.00, SD = 2.561) to 8-week post-intervention (M= 22.61, SD = 2.169), and from the initial intervention (M = 18.88, SD = 3.871) to 8-week post-intervention (M= 22.61, SD = 2.169).

Asthma Impact Survey. A one-way repeated measure ANOVA was also calculated comparing the AIS total score of participants at three different times: Pre-intervention, 4-week post-intervention, and 8-week post intervention. A significant effect was found (F (2, 44) = 51.621, $p < .001$). As with the ACT, follow-up protected t tests were performed and revealed that scores decreased significantly (all $p < .001$) from the initial (pre-intervention) test (M = 47.73, SD = 8.568) to the test at 4-week post intervention (M = 44.77, SD = 7.722), and again from 4-week post-intervention to 8-week post-intervention (M = 40.52, SD = 6.044).

Asthma Literacy Questionnaire. Each of the four items of the literacy questionnaire was analyzed individually in order to assess which areas the educational intervention was most helpful in addressing. Because of this, analysis of each of the four items will be discussed separately. The four items included:

1. I know what asthma is and could explain it to someone else.
2. I know how to use my metered dose inhaler and nebulizer machine (if applicable).
3. I know what triggers my asthma symptoms.
4. I know what do when I start to experience asthma symptoms

Each item asked participants to rate their level of understanding about your asthma using a Likert scale of no confidence (0), slight confidence (1), moderate confidence (2), or high confidence (3).

Item 1. The first item stated **"**I know what asthma is and could explain it to someone else." A one-way repeated measures ANOVA was also calculated comparing the responses to

Item 1 for participants at three different times: Pre-intervention, 4-week post-intervention, and 8-week post intervention. A significant effect was found (F (1, 22) = 65.098, p < .001). As with the ACT and AIS, follow-up protected t tests were performed and revealed that scores improved significantly (all p < 0.001) from initial evaluation (M = 1.58, SD = .578), to final evaluation (M = 2.43, SD = .507) and from initial evaluation (M = 1.58, SD = .578) to 4-week follow-up (M = 2.26, SD = .449). There was no statistically significant improvement in scores between 4-week follow-up (M = 2.26, SD = 0.449) and 8-week follow up (M = 2.43, SD = .507).

Item 2. The second item stated, ***"***I know how to use my metered dose inhaler and nebulizer machine (if applicable)." Results for Item 2 were similar to Item 1. A significant effect was found (F (2, 44) = 28.348, p < .001). Follow-up protected t tests were performed and revealed that scores improved significantly (all p < .001) from initial evaluation (M = 2.15, SD = .543), to final evaluation (M = 2.96, SD = .209) and from initial evaluation (M = 2.15, SD = .543) to 4-week follow-up (M = 2.87, SD = .344). There was no statistically significant improvement in scores between 4-week follow-up (M = 2.87, SD = .344). and 8-week follow up (M = 2.96, SD = .209).

Item 3. The third item states, "I know what triggers my asthma symptoms." Results for Item 3 varied from the previous two items in that all three protected t tests were statistically significant (all p < 0.001). A significant effect was found (F (2, 44) = 44.425, p < .001). Follow-up protected t tests were performed and revealed that scores improved significantly (p < 0.001) from initial evaluation (M = 1.77, SD = .710) to final evaluation (M = 2.96, SD = .209) and from initial evaluation (M = 1.77, SD = .710) to 4-week follow-up (M = 2.87, SD = .344), as well as from 4-week follow-up (M = 2.87, SD = .344) to 8-week follow up (M = 2.96, SD = .209).

Item 4. The fourth item stated, ***"***I know what do when I start to experience asthma symptoms." Results for Item 4 were similar to Items 1 and 2 in that there was significance from initial evaluation to final evaluation and initial evaluation to 4-week evaluation. There was not a significant improvement from 4-week to 8-week evaluation. A significant effect was found (F (2,

44) = 54.218, $p < 0.001$). Follow-up protected *t* tests were performed and revealed that scores improved significantly (all $p < 0.001$) from initial evaluation ($M = 1.77$, $SD = .587$), to final evaluation ($M = 3.00$, $SD = .00$) and from initial evaluation ($M = 1.77$, $SD = .587$) to 4-week follow-up ($M = 2.65$, $SD = .485$). There was no statistically significant improvement in scores between 4-week follow-up ($M = 2.65$, $SD = .485$) and 8-week follow up ($M = 3.00$, $SD = .00$).

