The Dissertation Committee for Tatiana Victorovna Makhinova Certifies that this is the approved version of the following dissertation:

Improving Asthma Management: Patient-Pharmacist Partnership Program in Enhancing Therapy Adherence

Committee:

Jamie C. Barner, Supervisor

Carolyn M. Brown

Karen L. Rascati

Kristin M. Richards

Arpita Nag Acharyya

Improving Asthma Management: Patient-Pharmacist Partnership Program in Enhancing Therapy Adherence

by

Tatiana Victorovna Makhinova, B.PHR., M.S.P.S.

Dissertation

Presented to the Faculty of the Graduate School of

The University of Texas at Austin

in Partial Fulfillment

of the Requirements

for the Degree of

Doctor of Philosophy

The University of Texas at Austin

August 2016

Dedication

This dissertation is dedicated to my beloved parents, Victor and Elena.

Acknowledgements

My years in the graduate program and the dissertation project particularly have been an amazing life changing journey that I was honored to take. Here, I would like to thank people that I am extremely grateful for their support and encouragement on the way. Above all, I would like to express my sincerest gratitude to my wonderful supervising professor, Dr. Jamie C. Barner. The accomplishment of my dissertation would be impossible without her thoughtful guidance, sage support, and life wisdom. I also would like to thank my committee members, Drs. Carolyn Brown, Karen Rascati, Kristin Richards, and Arpita Nag for their invaluable help and contributions on the dissertation project.

I am obliged to Prof. Sharon Rush, Dr. Nathan Pope, all the pharmacists, pharmacy residents and patients who enthusiastically participated in the project and made it possible. I deeply thank Belinda Lehmkuhle, Vicki Matustik, Benita Bamgbade, Andrew Thach, Tania Bahamóndez, Daniel Moraga-Espinoza, Tatiana Artamonova, Dee Gonzales for their assistance in developing materials for the project. Arlyn Kloessel Endowment award provided funding for this project.

I would like to extend my gratitude to the faculty members and fellow students of Health Outcomes and Pharmacy Practice Division for their assistance and inspiration. I am thankful to Stephanie Crouch for taking care of us so diligently.

I also want to thank friends from my home city of Voronezh (Drs. Natasha Shcherbakova, Marina Puzakova, Alexandra Dema, Yelena Kosheleva) for sharing with me their upbeat spirit and cheer. I would like to thank my family, whose encouragement and belief in me I felt every day despite the thousands of miles separating us.

Improving Asthma Management: Patient-Pharmacist Partnership Program in Enhancing Therapy Adherence

Tatiana Victorovna Makhinova, Ph.D.
The University of Texas at Austin, 2016

Supervisor: Jamie C. Barner

Adherence to long-term asthma controller medications is an important factor in effective asthma management. Suboptimal adherence to asthma controller medications is prevalent. This three-study dissertation presents a patient-pharmacist partnership program designed to enhance therapy adherence and provides preliminary results on the effectiveness of this program.

Study one consists of two parts. First, patient-centered, asthma-specific tools addressing key asthma adherence barriers in community pharmacy settings were developed. Second, five interviews with community pharmacists were conducted and three main topics were covered. In the first topic, "use of tools and overall approach", pharmacists reported the need for the identification of patients' barriers and that they found the proposed tools to be helpful in identifying and addressing patients' concerns. In the second topic pharmacists reported "barriers to implementation", such as time and workflow, patients' perception of the pharmacists and absence of reimbursement. The last topic included "facilitators and suggestions for implementation" and the following were suggested: identifying patients upfront based on their refill history, placing a note

on filled prescriptions, raising awareness among patients, involving technicians in the process of identifying patients, having a dedicated pharmacist staff and adding the proposed approach into in-store health clinics/fairs.

Study two was a cross-sectional pilot test of the developed tool for identification of patients' barriers to adherence in community pharmacy settings. The objective was to examine the association between asthma control, adherence barriers and asthma management characteristics. Significant ($p<0.05$) associations were found between the Morisky adherence scale score and the modified ASK instrument barriers score, as well as with the reported number of barriers, but not between adherence and asthma control. Possession of an asthma action plan was found to be a significant ($p=0.001$) predictor of a higher level of adherence, although less than half of the patients had such a plan.

In study three, the developed tools were pilot-tested in community pharmacies to assess effectiveness. Adult patients with persistent asthma in both the intervention and control groups were evaluated for asthma medication adherence, barriers to adherence and asthma control at baseline and 3 months later. While patients in the control group received usual care, those in the intervention group were provided with patient-specific education and counseling pertaining to their adherence issues. At 3 months, patients' were evaluated again and the analyses showed a significant improvement in barrier score between the pre and post period (increase by 3.9 ± 6.9, $p=0.035$) and a clinically meaningful increase (by 2.7 points) in asthma control in the intervention group only. There were no significant changes in adherence pre to post in either the intervention group or control group.

These studies provide insight into adherence behavior of patients with asthma and demonstrate how suboptimal asthma management can be addressed in community pharmacy settings. Pharmacists can effectively target common reasons for poor asthma adherence and management, such as lack of understanding how medications work and not knowing the goals of therapy.

Table of Contents

List of Tables

List of Figures

1. CHAPTER ONE

1.1 SPECIFIC AIMS

Continuous medication use is vital for patients with persistent asthma; however, reaching optimal adherence to asthma therapy poses a number of challenges, which can often be addressed when healthcare providers work with patients to identify and target patient-specific barriers to adherence. Pharmacists are in a key position to address these barriers, as the provision of educational counseling to patients has been shown to be effective for other chronic conditions [1-4]. However, there is little evidence regarding the effectiveness and feasibility of an asthma-specific adherence program. Therefore, there is a critical need to establish an effective pharmacist-led program that will enhance asthma therapy adherence through the identification and resolution of barriers using patient-focused strategies, which, in turn, can reduce the burden of asthma.

The *long-term goal* of this project is to develop an effective and efficient component of Medication Therapy Management (MTM) services provided by pharmacists that will be a standard for counseling patients with asthma. Our *objectives* were to: (1) develop patient-centered and asthma-specific tools, (2) determine best practices for implementation of these tools in community pharmacy settings, and (3) determine if use of asthma-specific tools improve medication adherence and asthma control. To meet these objectives, we pursued four specific aims:

Aim 1: Develop asthma-specific tools to aid in identifying and resolving barriers to asthma medication adherence

We developed asthma-specific adherence instruments through the modification of established instruments.

Aim 2: Identify effective methods for patient-centered counseling implementation in pharmacy practice

Through a series of interviews with practicing community pharmacists, we solicited opinions on the effectiveness, feasibility and challenges of implementing the asthma-specific counseling tools. Based on their feedback, we identified the best practices for implementing the tools to facilitate patient-pharmacist counseling.

Aim 3: Determine if baseline characteristics differ between Intervention and Control groups

As part of the program (see Aim 4), patients completed surveys at baseline, including questions regarding adherence, asthma control, barriers to adherence, chronic conditions, gender, race, age and education.

Hypothesis$1_{a\text{-}h}$: There is no significant difference between patients receiving asthma-specific counseling (intervention group) and patients who did not receive asthma-specific counseling (control group) on the baseline characteristics (i.e., adherence$_{1a}$, asthma control$_{1b}$, barriers to adherence$_{1c}$, number of chronic conditions$_{1d}$, gender$_{1e}$, race$_{1f}$, age$_{1g}$ and education$_{1h}$).

Aim 4: Determine if identification of adherence barriers and patient-centered counseling using the developed asthma-specific tools leads to improved medication adherence and asthma control

We recruited and trained community pharmacists who conducted 3 consecutive appointments aimed at identifying and resolving asthma-specific barriers. Patients completed surveys at baseline and 3-months post-initial visit to assess change in adherence, asthma control and barriers to adherence resolution. Analyses were conducted both between the intervention and control groups, as well as within the intervention group (i.e., baseline to 3-month follow-up).

Hypothesis 2a: Change in asthma controller inhaler adherence (from baseline to 3-month follow-up) will show significantly higher improvement for patients in the intervention group compared to the control group, while controlling for covariates.

Hypothesis 2b: Among patients in the intervention group, adherence to asthma controller inhaler will increase significantly from baseline to 3-month follow-up, while controlling for covariates.

Hypothesis 3a: Change in asthma control (from baseline to 3-month follow-up) will show significantly higher improvement for patients in the intervention group compared to the control group, while controlling for covariates.