Secondary Outcome

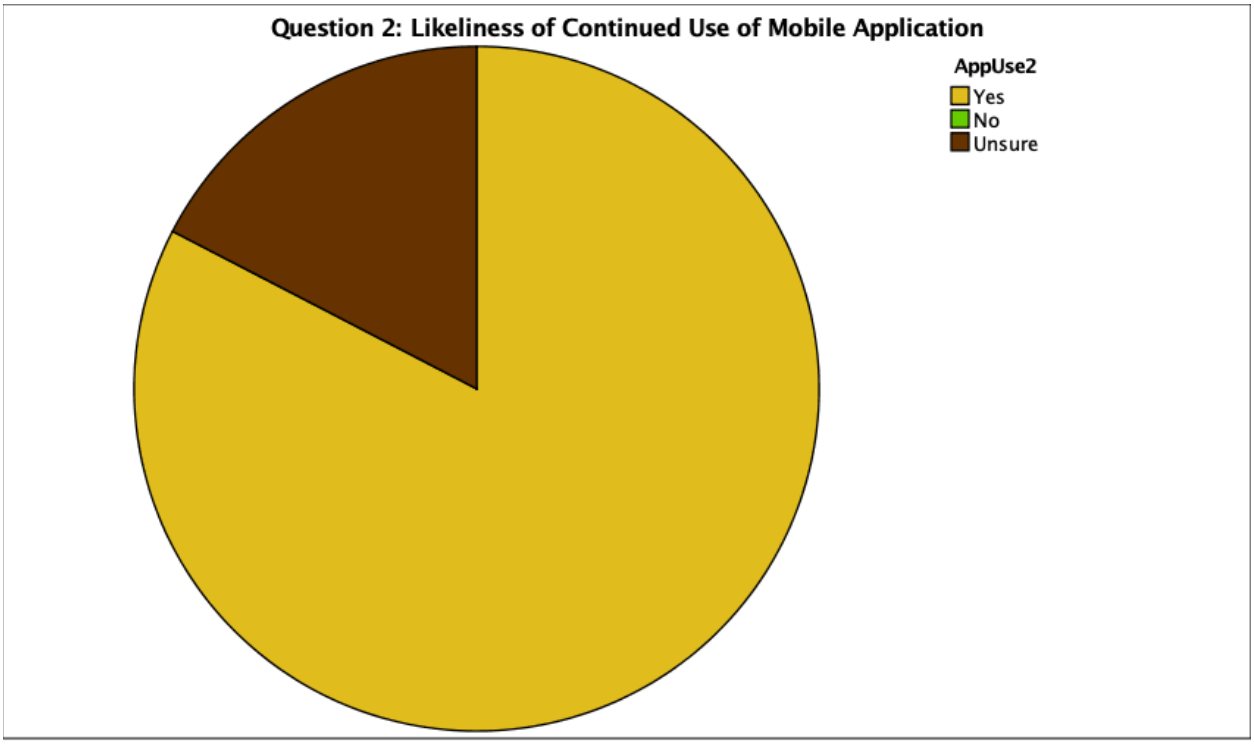
One secondary outcome was measured in order to evaluate patient's use of the mobile application. This survey is listed below, and asked whether patients used the mobile application, if patients felt that the application was beneficial in improving their asthma self-management, and if patients would continue to use the mobile application in the future.

Evaluation of Mobile Application Use

1. Do you feel that the mobile application was helpful in keeping track of your asthma symptoms??
    a. Yes
    b. No
    c. Unsure
2. Do you think you will continue to utilize the mobile application in the future to manage your asthma symptoms?
    a. Yes
    b. No
    c. Unsure
3. How many times per week did you log your symptoms on the mobile application?
    a. 0-2 times per week
    b. 3-5 times per week
    c. 6-7 times per week

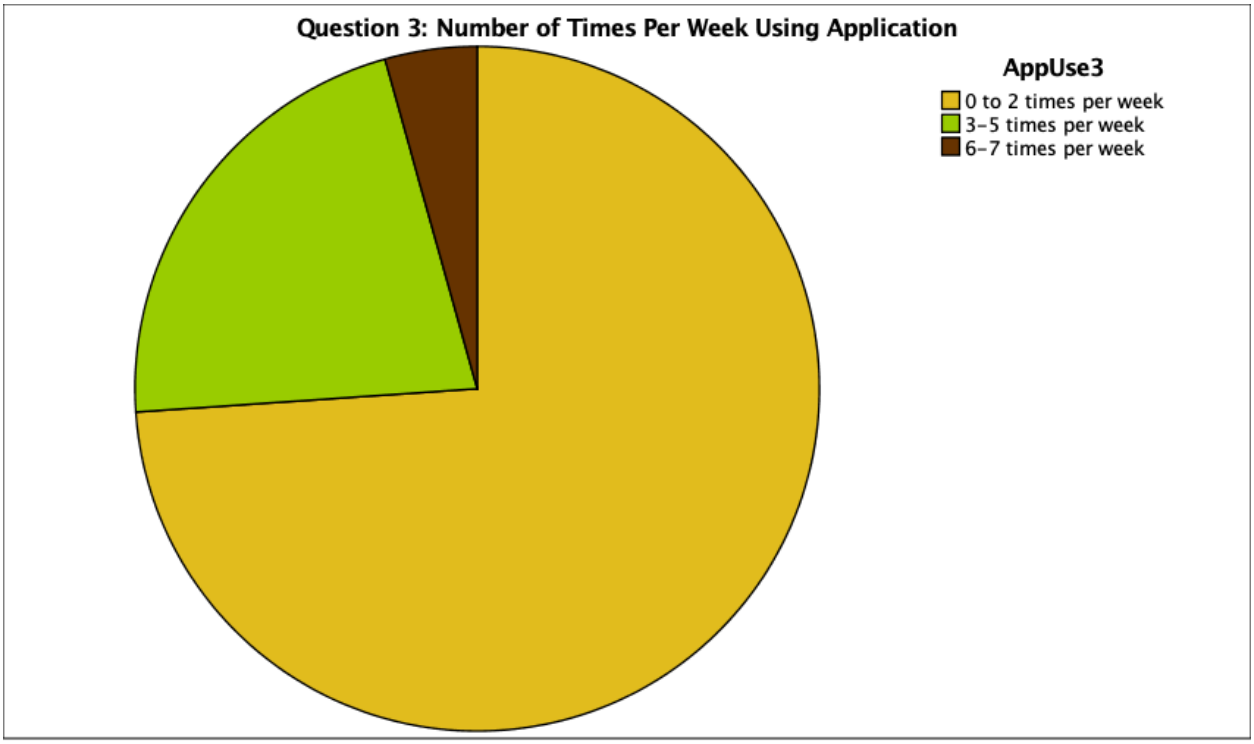
Of the 23 patients who completed the second follow-up, 100% of patients answered "yes" to question 1, stating that they did feel that the app was helpful in keeping track of asthma symptoms (Figure 4.6). Nineteen patients (82.6%) reported "yes" to question 2 indicating that they would continue to use the mobile application to track asthma symptoms in the future. Four patients (17.4%) of patients reported that they were unsure if they would continue to use the app in the future.

Figure 4.6 Likeliness of Continued Use of Mobile Application



Results for question 3 are displayed below in Figure 4.7. Of the 23 patients, 17 (73.9%) reported using the mobile application 0-2 times per week, 5 (21.7%) reported using the application 3-5 times per week, and 1 (4.3%) reported using the application 6-7 times per week.

Figure 4.7 Number of Times Per Week Using Application



Significance

The results of the statistical analyses answer the PICOT question "How effective is an intervention that includes education and self-management using digital asthma action plans and symptom tracking via mobile application, compared to the current standard of practice in improving quality of life, asthma control, and asthma literacy over an eight-week period?" The findings of the ACT analysis demonstrated a significant improvement in test scores with repeated-measures ANOVA, and post-hoc analysis using protected t tests demonstrated improvement from initial evaluation to 4-week follow-up, from 4-week follow-up to 8-week follow-up and from initial evaluation to 8-week follow-up. AIS-6 scores significantly decreased when analyzed using repeated-measures ANOVA, and post-hoc analysis using protected t tests demonstrated improvement (decreased scores) from initial evaluation to 4-week follow-up, from 4-week follow-up to 8-week follow-up and from initial evaluation to 8-week follow-up.

Asthma Literacy results are discussed above. In summary Items 1,2 and 4 demonstrated improvement in asthma literacy from initial evaluation to 4-week follow-up and from initial evaluation to 8-week follow-up, however there was no statistically significant improvement between 4 and 8-week follow-ups. Item 3 demonstrated statistically significant improvement from initial evaluation to 4-week follow-up, from 4-week follow-up to 8-week follow-up and from initial evaluation to 8-week follow-up. This demonstrates that there was an increase in knowledge that was statistically significant in all areas of asthma education.

One secondary outcome evaluating participants' use of the mobile smartphone app suggested that 100% of patients would recommend the mobile application and found it helpful. Nineteen patients (82.6%) reported that "yes" they would continue to use the mobile application to track asthma symptoms in the future. Seventeen participants (73.9%) reported using the mobile application 0-2 times per week, 5 (21.7%) reported using the application 3-5 times per week, and 1 (4.3%) reported using the application 6-7 times per week. This demonstrates that overall patients found the mobile app helpful, would continue to use the app, and were actively engaged in using the mobile app throughout the intervention.

CHAPTER 5

DISCUSSION

This evidence-based practice project utilized a multi-component asthma self-management intervention that included an educational session as well as the use of a mobile smartphone application for symptom tracking and a digital asthma action plan. The purpose of this project was to improve asthma control, asthma-related quality of life, and asthma literacy among adult patients with asthma. The purpose of chapter five is to provide an evaluation and interpretation of the results presented in Chapter 4. This chapter will also discuss the strengths and limitations of the theoretical framework and EBP model that were utilized to guide the implementation and evaluation of the project. Strengths and limitations of the EBP project as a whole will be described as well as implications for future utilization of the project in clinical practice, nursing theory, research and education.

Explanation of Findings

The first outcome that was evaluated was the ACT, the test that evaluates the patient's self-perceived asthma control. As discussed in the previous chapter there was a statistically significant increase in test scores (all $p < .001$) from the initial (pre-intervention) test to the test at 4-week post intervention, from 4-week post-intervention to 8-week post-intervention, and from the initial intervention to 8-week post-intervention. The ACT was an appropriate measure of asthma control for several reasons. First, the ACT is utilized frequently in asthma literature, and it used as a measure of asthma control in several clinical practice guidelines. The ACT is a self-administered questionnaire that asks five questions about patients' overall control of their asthma symptoms. Each question has five possible options, rated on a Likert Scale with the responses ranging from one (reflecting poor control) to five (reflecting good control) points each. Questions address the amount of time that asthma hinders daily productivity, how often patients experience shortness of breath, how often patients experience nocturnal symptoms or interference with sleep, how often rescue inhalers or nebulizers are

required and an overall rating of asthma control over the last four weeks. The questionnaire is clearly worded, simple to understand, and takes only a few minutes to complete. It has proven reliability and validity, and the scoring and interpretation of results is very simple.

The scores on the ACT range from 5 to 25, with a score of 19 of less indicating that the patient may have uncontrolled asthma. Prior to intervention, patients mean ACT score was 18.9. This indicates that the overall, patients had uncontrolled asthma symptoms. At the completion of the intervention, the mean patient score increased from 18.9 to 22.6, indicating that asthma symptoms are well controlled. Therefore, the intervention helped the majority of patients to better control their asthma symptoms according to the ACT scoring system.

Another significant finding is that there was a statistically significant improvement in the ACT score from the 4-week to 8-week follow up visit. This was somewhat unexpected. In the development of this project, there was question as to whether the intervention should be implemented for four weeks or eight weeks, as the literature did not specify the recommended length of the intervention. Had the intervention only been ongoing for four weeks (the length of the ACT recall period) the improvement in scores would not have been nearly as significant (mean increase from 18.9 to 21 after four weeks versus increase from 18.9 to 22.6 after eight weeks). This demonstrates the need for the full eight-week intervention, and the opportunity for further research to expand the duration of the intervention.

The next primary outcome was the AIS-6, which measured asthma-related quality of life. The Asthma Impact Survey is a brief 6-item patient-based assessment designed to measure the impact of asthma on an individual's health-related quality of life (Kosinski, Turner-Bowker, Bayliss, & Fortin, 2003). It surpasses traditional measures of disability associated with asthma, to assess relevant aspects of functional health and well being, including physical, social and psychological domains (Kosinski et al., 2003). The Asthma Impact Survey was designed to produce a measure of asthma impact that is easy for clinicians to use, and for clinicians and

patients to interpret. Asthma impact scores range from 36 to 78 with higher scores reflecting greater impact.

The average impact score for patients with asthma is 48. Scores above 48 reflect worse-than-average asthma impact and scores below 48 reflect less-than-average asthma impact. If a patient's score is higher than 48, a health care provider should discuss the patient's asthma with her/him and determine whether intervention is warranted. Prior to intervention, the mean AIS-6 score was 47.4, indicated that asthma impact was near the average of 48 and that discussion of asthma symptoms and management was warranted. At four weeks post-intervention, the mean AIS-6 score decreased to 44.8, and at the final eight week follow up the mean AIS-6 score decreased to 40.5. This indicates that throughout the course of the intervention, the overall AIS-6 score improved from "average asthma impact" to "less-than-average asthma impact."