Hypothesis 3b: Among patients in the intervention group, asthma control will improve significantly from baseline to 3-month follow-up, while controlling for covariates.

Hypothesis 4a: Change in adherence barrier score (from baseline to 3-month follow-up) will show significantly higher improvement for patients in the intervention group compared to the control group, while controlling for covariates.

Hypothesis 4b: Among patients in the intervention group, adherence barrier score will decrease significantly from baseline to 3-month follow-up, while controlling for covariates.

This study will provide healthcare professionals (pharmacists and others) with an asthma patient-centered counseling strategy. This project plays an important role in the initial identification and modification of instruments that will be asthma-specific and developed using pharmacists' input. This intervention resulted in improved outcomes for patients with asthma in community pharmacy settings and should be tested on a larger scale and in variety of practice settings. These instruments and their implementation may also be adapted for chronic obstructive pulmonary disease (COPD), another highly prevalent lung condition requiring the regular use of inhalers. Additionally, future research efforts should be focused on modifying our approach for children and adolescents with asthma, as they have age-specific barriers to medication adherence. The results of this study significantly contribute toward the effort of reducing the burden of asthma in adults.

1.2 BACKGROUND

Review of Relevant Literature

The following background section provides an overview of asthma incidence, prevalence and costs, followed by estimates of adherence to asthma controller medications. Next, general factors impacting medication adherence are reviewed, in addition to specific barriers to asthma medication adherence. Following that, studies in the pharmacy practice setting that address barriers to adherence are presented. Lastly, an overview of relevant instruments measuring medication adherence and/or barriers to medication adherence are addressed.

Definition and epidemiology

Asthma, one of the most prevalent chronic diseases worldwide, is characterized by a complex interrelation of airflow obstruction, bronchial hyperresponsiveness and underlying airway inflammation [5]. In 2011 asthma prevalence in the U.S. reached 24.6 million (8.6%) and the mortality rate for asthma was 1.1 per 100,000 in 2007 [6]. According to the National Center for Health Statistics, approximately 25 % of all emergency department (ED) visits in the US were due to asthma-related events [7]. Nearly 500,000 hospitalizations and approximately 14 million outpatient visits are evidence of high asthma morbidity [6]. Estimated annual direct and indirect costs of asthma were $18.3 billion in 2000, which increased to $56 billion in 2011 [8, 9].

Based on severity level, asthma can be classified as intermittent or persistent. Patients with intermittent asthma usually have minimal asthma symptoms and no

interference with normal activity, whereas patients with persistent asthma have more severe symptoms and limitations in normal activity due to reduced lung function [5]. Since inflammation is a key component of the asthma disease process, all patients with persistent asthma should use anti-inflammatory controller agents on a regular daily basis [5].

According to the *Expert Panel Report 3 (2007): Guidelines for the Diagnosis and Management of Asthma published by the National Heart, Lung, and Blood Institute* (EPR-3), persistent asthma is defined based on the frequency and severity of asthma symptoms, and on pulmonary function test results when possible [5]. Persistent asthma can be identified through surveying patients about their symptoms, functional limitations and asthma exacerbations in the prior 12 months. The survey to identify/confirm persistency of asthma (based on the EPR-3 criteria) was developed by Schatz et al. [10]. The survey includes 4 "Yes/No" items on impairment asking whether the patient in the past 30 days had 1) "experienced asthma symptoms at least 3 times per week"; 2) "used your rescue inhaler for symptoms at least 3 times per week"; 3) "been awakened by asthma symptoms at least 3 times"; 4) had asthma that "interfered with the normal activity". It also has a question assessing risk: 5) "In the past 12 months how many times have you been given oral corticosteroids (such as prednisone, methylprednisolone, medrol) for a flare up of your asthma?" Finally, it asks whether a patient has been taking asthma controller medication every day for the last 30 days. If a patient replies "yes" to one or more yes/no questions or had ≥2 oral corticosteroids (OCS) dispensed for an asthma flare indication in the past 12 months, persistency of asthma is indicated [5, 10].

Asthma controller adherence

Adherence is "…the extent to which a patient acts in accordance with the prescribed interval and dose of a dosing regimen…" [11]. Medication nonadherence is one of the major drivers of healthcare costs. The estimated avoidable cost of nonadherence in 2012 was $105.4 billion [12] — avoidable because better adherence can prevent costly events, such as emergency department (ED) visits and hospitalizations, thus reducing total healthcare spending. Asthma is one of the conditions in which nonadherence is widely observed, despite the established association between low adherence and poor outcomes [13]. Among the negative consequences of controller therapy nonadherence are avoidable exacerbations (with consequent ED visits and hospitalizations), absenteeism, and higher total expenditures [14, 15].

Adherence to asthma long-term controller medications is one of the key drivers to improve asthma management among patients with persistent asthma [5]. Nonadherence contributes to poor asthma control in conjunction with increased mortality, increased health care utilization, reduced lung function and decreased quality of life [16-22]. Medication adherence to controller therapy is consistently low, ranging between 30% and 70%,but often is reported to be between 30% to 40% in "real-world" practice settings (not in clinical trials) [23-29]. Therefore, addressing adherence to controller medications is critical in asthma management.

Factors impacting adherence in asthma

Given the goal of this research was to identify and resolve common barriers to adherence among patients with asthma, it is important to review conceptual models that have examined factors impacting adherence [30]. The World Health Organization (WHO) model purports that adherence is affected by five types of factors: patient-specific, health care team and health system-related, therapy-related, condition-related, and socioeconomic (Figure 1) [31]. A similar conceptual framework was proposed in the RAND review [30], which includes patient-related, provider-related, and health system-related factors, as well as cost-sharing and external cues (e.g., having the patient set an alarm reminder for times when the medications are to be taken) (Figure 2). *Note: Shading was applied to Figure 2 to show similarities to Figure 1.*

These two conceptual frameworks show that adherence to therapy is complex and multifaceted. Strategies to improve medication adherence should take a patient-centered vs. standard approach. As will be explored in the next section, the literature has identified several patient-related factors that impact adherence and several studies have shown successful outcomes with pharmacist interventions. Our study hypothesis was that identifying and addressing patient specific barriers facilitate effective collaboration and communication between patients and providers, thus leading to improved outcomes (i.e., asthma controller adherence and asthma control). Below is a detailed review of patient-related factors, followed by an overview of provider, health-system-related and other factors with a focus on asthma.

Patient-related factors

In general, patient-related factors include knowledge, attitudes, beliefs, perceptions, and expectations [31]. For example, does the patient understand that even if s/he does not have asthma symptoms, the controller medication still needs to be taken regularly? What is the level of self-efficacy/confidence in using an inhaler or a peak flow meter to manage symptoms? What are patients' beliefs about regular use of inhaled corticosteroids? This section will be reflective of the patient-related factors hidden in these and similar questions.

Two systematic reviews identifying the most common barriers to treatment among asthma patients were conducted and several patient-related factors were identified. Bender et al. systematically analyzed 32 studies and identified that the most common patient-related barriers to treatment among patients with asthma were lack of understanding of the asthma medication prescribed, followed by the fear of adverse effects [26]. Other patient-related barriers included: inconvenience, perception of intermittent need for controller medications, lack of knowledge regarding benefit of controller medications in prevention of symptom development and suspicion regarding medication effectiveness.