In the four-question asthma literacy questionnaire, the findings demonstrated statistically significant improvement in all areas of asthma education. Three of the four questions demonstrated improvement in asthma literacy from initial evaluation to 4-week follow-up and from initial evaluation to 8-week follow-up, however there was no statistically significant improvement between 4 and 8-week follow-ups. One of the items demonstrated statistically significant improvement from initial evaluation to 4-week follow-up, from 4-week follow-up to 8-week follow-up and from initial evaluation to 8-week follow-up. These findings indicate that while there was a clear benefit to continuing the intervention for eight weeks as far the ACT and AIS-6 scores were concerned, there was not a significant improvement in three of the four areas of education from the four to eight-week follow up. However the one area that did improve significantly at both four and eight-week follows ups was the item that stated, "I know what triggers my asthma symptoms." It is likely that this improvement is due to patient's use of the symptom tracker on the mobile application, and further supports the use of the mobile app.

Measuring the secondary outcome was important because it was crucial to know if patient's improvement in asthma symptom management was actually due to them using the

mobile application. Therefore the final assessment was a survey of the participants' use of the application throughout the intervention. This was collected only once at the conclusion of the project. Findings revealed that 100% of patients would recommend the mobile application and found it helpful. This was very encouraging and supported the idea of implementing the mobile application at the clinical site in the future. 82.6% of participants reported that "yes" they would continue to use the mobile application to track asthma symptoms in the future. Seventeen participants (73.9%) reported using the mobile application 0-2 times per week, 5 (21.7%) reported using the application 3-5 times per week, and 1 (4.3%) reported using the application 6-7 times per week. The mobile application use per week was lower than was initially asked of the participants, who were asked to log symptoms at least once daily. This decreased use of the mobile application may have impacted the results of the project. However, the findings demonstrate that overall patients found the mobile app helpful, would continue to use the app, and were actively engaged in using the mobile app throughout the intervention.

All of the findings of this EBP project demonstrated that the intervention was successful in improving patient's asthma control, asthma-related quality of life, and asthma literacy. All three primary outcomes had statistically significant improvement in scores throughout the course of the intervention, and both the ACT and AIS-6 had significant improvement at all intervals of data collection. Asthma literacy improved significantly from the initial assessment to the four-week follow-up, with one item also improving at the eight-week follow-up. Overall, the results were supportive of the continued use of the intervention in the clinical setting, and the findings provide evidence regarding the long-term beneficial effect of the intervention on patient-reported outcomes.

Evaluation of Applicability of Theoretical and EBP Frameworks

Both a theoretical framework and an evidence-based practice model were used to guide the implementation of EBP in the clinical practice setting. This project utilized the Self-Care Deficit Nursing Theory and the Stetler Model, as the tools to guide this change in practice. This

section will discuss how the theoretical framework and evidence-based practice model were used to guide the implementation and evaluation of this project, including strengths and limitations, and how the framework and model were able to be applied to this EBP project.

Theoretical Framework

The framework used to guide the development and implementation of this EBP project was the Self-Care Deficit Nursing Theory by Dorothea Orem. This theory proposes that when self-care demands are greater than the patient's self-care abilities, nursing care is required (Orem, 2001). The nurse is able to assess the situation, develop a plan of care and a nursing system to meet the needs of the patient, and implement and evaluate the system over time (Orem, 2001). As discussed in Chapters 1 and 2, self-management is a crucial component to managing asthma symptoms. For patients, this means being independent in managing medications, tracking symptoms, and intervening appropriately before symptoms progress.

This theoretical framework was an appropriate fit for this project. There was a need in the literature to address the self-care deficit present in asthma care and management, and Orem's theory provides guidance on how to identify and address this. Orem's theory identifies how to determine that a self-care deficit exists, and then provides the necessary steps to create a plan, design a nursing system, and implement and manage the intervention. This aligned well with the EBP project, which had the goal to identify a clinical problem, develop an intervention to change practice, and evaluate the outcomes. The framework was applied throughout the entire process.

The initial steps of the framework outline the need to determine that a self-care deficit exists. Upon discussion with the clinical site facilitator, it was established that there was a lack of attention being given to asthma education and self-management in the office setting. The clinical site facilitator expressed that this was an area needing improvement. Therefore the project manager conducted a literature search, and evidence showed that asthma education and self-management were not being properly addressed in the primary care setting. Orem's

theory then discusses creating a plan of care to improve self-management. Utilizing the findings of the literature review, as well as the input of the clinical site staff, the project manager developed an intervention to improve the self-care deficit. A nursing system was created that fit with the goals of the project. In the case of this project, a supportive-educative system was chosen because the nurse functions primarily as a teacher or consultant (Orem, 2001). The primary role of the nurse in this EBP project was to provide patients with education, guidance, and skills so that they were better able to effectively self-manage their symptoms (Orem, 2001).

The final step of Orem's theory is the "Production and management of nursing systems" (Orem, 2001). The goal of this phase is to help patients learn to self-manage their asthma symptoms, therefore improving their self-care agency until it exceeds their self-care demand and removes the self-care deficit. Orem suggests achieving this through guiding, directing and supporting patients, stimulating patients' interest in self-care, assisting patients to monitor themselves to determine if self-care is effective, and promoting daily living routines that support the integration of self-care (Orem, 2001). This step really helped the guide the implementation of the intervention. The project manager was able to use the educational session to help patients understand their asthma symptoms, ask questions, and fully understand the physiology behind asthma and how it impacts the body. Patients were able to discuss their concerns about self-managing their asthma and how they could improve their understanding or their asthma symptoms and what steps should be taken when they occur. The goal of this EBP project was to give patients the knowledge and understanding to know what is happening within their body and act accordingly, therefore preventing worsening asthma exacerbations.