Figure 1.1 World Health Organization Five-Dimension Model of Adherence

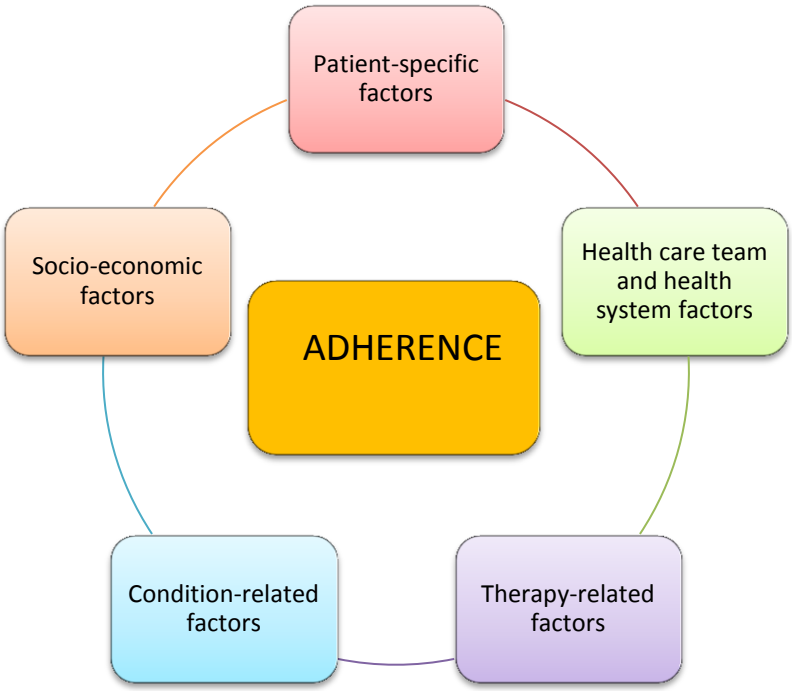
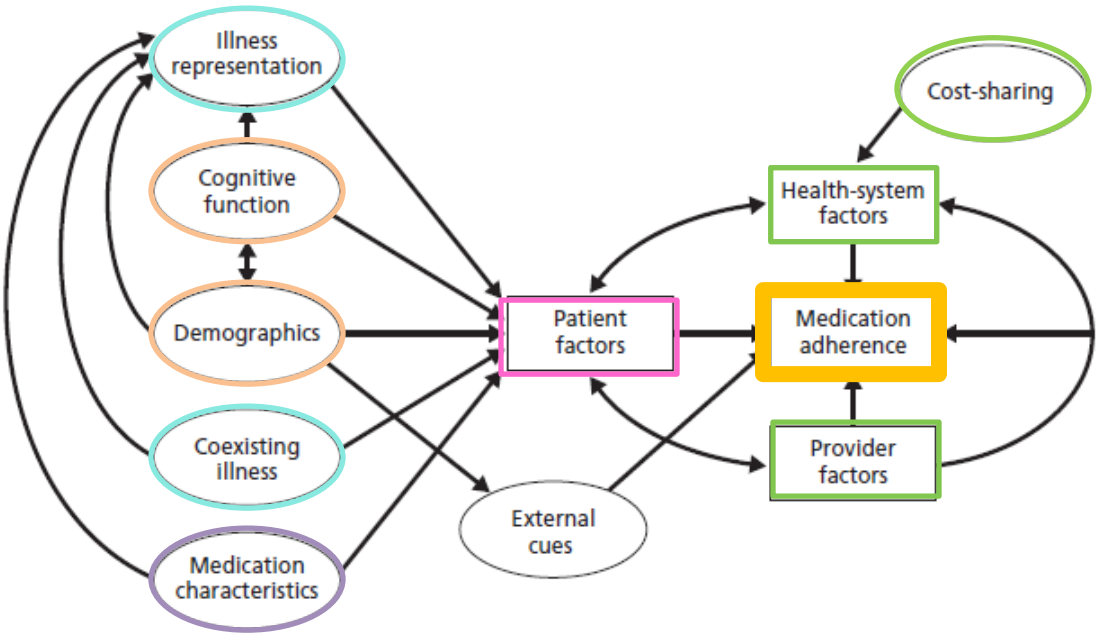


Figure 1.2 Rand Factors Impacting Medication Adherence: Conceptual Model



Howell (2008) performed another review of 22 studies (including 8 focused on barriers to adherence) [32]. Similar to Bender et al., Howell revealed the following patient barriers: lack of patient education and understanding of goals, difficulty with mastery of necessary skills, fear of asthma therapy, and misperception (controller medications are not helpful and do not prevent symptoms). In addition, Howell revealed barriers that are specific to devices used in asthma (i.e., inhalers and peak flow meters). For example, the author reported that patients were adherent to their controller inhaler 52.7% of the time vs. 83.2% to transdermally administered long-acting beta-agonists

[33]. Howell also reported other barriers to adherence, including difficulties with self-monitoring and lack of perception of disease severity.

The preceding two reviews of barriers to asthma therapy adherence were based primarily on descriptive studies and not on studies with interventions or those that included inferential analyses examining the relationship between barriers and adherence. However, several studies have evaluated this relationship and they are presented in Table 1.1 and discussed below.

From the five identified studies in Table 1.1, two illustrated the relationship between the presence of mental health issues and adherence to controller medications [34, 35]. In a study by Baiardini et al. anxiety was significantly ($p<0.05$) and positively correlated with difficulty accepting the asthma diagnosis and fear of side effects and negatively correlated with acceptance of the limitations caused by the illness [34]. Smith et al. found that patients' depression was positively correlated with fear of asthma medication side effects, lower level of illness knowledge, and lower ability to identify worsening signs [35]. Even though Baiardini et al.'s study does not provide information on how anxiety affects adherence, it demonstrates a strong relationship between mental health characteristics and common patient-related barriers to adherence. Smith et al. found that after adjusting for covariates, high levels of depressive symptoms was a significant predictor of nonadherence: the increase in odds of poor adherence (<50%) to therapy was 11.4 (95% CI=2.2–58.2, $p<0.01$) when compared to patients without high levels of depressive symptoms [35]. Therefore, patients' co-morbid psychiatric conditions may play a significant role in adherence to asthma controllers.

Another driver of nonadherence is patients' fears, concerns, and suspicions about medications. According to Bender et al.'s review, several studies showed that one of the central adherence barriers was fear of adverse effects [26]. Hansson et al. showed that during in-depth interviews, patients identified fear of adverse effects most frequently as a reason for not taking a medication as prescribed. Other identified fears were addiction to the medication, losing identity, and being labeled as having a chronic disease [36]. Ponieman et al. found adherence (measured through the Medication Adherence Reporting Scale (MARS)) to be significantly and negatively affected by worries about side effects of inhaled corticosteroids (ICS) (OR=0.52 (0.36–0.74), $p<0.001$), worries about getting addicted to ICS (OR=0.4 (0.2–0.8), $p<0.05$) and fear that ICS will stop working if used all the time (OR=0.4 (0.2–0.9), $p<0.05$) [37].

Ponieman et al. found two other factors that significantly influenced adherence to controller therapy: self-efficacy and necessity [37]. When patients were confident that they were able to use medication as prescribed, their odds of being adherent were 3.5 times higher than for those who were not (OR=3.5 (1.6–7.6), $p<0.05$). The odds of being adherent were also significantly higher for those who understood that ICS needs to be taken even when one is asymptomatic (OR=5.8 (2.3–14.6), $p<0.05$) compared to those who did not believe this statement [37]. This barrier is in line with Halm et al.'s study where patients had misconceptions about asthma. Specifically they had the following belief: "no symptoms, no asthma" [38]. Patients with this belief were more likely to have lower adherence than those who did not have this belief (OR=0.35 (0.19-0.64), $p=0.0005$) [38].

In summary, most of the barriers to asthma therapy adherence relate to patients: their understanding and education regarding side effects, addiction (dependence on medication), convenience, beliefs about medication effectiveness, and importance of consistent use of inhaled corticosteroids. If healthcare providers can identify these barriers in a timely manner and address them through effective communication with patients, this may help improve adherence to asthma therapy and overall control of asthma.