Orem's Self-Care Deficit Theory was overall an appropriate theory to use to guide the implementation of this EBP project. The steps in the theory aligned well with the steps of developing the EBP project, and provided insight as to how to determine the presence of a deficit and how to address it. Each step of Orem's theory was reflected in the EBP project development. One of the strengths of Orem's theory is that it provides a comprehensive base

for nursing practice and is applicable in many settings including education, clinical practice, administration and research (George, 2011). It can be used by all levels of nursing from beginning practitioner to an advanced clinician (George, 2011). This was important in the case of this EBP project since the project manager completing an EBP project for the first time. Orem's theory follows the nursing process and therefore was very logical in its progression.

One limitation of Orem's theory is that it does not give specific information on how to evaluate the success of the intervention. The theory states that nursing process is constantly evaluated and modified to meet the needs of the patient, however it does not give information as to how to evaluate and make changes. Fortunately the EBP model that was used does give specific information on evaluation. Also, the theory focuses primarily on the individual rather than the family, the environment, or the community. With patients with asthma, all of these can also be a contributing factor in the patient's ability to care for himself. George (2011) noted that when determining a patient's placement within a system, a major determinant is the patient's capacity for physical movement without any concern for emotional needs. This may be a limitation to the overall theory as not all patients are limited only by physical constraints or illness. Often the reason patients are unable to perform self-care is due to mental illness or emotional state. This was actually an issue during the implementation of this project, as the project manager did encounter several participants who were unwilling to participate in the project citing that they were struggling with other aspects of life or felt too emotional or overwhelmed to take on another thing. This limited the participants in the study, and the self-care deficit theory does not address how to best help these people.

EBP Framework

In addition to the Self-Care Deficit Theory, an EBP model was also used to guide the development and implementation of this EBP project. The Stetler Model aims to provide practitioners with step-by-step instructions for integrating research into practice, and it is useful to help nurses deliver safe patient care. Overall, the Stetler Model provides steps to assess and

use research findings to facilitate the implementation of evidence-based practice in the clinical setting (Melnyk & Fineout-Overholt, 2015). Five steps make up the model, including preparation, validation, comparative evaluation/decision making, translation/application, and evaluation, and each of these steps was crucial in developing, implementing and evaluating the success of the project (Stetler, 2001).

The first phase was preparation. This included speaking with the clinical site facilitator, office staff, and key stakeholders to determine an exact clinical problem. The project manager discussed the need for improved asthma education with the site facilitator and evaluated the feasibility of making this change. Once it was determined that there was in fact a significant need for improvement, the project manager had to determine if there was sufficient evidence to support a change in practice. Phase two included an extensive review of literature. This included searching multiple databases, professional organization websites, and published guidelines. Evaluation of the evidence also included rating the level and quality of evidence, as described in chapter 2. In phase three, “Comparative Evaluation/Decision Making,” the project manager sorted the evidence into tables based on level and quality of evidence. From this body of evidence, the project manager was able to determine that there was sufficient evidence to be used to guide practice.

Phase four was the most difficult since this phase involved translation and application. Essentially this phase included applying research findings into clinical practice by designing and implementing the intervention. Change is often difficult in the healthcare field, and is often met with hesitation and resistance. The project manager had to consider barriers to change and how to address them. This involved speaking with the site facilitator as well as the office manager, registration staff, and medical assistants to determine the best way to implement the intervention with the least amount of interruption. Phase five is the evaluation of the project. This process was ongoing throughout the implementation phase of the project, and it included

assessing patient's willingness to participate, addressing patients' questions and concerns, and making changes to the process as needed.

Overall, the Stetler model provided a solid foundation upon which this EBP project was developed, implemented and evaluated. The model's step-by-step approach to integrate research into practice was helpful throughout the entire course of the project completion. One of the strengths of the model was that it served as a guide for the preparation of the project, including determining the need for practice change and conducting a review of the literature. This was helpful to the project manager, who was a novice to the EBP process. A weakness of the model is that it focuses on individual practitioner-led change, rather than organizational-level change. Therefore, because solely the project manager implemented the intervention, more work must be done in order to encourage organization-level change.

Strengths and Limitations of the EBP Project

Evaluation of this EBP project revealed both strengths and weaknesses of the project. The following section provides a detailed evaluation of the strengths and weaknesses and provides an overview of factors that potentially impacted the implementation and results of this EBP project. The following section will also discuss recommendations for improvement of future EBP projects related to asthma self-management.

Strengths

The goal of this project was to improve patient's overall asthma self-management. One of the strengths of this EBP project was the quality of evidence related to this topic. All of the evidence that was utilized in the development of this project was level one or level two, and the quality of the evidence was all rated as high or good. The review of the literature demonstrated a clear need for this project, and the evidence supported the use of education and personalized asthma action plans. There are several guidelines published by professional organizations that contributed to the high level of evidence that was available. Newer research supporting the use of mobile technology for asthma control was also integrated into the project. Many studies are

currently being done to assess the role of technology in managing asthma, and including this component into the EBP project can provide valuable insight into future research.

Another strength is the use of reliable and valid instruments to collect patient-reported outcomes in clinical setting. The ACT and AIS-6 are tools widely used within the asthma literature, and have proven reliability and validity. Measuring self-reported asthma outcomes is supported in the literature, and compliant with the current guidelines. The ACT and AIS-6 are quick screening tools with simple scoring, and are easy to use in clinical settings to assess asthma control and quality of life.

Another strength of this project was that it filled a need in the clinical setting. The site at which the project occurred was not currently utilizing any type of formal asthma education with their patients. Action plans were not being created with patients, and patients were not being properly educated on managing their asthma symptoms. Therefore patients were more likely to experience acute asthma exacerbations requiring treatment in the office, urgent care, or emergency room. The providers in the office felt that there was a need for improved education among asthma patients, and this project was able to provide that. Because this project was greatly influenced by the providers in the office, there was support from the clinical staff including medical assistants and registration staff. The project manager was able to gain access to patients much easier because of assistance from clinical staff. Patients were able to take part in the project during their regularly scheduled office visits so there was no need for patients to make additional trips to the office in order to participate. The project manager was available to recruit patients in the office for more than 300 hours throughout the course of implementation.