Table 1.1 Patient-related Barriers to Adherence among Adult Patients with Asthma

Study	Patient Population Description	Barrier Addressed	Adherence Measurement	Other Outcomes (if applicable)	Key Findings
Psychological Issues					
Baiardini et al., 2006 [34]	N=63; outpatient clinic	Anxiety Depression	Self-reported (Adherence Schedule in Asthma questionnaire)	1) Difficulty in accepting the illness 2) Acceptance of illness limitations 3) Fear of the side effects of medication 4) Knowledge of the illness 5) Ability to identify worsening signs	**Anxiety:** 1) Positive correlation with 1 (rho=0.33) 2) Negative correlation with 2 (rho= -0.30) 3) Positive correlation with 3 (rho=0.37) **Depression:** 1) Negative correlation with 3 (rho= -0.32) 2) Negative correlation with 4 (rho= -0.29) 3) Negative correlation with 5 (rho= -0.31)

Table 1.1 (continued)

Smith et al., 2006 [35]	N=59; patients after discharge who were hospitalized for asthma exacerbations (Inner-city academic hospital)	Depressive symptoms (Center for Epidemiological Studies-Depression scale)	Electronic monitors (2 weeks after discharge)	N/A	Mean adherence to therapy was significantly lower in patients with high levels of depressive symptoms (vs. without) (60±26% vs. 74±21%, p=0.02). High levels of depressive symptoms were associated with a 11.4-fold increase (95% CI, 2.2 to 58.2) in the odds of poor adherence to therapy after adjustment for potential confounders
Fears/Concerns					
Hansson Scherman et al., 2004 [36]	N=30; referred to specialty clinic	Fear of side effects	Self-reported (Two in-depth interview with the interval in 8 years)	N/A	Fear of side effects was a significant (p<0.05) contributor to nonadherence. Other fears contributing to nonadherence were: mistrust of the prescribing physician and pharmaceutical companies, fear of addiction to the medication,

Table 1.1 (continued)

					fear of losing identity and fear of being labeled as having a chronic disease.
Ponieman et al., 2009 [37]	N=261; persistent asthma; observed at the baseline, 1 and 3 months after	**Concerns** 1) Worried about **side effects** of ICS 2) Worried about **getting addicted** to ICS 3) If use ICS all the time they **will stop working**	Self-reported (Medication Adherence Reporting Scale (MARS); dichotomized)	N/A	All concerns were significantly associated with decrease in adherence 1) Side effects (OR=0.52 (0.36–0.74), p<0.001) 2) Getting addicted (OR= 0.4 (0.2–0.8), p<0.05) 3) Will stop working (OR=0.4 (0.2-0.9), p<0.05)
Self-efficacy					
Ponieman et al., 2009 [37]	N=261; persistent asthma; observed at the baseline, 1 and 3 months after	1) Confident in ability to use ICS as prescribed 2) Confident in ability to control asthma 3) Confident can control future health	Self-reported (Medication Adherence Reporting Scale (MARS))	N/A	Only first measure was significantly associated with adherence: OR=3.5 (1.6–7.6), p<0.05
Necessity					
Ponieman et al., 2009 [37]	N=261; persistent asthma; observed at the baseline, 1 and 3 asthma	1) Important to use ICS when symptomatic 2) Important to use ICS when asymptomatic	Self-reported (Medication Adherence Reporting Scale (MARS))	N/A	Only second measure was significantly associated with adherence OR=5.8 (2.3–14.6), p<0.05

Table 1.1 (continued)

Misconceptions of asthma					
Halm et al., 2006 [38]	N=198, hospitalized at least once over a 12-month period with asthma	Presence of "No symptoms – no asthma" belief	Self-reported (Use of ICS all/most of the times when asymptomatic)	N/A	The difference in the likelihood of being adherent between Those who had "no symptoms no asthma" belief were less likely to be adherent (OR=0.35 (0.19-0.64), p=0.0005) compared to those who did not have the belief

Healthcare- and provider-related factors

Healthcare-related factors represent factors such as cost-sharing, formularies, prior-authorization requirements, and access to care, which can significantly affect adherence [30]. The organization of care (e.g., ease of making appointments, evening hours, consistency of care, onsite pharmacy) affects adherence [39, 40]. There is lack of evidence how healthcare-related factors influence adherence specifically among patients with asthma; however, cost of asthma controller inhalers often serves as a barrier to adherence, when patients mention that they cannot afford using their controller medication regularly because of the price [41, 42]. In the review study conducted by Bender et al., medication cost was one of the most common barriers to adherence [26]. These results were supported by the survey study (n=200), where the same author (in a later study) found cost of medicine being a barrier to adherence [43].

Provider-related factors, which include patient-provider communication, can influence patient's adherence along with other outcomes [44]. Factors, such as duration of consultations and level of satisfaction/trust-distrust between patients and providers also contribute to level of adherence [30]. For instance, George eat al. found that distrust of healthcare providers was associated with decreased adherence [45], and dislike of the provider was cited as one of the most common barriers to adherence in the Bender et al. review study [26]. Also, patients' mistrust of prescribers and pharmaceutical companies was negatively associated with adherence [26].

In conclusion, even though barriers to adherence are often patient-related, other factors, such as access to care and effective patient-provider communication has to be evaluated and addressed in practice.

Other factors

Socio-economic factors also contribute to nonadherence. Low socio-economic status, African American ethnicity, older age, and being female have been associated with lower adherence [18, 46]. Disease-related factors are mainly associated with the chronic nature of the condition and the need for continuous and regular use of the medication, which itself is a barrier to adherence for many patients [31]. Finally, asthma therapy-related factors may be barriers to adherence because treatment requires the use of devices (e.g., inhalers for quick relief and controllers, peak flow meters, spacers). Inhaled route of delivery can be a barrier among patients with asthma, with one study finding adherence to inhalers to be 30% lower than to transdermally administered medication

[33]. The complexity of the regimen has been found to be a barrier to adherence, as patients who are taking several medications by various routes are more likely to be nonadherent [34, 47]. Patients who reported that ICS regimen was hard to follow were less likely to be adherent (OR=0.2 (0.05–0.8), $p<0.05$) [37].

All five groups of factors impacting patient adherence to controller medication are often inter-related. To resolve patient-related barriers, efficient patient-provider communication is needed. Therapy-related barriers might be connected to person-related barriers, or vice versa. With this, careful attention to patients' needs and "seeing the big picture" are crucial for healthcare providers when addressing barriers to adherence.

Interventions involving pharmacists in improving asthma medication adherence

With an understanding of common factors impacting asthma medication adherence, it is important to learn what strategies have been implemented for asthma improvement, and the effectiveness of these strategies. In 2008, the Global Initiative for Asthma (GINA) group published guidelines for addressing common barriers to medication adherence. Specifically, the guidance includes drug-related and nondrug-related factors that impact medication adherence with corresponding interventions to address each factor (Table 1.2) [48]. Also, patients can be nonadherent unintentionally (e.g., due to forgetfulness, carelessness in taking a medication), or intentionally (not taking medication when feeling better or worse) [49].

This section provides an overview of interventions involving pharmacists and the impact of interventions on asthma controller medication adherence. Overall, the

interventions were patient-centered and targeted at patient-related factors such as disease state and medication knowledge, self-management and medication-related factors (asthma inhaler technique and peak flow meter use).

Table 1.2 Factors Affecting Adherence to Asthma Treatment and Interventions to Address Barriers, GINA 2008

Factors affecting adherence	Interventions to improve adherence[a]
Drug-related factors	
Difficulties with inhaler devices	Identify the appropriate device for patient. Demonstrate use and have patient demonstrate technique in turn [b]
Awkward regimens—e.g., 4 times daily—or multiple drugs	Simplify regimen or tailor to patient preference [b]
Fears about side effects	Determine whether concern is theoretical or specific. If specific, relate the persistence of the symptoms vs likelihood of side effects. Use Motivational Interviewing to assess pros vs cons and reduce ambivalence. Consider referral to support group [c]
Cost of medication	If patient has prescription plan, select least expensive drug. If not, refer to discount pharmacy plans or pharmaceutical programs [d]
Dislike of medication	Reduce allergic or irritant exposure to decrease symptoms or medication [e] Use Motivational Interviewing to discuss "pros and cons" and reduce ambivalence [c]
Distant pharmacies	Identify capability of receiving prescription by mail [d]
Non–drug-related factors	
Misunderstanding or lack of instruction	If lack of instruction, provide instruction. Assess level of literacy. If low, provide suitable education strategy. Review pathophysiology and rationale for treatment as well as consequences of no treatment. Provide instruction and have patient demonstrate technique [f]
Dissatisfaction with health care professionals	Have patient speak to administrator regarding issue. May require patient to see another provider if interactions do not improve [d]
Unexpressed/undisclosed fears or concerns	Identify concerns and address each. Determine whether they are theoretical or actual. Consider referral to a support group. May require psychological intervention if fears or concerns persist [c,d]
Inappropriate expectations	Clarify expectations from a medical perspective. If patient expects greater or quicker improvement, attempt to reset expectations. Review role of allergen/irritant exposure as factor [f]

Table 1.2 (continued)