Patients were overall very receptive to the intervention and were willing to participate. Many stated that they had never had an asthma action plan created for them, and they were excited to learn more about asthma and how they could better manage their symptoms. Patients were provided with a complimentary educational booklet, which included a written action plan and variety of information about asthma. They were also instructed on and assisted with

downloading and setting up the mobile smartphone app. While there was some minor attrition, overall patients were compliant with follow-up phone calls and office visits, and completed the entire eight-week project. The feedback received by the project manager was positive, and 100% of patients felt that the mobile application was helpful.

Limitations

While the overall results of the project demonstrated statistically significant improvement in asthma control and quality of life, this EBP project was not without limitations. One limitation was the small sample size. The initial goal for sample size was 40 to 50 participants, however the number of people who participated in the intervention was only 26. After losing three patients to attrition, the final number of participants who completed the entire eight-week intervention was 23. Ideally, future studies should be completed using a larger sample size. However, with repeated measures of the outcomes, the project manager was able to examine the longitudinal changes of the outcomes over three data collect points.

The small participant size is likely due in part to another limitation, which was that the project manager was the sole person implementing the intervention. Because the implementation of the intervention involved 30 minutes of education as well as assisting the patient with the mobile application, it was too lengthy of a process to be done by the medical assistant or the provider. Because of this, there was a significant amount of time that the project manager was not at the site and able to recruit patients who may have fit the requirements for participation. This contributed to the small participant size, and also resulted in any missed patients who would have been candidates for participation in the project.

The most significant limitation to this EBP project was the length of time that the implementation of the intervention took. The project manager had to first talk with the participants about the project, discuss what it entailed, and obtain informed consent. After this the patients completed three surveys, which included the ACT, AIS-6 and asthma literacy questionnaire. This took approximately 10 minutes. The project manager then spent

approximately 30 minutes reviewing the educational booklet, answering questions, and discussing medications. The next step of the intervention included downloading the mobile app, entering the patient's information and medications, and explaining how to use the app. Depending on the patient, this process took between 10 and 20 minutes. Therefore in total the entire intervention took approximately 45 minutes to an hour to complete. Taking this amount of time to focus on asthma education, though certainly beneficial, is simply not feasible in the primary care setting. Providers do not have the time in their schedules to allot this amount of time to educate patients specifically on asthma. Therefore the likelihood of continuing this intervention as it was presented in this EBP project is low. The project manager has discussed this with the site facilitator and has been working to develop a one-sided handout to be given to patients, which will feature some facts about asthma, websites that provide asthma-related material, and information encouraging patients to download the AsthmaMD® mobile application.

Implications for the Future

This EBP project demonstrated statistically significant improvement in patient's asthma control, asthma-related quality of life, and asthma literacy over an eight-week period. In addition to improving these outcomes among the study participants, the overall goal of this EBP project was to initiate a change in practice that can be integrated and maintained beyond the completion of the project. The following section will discuss ways that the findings of this EBP project can be applied to practice, theory, research, and education.

Practice

Advanced practice nursing is a professional that highly values the importance of evidence-based practice. Nurse practitioners are therefore vital in ensuring that EBP is being implemented in the clinical setting. The purpose of this EBP project was to implement evidence-based findings from the literature in order to design an intervention that could create a lasting practice change at the clinical site. A review of the literature demonstrated that there is a need for improved asthma education in the primary care setting, and the results of this EBP

project showed that there was a significant improvement in primary outcomes when this project was implemented. The participants in this study experienced significant improvement in their asthma control as well as their ability to adequately manage their asthma symptoms. These participants will be able to continue using the strategies and tools that they learned from this EBP project throughout their lives. The intervention used in this EBP project was successful, and ideally further studies can be done utilizing a similar technique as long as there is sufficient time to do so. Future research is needed to develop an equally effective but less time-consuming alternative to the intervention described in this project so that providers will be more inclined to incorporate asthma education into routine patient visits.

Theory

Orem's Self-Care Deficit theory and the Stetler model were used as the fundamental frameworks for this EBP project. Utilizing these frameworks allowed for the development of a successful asthma self-management intervention. This intervention may lead to a potential change in practice in the clinical setting and therefore improve asthma management. Orem's Self-Care Deficit theory served as the framework for this project. While the theory often refers to patients who are struggling with the loss of mobility, mental status, or health, in the case of this EBP project self-care referred to the patients' ability to self-manage their asthma symptoms. This included being compliant with medications, recognizing and addressing worsening symptoms, and having the awareness to know when symptoms were worsening. Self-care is an essentially part of asthma self-management. By encouraging patients to take ownership of managing their asthma symptoms, we can decrease the patient's self-care demand and improve their self-care agency, which will eliminate the self-care deficit (George, 2011).

The Stetler model provided the step-by-step foundation that guided the implementation of this EBP project. Using this model, the intervention was implemented and data was collected and analyzed. The Stetler model was used to encourage ongoing evaluation throughout the duration of the project, as well as to guide dissemination of the findings within the clinical

setting. Future projects aimed to improved asthma outcomes in the primary care setting should also be grounded using an appropriate nursing theory and framework.

Research

The findings of this EBP project can add to the body of evidence that can be used to create clinical practice guidelines and implement policy changes. Overall, this EBP project was successful in improving asthma outcomes. Patients experienced statistically significant improvement in asthma control, quality of life, and asthma literacy through the project. This is consistent with the findings of existing studies that support the use of symptom tracking, personalized asthma action plans, and mobile technology. Studies on the benefit of mobile technology, specifically using a mobile application for symptom tracking and a digital action plan, are very new in the literature. This EBP project can add to the information that is available in this new area of research and provide valuable input for future studies. Future research is warranted to examine the long-term effects of using the mobile application. Further studies should also be conducted to evaluate the effectiveness of education and a mobile application in the pediatric population.