Poor supervision, training, or follow-up	Encourage supervision for children/elderly. Review use of medication in office. Schedule appropriate follow-up [f]
Anger about condition or its treatment	Identify reason for anger. Express that treatment may improve condition. Assess ambivalence about treatment and review possible alternatives [c]
Underestimation of severity	Relate symptoms with pulmonary function or use exercise challenge to demonstrate severity of condition [e]
Cultural issues	Appreciate that varying cultures have different concepts of development of asthma, factors that exacerbate it, and treatment choices. Take advantage of community health workers to clarify issues [f]
Concerns about stigmatization	Assess patient reaction to diagnosis. Understand the patient's concerns and refer to support group if the concerns persist [c]
Forgetfulness or complacency	Determine whether the problem is forgetting to follow treatment vs other reasons. Consider tailoring medication use to patient's daily activities [f] Address complacency by withdrawing treatment to determine actual need for treatment [e]
Attitudes toward ill health	Assess patient's health beliefs about asthma and treatment. For patients who question the diagnosis or efficacy of treatment, consider stopping treatment and having patient monitor lung function at home [e]
Religious issues	Clarify how patient's religious beliefs may affect attitudes about diagnosis and treatment. Discussing this with patient's religious leader may give insight and source of support for the patient [f]

[a] Global Strategy for Asthma Management and Prevention, Global Initiative for Asthma (GINA) 2008. Available at http://www.ginasthma.org.
[b] Guidelines for the Diagnosis and Management of Asthma (EPR3) 2007. NIH, NHLBI. August 2007. NIH publication no. 08-4051.
[c] Borelli B, Riekert K, Weinstein A, Rathier L. Brief motivational interviewing as a clinical strategy to promote asthma medication adherence. *J Allergy Clin Immunol.* 2007;120:1023-1030.
[d] Asthma PACT (Personalized Assessment and Control Tool). Asthma and Allergy Foundation of America, 2004-2010. Available at www.AsthmaPACT.org. Accessed February 19, 2010.
[e] Weinstein AG. Clinical Management Strategies to Maintain Drug Compliance in Asthmatic Children. Annals of Allergy 1995;74:304-310.
[f] Rand C, Bender B, Boulet L-P, Chaustre I, Weinstein A. Asthma, Chapter 7, *World Health Organization Report 2003: Adherence to Long-Term Therapies: Evidence for Action*. Geneva, Switzerland: World Health Organization, 2003:50.
Adopted from Weinstein The potential of asthma adherence management to enhance asthma guidelines Ann Allergy Asthma Immunol. 2011;106:283-291[48]

As shown in the previous section and in Table 1.2, most patient-related barriers to adherence can be resolved through communication with patients to: (1) identify the barrier/specific problem and (2) target/resolve the barriers to adherence. Among health

care professionals, pharmacists are placed in a position where they are accessible and can effectively communicate with and educate patients about how to effectively manage their asthma. As mentioned previously, barriers to adherence can be diverse and complex. The current study's approach to possible barriers to adherence was conceptually driven by the WHO Medication Adherence model (Figure 1). The complex nature of barriers also signals the need for a partnership approach to build effective skills for self-management. Below is a brief review of examples where pharmacists have identified and resolved barriers. Following this section is a more expanded review of intervention studies.

Community pharmacists in adherence improvement programs

Community pharmacists were effective in identifying patients in need of asthma control and adherence improvement [50, 51]. Patients with asthma (n=1,048) were asked to complete a questionnaire with demographic, asthma control test and asthma control perceptions items. Almost 70% of those with inadequate control (measured by ACT) considered themselves to be "well-controlled" or "completely controlled," which revealed a disconnect with the patient perception and signaled the need for pharmacist intervention [50]. Another group of researchers identified patients at risk (6 or more asthma reliever inhalers during a 12-month period) and then conducted either face-to-face or mail intervention providing patient education and referral to a general practitioner, which yielded improvement in preventer (controller):reliever (resque) inhaler ratio [51]. Also, community pharmacist-based approaches for asthma management demonstrated significant improvements in clinical, humanistic, and economic outcomes [52, 53]. Smith et al. found that effective collaborative goal-setting with patients was positively

associated with asthma control [52]. Mangiapane et al. reported improvement in humanistic outcomes (e.g., asthma-specific quality of life, knowledge, self-efficacy) and asthma symptoms (e.g., asthma severity, self-reported symptoms, peak flow values) due to a cooperative model of care in Germany during 2 years [53]. In addition, one study compared reactions of pharmacists and physicians after reviewing inappropriate asthma medication use via prescription records [54]. The study showed that pharmacists were more proactive in addressing the medication-related problems. Thus, their interest in this area was evident.

Table 1.3 shows that pharmacists provided various educational interventions in three different domains: drug regimen management, education, and behavior. Some of the intervention programs were focused on a single issue approach (e.g., inhaler technique only), while others were comprehensive models that involved complex patient care, such as MTM.

Patient education can be delivered by different modes, but one is crucial: patients' needs should be identified first. If a patient's learning deficits are not known, then the intervention does not address patient-specific needs, which can negatively impact effectiveness [55]. This highlights the importance of patient-tailored education; as evidence of this, one study showed that patients were found to be dissatisfied with education that was not individualized [56]. Among the reviewed studies in Table 1.3, four explicitly indicated that interventions were patient-focused [57-60].

Most of the studies (Table 1.3) were randomized controlled trials [57, 59-62] and conducted outside of the U.S. [57-61, 63] and in community pharmacy settings [57-61,

63]. Only one study focused on a single training aspect — inhaler technique [63]. The remaining studies included several elements as a part of the educational training: inhaler device technique (all discussed studies); asthma knowledge or understanding asthma and asthma medications [58, 59, 61]; asthma control [57, 59, 60] and perceived control [59, 62]; asthma-related quality of life [59-62]; lung function [59, 62]; medication profile and daily dose [59]; action plan ownership [59, 60]; asthma exacerbations [60]; and smoking cessation [61]. Adherence was measured through self-report [57-59, 61, 63], prescription claims [61], and objectively through dose counter monitoring devices [60, 62]. Prior to providing the interventions, three studies indicated that pharmacists were trained: in inhaler technique (2-hours) [63] and implementing personalized patient education (one- [57] or two-day [59] workshops). Other studies did not provide training information. To better focus on patient needs and to tailor interventions accordingly, patients were evaluated at baseline for: asthma control with the asthma control questionnaire (ACQ) [57, 63] or the asthma control test (ACT) [61], inhaler technique using the checklist to evaluate skills [59, 63], asthma knowledge [57], and asthma concerns using the Patient Asthma Concerns tool [60].

After the main intervention session, patients were followed for 6–12 months and evaluated after a 3- or 6-month period and at the end of the study. Results demonstrated that all of the interventions conducted in the pharmacy settings were successful such that adherence to the controller therapy significantly improved. Educational interventions had a significant positive effect on adherence to controller therapy regardless of how adherence was measured, whether by the scores from the self-reported instruments, or by

the ratio of adherent-nonadherent patients, or through data from electronic dose counters. It is difficult to conduct a comparative effectiveness investigation, because adherence and other outcomes were measured differently and all of the details of each intervention, especially when they were designed to be patient-specific, are hard to compare. In a review article by Axelsson and Lövall, the authors proposed a model comparing the impact of varying levels of interventions on adherence relative to the cost of delivering the intervention [64] (Figure 3). Based on the studies reviewed, the interventions were patient-centered, thus falling on the continuum of high impact and high cost.

Table 1.3 Strategies to Improve Asthma Adherence in Community Pharmacy Settings

Study	Patient Population Description	Type and Method of Management	Adherence Measurement	Other Outcomes	Key Findings
Inhaler technique					
Giraud et al., 2011, France [63]	N=727; Prospective observational study; Duration: 4 months	Inhaler training session (6 min) Evaluation: check-list for each inhaler device type	Self-reported (4-item Morisky scale): scores range between 0 (very good adherence), to 4 (very poor adherence).	Asthma control (ACQ); 7 items, 1 week recall, scores range between 0 (totally controlled) and 6 (severely uncontrolled).	Poor asthma control (ACQ<1.5) was significantly associated with poor inhaler technique ($p<0.05$) and with poor adherence ($p<0.05$); At one month follow-up % of patients with optimal inhaler technique increased from 24% to 79% ($p<0.001$); asthma control improved from ACQ 1.8(1.2) to 1.4(1.1), $p<0.001$; adherence improved from Morisky scale score 1.4(1.3) to 1.1(1.3), $p<0.001$.

Table 1.3 (continued)

Education					
Mehuys et al., 2008, Belgium [61]	N=201; Parallel group RCT; Duration:6 months Follow-up (0-1m-3m-6m)	Education on use of inhaler device, understanding asthma, understanding asthma medication and smoking cessation (Control group: usual care)	1) Prescription refill rates 2) Self-reported (How often do you **not** take your controller medication as prescribed? Never, 1–2 times/year,1–2 times/month, 1–2 times/week, daily).	1) Asthma control (ACT); 5 items, 4-week recall, scores range between 5 (poor control of asthma) to 25 (complete control of asthma), with higher scores reflecting greater asthma control. 2) Severe exacerbations 3) Asthma-specific quality of life 4) Knowledge about asthma and treatment 5) Inhalation technique	Adherence: Based on refill rate IV group had higher adherence 90.3±30.3% vs. 74.6±36.5% (p=0.016); self-reported adherence did not differ. Significant improvement was in: inhaler technique, decrease in rescue medications use.
Garcia-Cardenas et al., 2013, Spain [57]	N=336; Cluster RCT; Duration:6 months Follow-up (0-3m-6m)	Education on individual needs: asthma control, inhaler technique, medication adherence. Included verbal, demonstration and written parts and goal-setting (Control group: usual care)	Self-reported (4-item Morisky scale): scores range between 0 (very good adherence), to 4 (very poor adherence).	1) Asthma control (ACQ) 2) Inhaler technique	Number of adherent patients increased by 40.3%, p<0.001 Number of patients with controlled asthma increased by 30.1%; At 6 months patients in IV group were more likely to have controlled asthma compared to control group (OR=3.06, 95%CI:1.63-5.73, p<0.001) Number of patients with correct inhaler technique increased by 56.2%, p<0.001; Number of adherent patients increased by 60.8%, p<0.001.

Table 1.3 (continued)

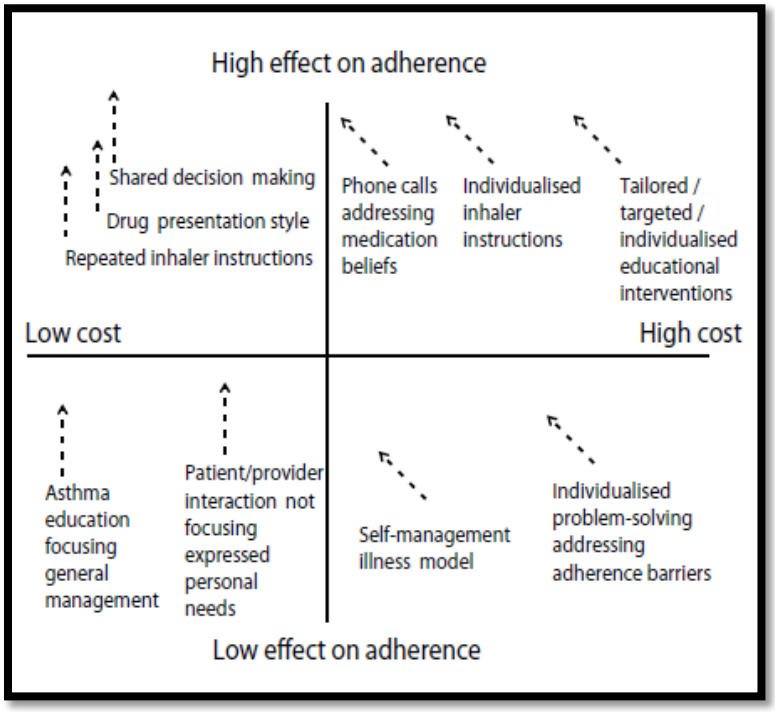
Saini et al., 2011, Australia [58]	N=570; Parallel group design; Duration: 6 months Follow-up (0-6m-12m)	Tailored education based on asthma knowledge results	True/false Item: "With asthma preventer medications it doesn't matter if some doses are missed or if you go on or off"	Asthma knowledge (Consumer Asthma Knowledge Questionnaire): 12-item questionnaire comprising a series of true/false questions. A higher score indicates better asthma knowledge.	Asthma knowledge significantly improved (7.65 vs. 8.78, p<0.001). Higher proportion of patients identified adherence item as "false" (i.e. realized the regular use of controller is needed) (IV vs. control: 79% vs.71%, p=0.006).
Armour et al., 2007, Australia [59]	N=396; Multi-site, repeated measures RCT; Duration: 6 months	Pharmacy Asthma Care Program (PACP): cycle of assessment, goal setting, monitoring and review	BMQ, Risk for nonadherence; 11 yes/no questions (yes=1 in favor of risk for nonadherence, no=0)	Asthma severity/control, Lung function, Medication profile, Daily dose of medications, Inhaler technique, Action plan ownership, Asthma-related quality of life, Perceived control of asthma, Asthma knowledge	IV group resulted in improved scores on risk of non-adherence (difference 20.44, 95% CI 20.69 to 20.18; p = 0.04); Proportion of IV patients with severe asthma declined from 88% to 53% (p<0.001) while controlgroup patients remained unchanged (71% to 68%; p= 0.11). Asthma quality of life score (p=0.05), consumer asthma knowledge score (p<0.01) and perceived control of asthma score (p<0.01) improved significantly compared to control group.

Table 1.3 (continued)

Goeman et al., 2013, Australia [60]	N=114; Single-blind, parallel RCT; Duration: 12 months Follow-up (0m-3m-12m)	Person-center education: device technique and any patient concern vs. written information-only education	Dose counter device monitor (over three two-week periods)	Asthma control, Asthma-related quality of life, Asthma exacerbations, Action plan ownership	IV participants experienced improvements in asthma control, adherence to asthma controller medication (difference was 19.3%, reduced exacerbations, improved quality of life and an increase in asthma action plan ownership at 3 and 12 months.
Janson et al., 2009, Bay Area, US [62] (not in the pharmacy settings)	N=84; Prospective RCT; Duration: 6 months (1 month of IVx2, 5 months of observation held once a month)	Self-management education (30-min intervention): self-monitoring of symptoms, peak flow monitoring, inhaler technique	Electronic device validated for monitoring MDI use.	Pulmonary function, Quality of life, Perceived control, Asthma symptoms	IV group maintained consistently higher ICS adherence levels and showed a 9-fold greater odds of more than 60% adherence to the prescribed dose compared with control subjects at the end of the intervention ($p=0.02$) and maintained a 3-fold greater odds of higher than 60% adherence at the end of the study. Significant improvements were found in: perceived control of asthma, nighttime awakenings, and inhaled β-agonist use compared to control group ($p<0.05$)

ACQ = Asthma control questionnaire; ACT= Asthma control test; BMQ=Brief Medication Questionnaire, IV=Intervention; MDI= Metered dose inhaler; RCT=Randomized controlled trial.

Figure 1.3 Model suggesting the potential effect of interventions on adherence



In summary, this analysis has demonstrated that pharmacists play an important role in delivering asthma management interventions that improve adherence to controller medications and asthma control by addressing both intentional and unintentional barriers. Most of the studies reviewed above were conducted abroad, whereas in the US, the niche where adherence to controller medications is addressed is in the provision of MTM services.

Few studies have explored the provision of MTM services with a focus on asthma education. The most relevant study was conducted as a part of the Asheville Project, in which clinical, humanistic, and economic outcomes were evaluated over 5 years of an

asthma education and MTM program [65]. Even though the program did not evaluate adherence, the strategy and the effectiveness of the program is worth noting. An asthma educational program was provided to 207 patients over a period of 5 years in Asheville, NC. The intervention consisted of two parts: one-on-one asthma education provided by a certified asthma educator in one or two sessions (60-90 min) and follow-up regular appointments with a pharmacist every 3 months (30 min). The main outcomes measured were FEV1, asthma severity, symptom frequency, quality of life, presence of an asthma plan, asthma-related ED visits/hospitalizations, and asthma-related costs. As was found in the previous research where similar interventions were performed, all of the outcomes measured were significantly better after 1 year or longer in the program. Even though adherence was not measured, the medication-related costs increased, which may be an indicator of improved adherence as well as improved control of asthma. Overall, this study demonstrated how a community pharmacy-based MTM program can significantly improve asthma outcomes.

Moore et al. recently conducted a study evaluating the provision of MTM services for high-risk patients, including those with asthma [3]. The authors assessed plan-paid health care costs, utilization of medical services, overall days supply of targeted medications, and adherence [measured using medication procession ratio (MPR)]. Two groups (those who received MTM services and a control group) were compared using data from 1 year pre and post intervention. All of the outcome measures were not specified by disease state, but overall. MPR did not change significantly between the intervention and control groups. Only bivariate (unadjusted) analyses were conducted.