Education

The project manager identified early on in the development of this project, that there was a need to educate patients about asthma and the importance of managing asthma symptoms. Therefore, education was the primary intervention occurring within this EBP project. Education focused on understanding asthma and how it impacts the body, understanding asthma medications and how to properly use them, what triggers asthma, how to recognize and treat worsening asthma symptoms, and when to seek emergent medical care for severe symptoms. Education was provided solely by the project manage, within the primary care setting, before or after patient's regularly scheduled visits with the provider. Education also included discussion of an educational booklet, which patients were able to keep at no cost to them, and integration of the mobile smartphone app. In addition to education and the use of the mobile application

resulting in improved asthma control and quality of life, patients also had improved asthma literacy. This demonstrates that the educational intervention was beneficial in helping patients to better understand asthma, their medications, their asthma triggers, and what to do when symptoms worsen. This project demonstrates that asthma education should be incorporated into routine primary care visits in order to improve knowledge and prevent exacerbations.

Conclusion

This EBP project sought to answer the PICOT question, “How effective is an intervention that includes education and self-management using digital asthma action plans and symptom tracking via mobile application, compared to the current standard of practice in improving quality of life, asthma control, and asthma literacy over an eight-week period?” Findings indicate that there was statistically significant improvement both asthma control and asthma-related quality of life from initial evaluation to 4-week follow-up, from 4-week follow-up to 8-week follow-up and from initial evaluation to 8-week follow-up. Asthma literacy improved significantly with all four questions from the initial evaluation to four-week follow up. One of the four items, Item 3, demonstrated statistically significant improvement at both four and week-week follow up which demonstrates that there was a significant increase in all areas of asthma education. Secondary outcomes evaluated participants’ use of the mobile smartphone app and revealed that 100% of patients found the mobile application helpful. Additional secondary outcome questions demonstrated that overall patients found the mobile app helpful, would continue to use the app, and were actively engaged in using the mobile app throughout the intervention.

The intervention was successfully implemented, and demonstrated the importance of asthma education in the primary care setting. Due to the time required to complete this intervention, modifications will be made in order to encourage continued use in the clinical setting. A one-page handout will be developed to be given to patients, and will feature some facts about asthma, websites that are helpful in finding asthma-related material and some information encouraging patients to download AsthmaMD®. This will decrease amount of time

required of primary care providers to implement the intervention, yet still encourage asthma education. Advanced practice nurses are at the forefront of evidence-based practice and education, and through continued efforts can improve the lives of patients with asthma.

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BIOGRAPHICAL MATERIAL

Lindsay J. Humpfer

Lindsay graduated from Grand Valley State University in Grand Rapids, Michigan with her Bachelor of Science in Nursing in 2011, after which she began her nursing career working on a hematology/oncology/bone marrow transplant unit. After moving back home to Indiana in 2013, she worked in the Intensive Care Unit (ICU) as well as home hospice. For the last four years, Lindsay has worked at the Saint Mary's Valparaiso Health Center Immediate Care. Lindsay began the DNP program at Valparaiso University part-time in 2014, and she is looking forward to graduating this May. Lindsay is a member of the Coalition of Advanced Practice Nurses of Indiana (CAPNI) and Sigma Theta Tau. She was selected to represent Valparaiso University and the Zeta Epsilon Chapter of Sigma Theta Tau International, as one of the Rising Stars of Research and Scholarship at the organization's 2019 Creating Healthy Work Environments event in New Orleans in February. She also presented her project at the Northwest Indiana Research Consortium this past November. Lindsay's longtime personal history of asthma led her to pursue an evidence-based practice project focused on the use of a mobile smartphone application in conjunction with education to improve asthma control and quality of life in adult patients with asthma. Lindsay hopes that this project can provide new and innovative ways for practitioners to help their patients with asthma better manage their symptoms, thus reducing or preventing lost days of work and school, as well as visits to the emergency room. She is currently working on preparing a manuscript to be considered for publication in a nursing journal, and she is hopeful that her findings will be published. In the future, Lindsay hopes to work in either family practice setting or in an immediate/urgent care setting. In addition to improving asthma outcomes for patients, Lindsay is also passionate about improving palliative and hospice care services for patients at the end of life.