However, the mean MPR in the intervention and control groups were low: 56.8% (SE 1.5) and 53.8% (SE 1.6), respectively. Healthcare costs and inpatient visits in the intervention group decreased by 10.3% and 16.8%, respectively; whereas both parameters increased in the control group ($p=0.048$ and $p<0.001$), respectively. Even though overall average days supply increased in the MTM group by 72.7 days over baseline (and decreased by 111.1 days in control group), mean MPR for asthma medications did not change.

The review of the studies demonstrated the value and effectiveness of pharmacists' services for patients' asthma management improvement, including adherence and outcomes; however, several gaps exist that need to be addressed:

1. Most of the patient-centered programs with the goal of improving adherence were conducted in Europe or Australia, whereas few studies were conducted in the US.

2. Little is known about effectiveness of individualized counseling based on the identified barriers to adherence conducted by pharmacists. The most common discussion points addressed in the counseling sessions were asthma action plan, medication assessment, inhaler technique, and symptoms frequency; whereas other adherence barriers factors, such as patient-specific or provider-related factors, are lacking.

Therefore, there is a need for more evidence on effectiveness and feasibility of patient-centered asthma specific counseling provided by pharmacists designed to improve adherence to controller therapy. Establishing an effective pharmacist-led program that will enhance asthma therapy adherence through identifying patient barriers and resolving them using patient-focused strategies will be an important step in addressing this need.

The previous sections discussed common barriers to asthma controller therapy adherence, as well as strategies that were used by pharmacists (mainly abroad) to improve adherence. As identification of patient adherence barriers is one of the crucial steps in promoting adherence [49], it is important to have an instrument that will address this need. The next section offers an overview of the instruments that can be utilized by pharmacists during MTM provision to estimate adherence and/or identify underlying reasons for nonadherence.

Instruments to assess adherence and identify barriers

Items that measure adherence and barriers to adherence are often related and are presented jointly in this section. A limited number of instruments exist that assess adherence and identify barriers to adherence. In this section, the focus will be on the instruments that allow some level of assessing reasons for nonadherence. A description of the instruments will be presented, followed by a comparison of the instruments regarding the type of adherence factors included.

The following self-reported instruments have been used in evaluating adherence in clinical practice: Adherence Estimator (AE), Adult Asthma Adherence Questionnaire™(AAAQ), Medication Adherence Report Scale for Asthma (MARS-A), Morisky scale (MMAS-8 and MMAS-4), Beliefs about Medicines Questionnaire (BMQ), Adherence Starts with Knowledge (ASK-20 and ASK-12) and the DRug Adherence Work-up (DRAW) tool. The MMAS-4 [57, 63] and BMQ [59] have been used in

previously reviewed studies, whereas the other tools have not been used as frequently in adherence improvement programs.

AE is a 3-item questionnaire that assesses adherence by measuring three proximal beliefs about the medication: perceived concerns about medications, perceived need for medications, and perceived affordability of medications using a 6-point Likert scale [66]. This instrument allows identification of low (0), medium (3-7) and high (≥8) risk for adherence problems based on the scores assigned to each response item (scoring is provided by the author in the referenced study). AE has good sensitivity of 88% and when compared with pharmacy claims data the specificity was 49% and the positive predictive value was 68.4%. Discriminant validity was measured, but validity and reliability of the instrument was not reported. The short length is user-friendly and the items capture underlying intentional causes of nonadherence. This instrument, which was developed in 2009 has been used in a practice based study, where pharmacists reported that the AE helped to promote counseling on adherence [67].

AAAQ is 5-item asthma-specific questionnaire that identifies patients at risk for nonadherence and the specific barriers to adherence [68] focusing on the following 5 constructs: following a medication plan, forgetting, not “needing” the medications, side effects, and cost. The response scale is a 6-point Likert scale. AAAQ has low internal consistency reliability (<0.50), which suggests not combining all 5 items into one scale score. The presence of a problem on any of the five adherence questions was significantly and negatively related to the 6-month adherence (PDC < 0.50, $p<0.001$). Also, patients

with adherence problems were significantly more likely to have uncontrolled asthma (ACT< 20, p<0.001).

MARS-A is a 10-item questionnaire for assessing adherence to asthma controller inhaler among persistent asthmatics [69-71]. It has both general and asthma-specific items, as well as intentional and nonintentional nonadherence assessment. All the questions are framed negatively, reflecting nonadherence being normal with a 5-point Likert scale (1 = "Always" and 5 = "Never"), to the question "How often do you do the following?" Lower scoring indicates poor adherence with the mean score of lower than 4.5 demonstrating nonadherence [72]. All reliability and validity assessments were good: internal consistency (Cronbach's alpha=0.85); criterion validity (significant correlation with electronically measured adherence); and test-retest reliability (r=0.65, p<0.005).

The 8-item Morisky scale (MMAS-8) is designed to facilitate the identification of barriers to adherence to chronic medications [73, 74]. It allows identification of nonadherence (both, intentional and unintentional) and whether it is due to perceived need, difficulties following the regimen, or forgetfulness. Summary scores range from 0 to 8, with the first 7 items' response scale of "Yes" (1 point) or "No" (0 points) and the 8th item used a 5-point Likert scale. A total score greater than 2 indicates low adherence. MMAS-8 is reliable (Chronbach's alpha=0.83) and was used in practice among asthmatic patients [75]. Validity of MMAS-8 was not measured for patients with asthma. The MMAS-4, a shorter version of the MMAS-8, is the most widely used generic scale for adherence assessment, including asthma. Similar to the MMAS-8, every "Yes" response equals to 1 point and based on the scores patients are classified as highly adherent (0),

medium adherent (1-2), and low adherent (3-4). It has moderate to high reliability and criterion validity [76].

BMQ assesses subjects' treatment beliefs and has two five-item subscales measuring concerns (worries about side effects, long-term effects, becoming addicted) and beliefs about the necessity of the treatment (both present and future health depends on the asthma medication and the medication prevents a worsening of the disease) [69]. The BMQ items are measured on a 5-point Likert scale (1 = strongly disagree; 5 = strongly agree); both subscales have satisfactory internal consistency (Cronbach's alpha for 4 constructs was within 0.47-0.80).

ASK-20 and the reduced validated version, ASK-12, is developed for adherence barriers identification. The ASK-20 (Adherence Starts with Knowledge) survey is a generic instrument developed by Hahn et al. in 2008 to assesses behavior and barriers related to treatment adherence [77]. ASK-20 consists of three domains: Inconvenience/forgetfulness (4 items), treatment beliefs (9 items) and behavior (7 items) measured on a 5-point Likert scale. Reliability, as exhibited by internal consistency (Cronbach's alpha = 0.76) and test-retest reliability (Cronbach's alpha = 0.80) were in the acceptable range. It was also shown to be valid with significant correlations to the Morisky Medication Adherence Scale ($r = -0.61$, $p < 0.001$), and the SF-12 Mental Component Summary score ($r = -0.40$, $p < 0.001$) [78]. At present, only one study has employed the ASK-20 instrument for the purposes of identifying adherence barriers to provide patient-centered asthma education intervention [79]. In this study, participants (N=112) were asked to complete three surveys: ASK-20, ACT and a productivity

questionnaire before the intervention and 6 months after. Based on the specific barriers that were identified for each participant, patient-specific reports were created and utilized during the intervention consisting of two telephone conversations with patients and three educational mailings for patients. As a result, the number of barriers to medication adherence reduced significantly (3.8 to 2.8; p=0.0021), which was congruent with asthma control and productivity results. The number of participants with controlled asthma (i.e., ACT score > 19) increased from 50.0% to 64.6% (p=0.0285) and the mean number of missed days decreased from 3.1(5.1) to 1.8(2.8) (p=0.0185). Most of the participants were satisfied with the program. The main limitation of this study was lack of medical and pharmacy data regarding adherence (e.g., pharmacy claims) and asthma control (e.g., FEV1, healthcare utilization). In addition, it was an observational study with a convenience sample.