ACRONYM LIST

ACT: Asthma Control Test

AIS-6: Asthma Impact Survey

APN: Advanced Practice Nurse

CDC: Centers for Disease Control

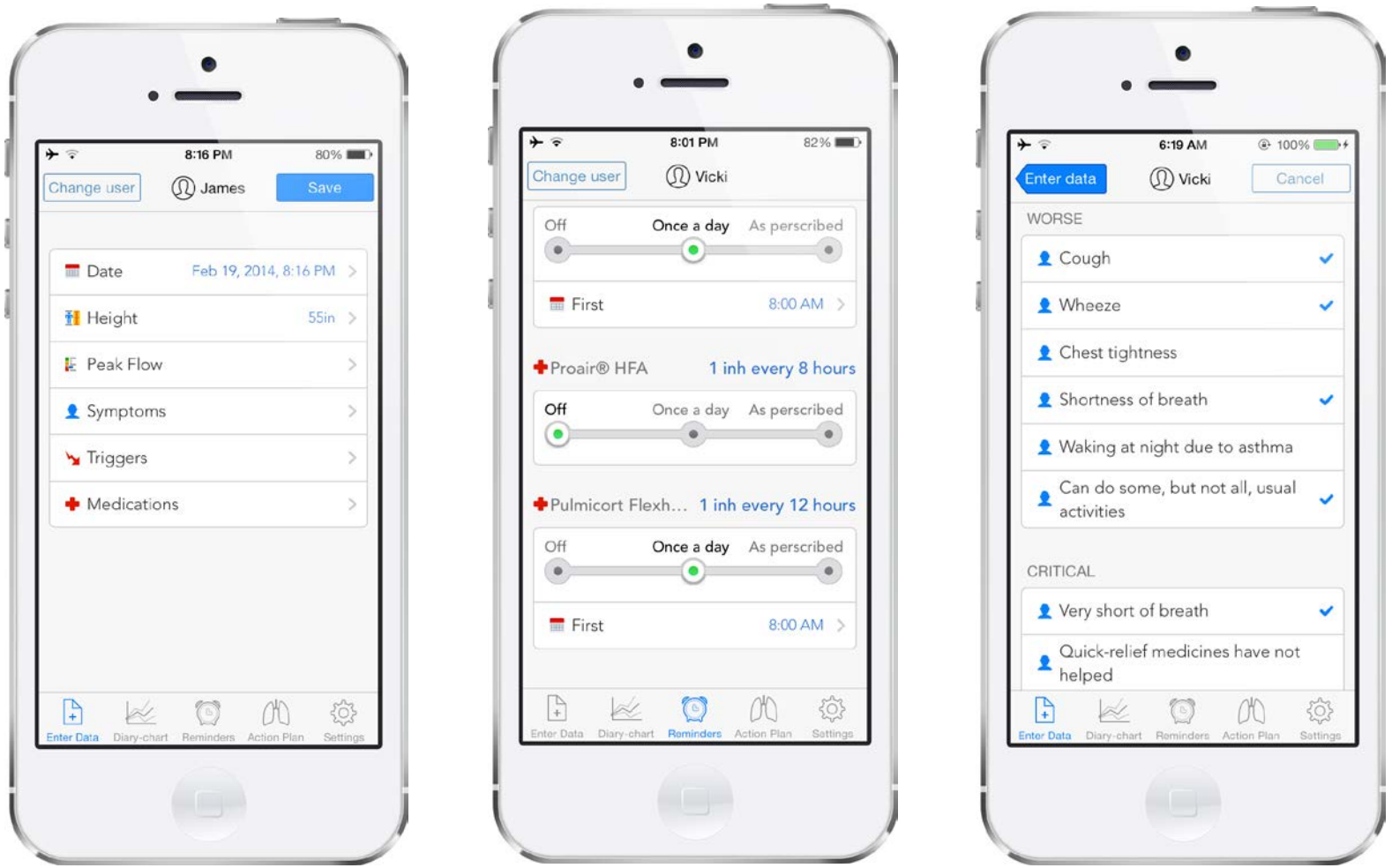
GINA: Global Initiative for Asthma

JBI: Joanna Briggs Institute

NCG: National Guideline Clearinghouse

NP: Nurse Practitioner

Appendix A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1 inh every 8 hours
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Once a day
As perscribed
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1 inh every 12 hours
Off
Once a day
As perscribed
First
8:00 AM
Enter Data
Diary-chart
Reminders
Action Plan
Settings
6:19 AM
100%
Enter data
Vicki
Cancel
WORSE
Cough
Wheeze
Chest tightness
Shortness of breath
Waking at night due to asthma
Can do some, but not all, usual activities
CRITICAL
Very short of breath
Quick-relief medicines have not helped
Enter Data
Diary-chart
Reminders
Action Plan
Settings

Appendix B

Evaluation of Mobile Application Use

1. Do you feel that the mobile application was helpful in keeping track of your asthma symptoms??
    a. Yes
    b. No
    c. Unsure
2. Do you think you will continue to utilize the mobile application in the future to manage your asthma symptoms?
    a. Yes
    b. No
    c. Unsure
3. How many times per week did you log your symptoms on the mobile application?
    a. 0-2 times per week
    b. 3-5 times per week
    c. 6-7 times per week

Appendix C

Asthma Literacy Questionnaire

Please answer the following questions about your level of understanding about your asthma.

0. I know what asthma is and could explain it to someone else.

    0- No confidence

    1- Slight confidence

    2- Moderate confidence

    3- High confidence

2. I know how to use my metered dose inhaler and nebulizer machine (if applicable).

    0- No confidence

    1- Slight confidence

    2- Moderate confidence

    3- High confidence

3. I know what triggers my asthma symptoms.

    0- No confidence

    1- Slight confidence

    2- Moderate confidence

    3- High confidence

4.I know what do when I start to experience asthma symptoms.

    0- No confidence

    1- Slight confidence

    2- Moderate confidence

    3- High confidence

Appendix D

Demographic Questionnaire

Please circle the answer to the following questions as accurately as possible. All information will remain confidential and be reported only in aggregate form.

1. **What race do you identify with?**
    a. White
    b. Black or African American
    c. Hispanic or Latino
    d. American Indiana or Alaska Native
    e. Asian
    f. Native Hawaiian or Other Pacific Islander
    g. Prefer not to answer

2. **What is your marital status?**
    a. Married
    b. Single (never married)
    c. Divorced
    d. Widowed
    e. Separated
    f. Prefer not to answer

3. **What is your household Income?**
    a. $24,999 or less
    b. $25,000 - $49,999
    c. $50,000 - $74,999
    d. $75,000 - $99,999
    e. $100,000 - $124,999
    f. $125,000 or greater
    g. Prefer not to answer

4. **What is the highest degree or level of school you have completed? (If you're currently enrolled in school, please indicate the highest degree you have *received.*)**
    a. Less than a high school diploma
    b. High school degree or equivalent (e.g. GED)
    c. Some college, no degree
    d. Associate degree
    e. Bachelor's degree
    f. Master's degree
    g. Doctorate

5. **How many years have you had asthma?** _____

Appendix E

Patient #	Age	Gender	Race	Marital Status	Income	Education	Asthma Years

	Lit1	Lit2	Lit3	Lit4	ACT 1	ACT 2	ACT 3	ACT 4	ACT 5	ACT Total	AIS 1	AIS 2	AIS 3	AIS 4	AIS 5	AIS 6	AIS Total	App 1	App 2	App 3
Pre																		X	X	X
4-wk																		X	X	X
8-wk																				