To reduce respondent burden, a shortened version of ASK-20, with 12 items (ASK-12) was developed and had similar reliability and validity as ASK-20 [80]. ASK-12 also consists of the same three domains as ASK-20, but with fewer items: Inconvenience/forgetfulness (3 items), treatment beliefs (4 items) and behavior (5 items) measured on a 5-point Likert scale. Even though it is not asthma-specific, it addresses most of the common barriers to adherence pertaining to asthma that were discussed previously. ASK-12 demonstrated good internal validity (Cronbach's alfa = 0.75) and test-retest reliability (intraclass correlation = 0.79). To establish convergent validity, several instruments were used and the following correlations were reported: Morisky Medication Adherence Scale (r=-0.74, p<0.001), Mini Asthma Quality of Life

Questionnaire (r=-0.33, p<0.001), SF-12 Mental Component Score (r=-0.32, p<0.01), and Proportion of Days Covered (PDC) for the previous 6 months (r=-0.20, p=0.059). With these findings, the authors suggested the shorter version for future use. To our knowledge there is no asthma-specific instrument for barriers to adherence identification.

All the discussed tools are instrumental in identifying patients at risk for nonadherence (Table 1.4). However, most of the tools address reasons for nonadherence selectively. The majority of the tools include patient-related factors: forgetfulness (AAAQ, MMAS-8, ASK-20, ASK-12), fear of side effects (AE, AAAQ, BMQ, ASK-20, ASK-12), misperception about need for the controller medication (AE, AAAQ, BMQ, MMAS-8, ASK-20, ASK-12), lack of support from others (ASK-20, ASK-12), and lifestyle habits (ASK-20). Also, another common barrier pertaining to the healthcare system and providers are: cost (AE, AAAQ, ASK-20, ASK-12), mistrust of healthcare providers/not working as a team (BMQ, ASK-20, ASK-12). Among therapy-related factors are: complexity of regimen (AAAQ, MMAS-8, ASK-20, ASK-12) and not having plan/not knowing health goals (ASK-20, ASK-12). Out of all tools, ASK questionnaires covered most of the factors that may serve as a reason for being nonadherent. As discussed previously, ASK-12 has good reliability and validity and, since it can capture more barriers to adherence, it is the preferred tool for this study.

In summary, ASK-12 can enhance MTM services provision since it can help pharmacists identify the underlying barriers to adherence and address them. It can also help pharmacists recognize individual participants' weaknesses in consecutive appointment(s) (whether one-on-one, telephone, or mail interaction) follow-up on

previously addressed issues. This allows the intervention to be patient-tailored and potentially more informative and efficient compared to previously conducted studies.

Table 1.4 Instruments measuring adherence and barriers to adherence

Instrument	Number of items	Measure	Response scale	Type of Barriers to adherence
Adherence estimator (AE)	3	Perceived concerns about medications, perceived need for medications, perceived affordability of medications	6-point Likert scale (Agree Completely – Disagree Completely)	✓ **Pt:** Fears about side effects ✓ **Pt:** Misperception (no need) ✓ **HC:** Cost of medication
Adult asthma adherence questionnaire (AAAQ)	5	Following "my medication plan," forgetting, not "needing" the medications, side effects, cost	6-point Likert scale (I agree completely-I disagree completely)	✓ **Pt/HC:** Misperception /complexity of regimen ✓ **Pt:** Forgetfulness ✓ **Pt:** Misperception (no need) ✓ **Pt:** Fears about side effects ✓ **HC:** Cost of medication
Medication Adherence Report Scale for Asthma (MARS-A)	10	Intentional and nonintentional adherence (No barriers or reasons for not taking ICS)	5-point Likert scale (Always-Never)	N/A
Beliefs about Medicines Questionnaire (BMQ)	18	Two parts: specific (necessity, concerns) and general (overuse, harm)	5-point Likert scale (Always-Never)	✓ **Pt:** Misperception (no need, harm) ✓ **Pt:** Fears about side effects, long-term effects, becoming addicted ✓ **HC:** Mistrust to HC provider
Morisky (MMAS-8)	8	Adherence + 3 items: perceived need, difficulties following the regimen, forgetfulness	Items 1-7 (Yes/No) Item 8 (5-point Likert scale Always-Never)	✓ **Pt:** Misperception (no need) ✓ **Pt:** Forgetfulness ✓ **Pt:** Fears about side effects ✓ **Therapy:** Complexity of regimen
Morisky (MMAS-4)	4	Adherence+ 2 items: perceived need	Yes/No	✓ **Pt:** Misperception (no need) ✓ **Pt:** Forgetfulness ✓ **Pt:** Fears about side effects

Table 1.4 (continued)

ASK-20	20	Inconvenience/forgetfulness, treatment beliefs, lifestyle/habits, help from others, collaboration with HC, side effects, cost	5-point Likert scale (Always-Never)	✓ **Pt:** Forgetfulness ✓ **Pt:** Misperception (no need) ✓ **Pt:** Not getting help from others ✓ **Pt:** Fears about side effects ✓ **Pt:** Lifestyle habits ✓ **HC:** Not working with HC team ✓ **HC:** Cost of medication ✓ **Therapy/HC:** Knowing health goals ✓ **Therapy:** Complexity of regimen/inconvenience
ASK-12	12	Inconvenience/forgetfulness, treatment beliefs, help from others, collaboration with HC, side effects, cost	5-point Likert scale (Always-Never)	✓ **Pt:** Forgetfulness ✓ **Pt:** Misperception (no need ✓ **Pt:** Not getting help from others ✓ **Pt:** Fears about side effects ✓ **HC:** Not working with HC team ✓ **HC:** Cost of medication ✓ **Therapy/HC:** Knowing health goals ✓ **Therapy:** Complexity of regimen/inconvenience

HC=Healthcare/provider-related factors; Pt=Patient-related factors; Therapy=Therapy-related factors;

Once adherence barriers are identified, pharmacists may need another tool to help them get started with the counseling (i.e., "Asthma Conversation Starter"). Doucette et al. (2012) developed an instrument to guide pharmacists while discussing adherence – the Drug Adherence Work-up (DRAW) tool [81]. It consists of 11 items, and unlike other

instruments discussed previously, it provides problem-solving recommendations. The DRAW tool consists of the following constructs: too many drugs/doses, forgetfulness, concerns about medications, beliefs about medication effectiveness, medication costs, and the presence of adverse events. The tool was field tested among seven community pharmacists while providing MTM services. Pharmacists reported that the tool was easy to use and well organized and that it improved their focus on adherence during MTM counseling [81]. To our knowledge, only one study used this tool in pharmacy practice after its development [67]. Pharmacists had positive feedback on the use of the instrument regarding the identification of specific barriers to adherence; however, the length of the DRAW tool along with the time it took to administer the tool and disruption of regular workflow were among concerns stated by participating pharmacists.

In conclusion, a few instruments addressing adherence and its barriers are available. However, most of the tools and instruments were recently developed and they lack the evidence of use in practice. Moreover, most of the instruments are generic, while asthma has unique issues related to use of inhalers and may warrant special attention.

Summary

The goal of this section was to bring attention to adherence improvement interventions conducted by pharmacists and especially during MTM services provision to patients with asthma. As MTM services are planned to be expanded in the next 5-10 years, it is important to provide healthcare practitioners and decision makers with strategies for adherence improvement, along with more real-world evidence. As asthma is

one of the conditions where low adherence to controller therapy is evident, it should be investigated so that MTM services delivery is effective. The identification of barriers to adherence needs to be individualized. When pharmacists provide MTM services, they need tools to help them quickly identify these barriers and find solutions so that their interventions are patient-tailored and have a higher likelihood of being effective and sustainable.

1.3 SIGNIFICANCE AND INNOVATION

Lack of agreement between medical advice and patients' behavior contributes significantly to the prevalence of uncontrolled asthma, which is associated with ED visits, hospitalizations, decreased quality of life, and loss of productivity [82]. The prevalence of asthma attacks has not decreased over time [8] and approximately 25% of all ED visits in the U.S. are due to asthma-related events [7]. Overall, 24% of exacerbations and 60% of asthma-related hospitalizations can be attributed to poor adherence [83]. Adherence to asthma controller therapy on average is less than 50%, with even lower levels among the underserved. In fact, suboptimal asthma controller adherence was identified among Texas Medicaid recipients (N=32,172) with adherence (50% proportion of days covered) for a mere 15% of the population [84]. This project serves as a natural progression from aforementioned Texas Medicaid project to better understand how to improve adherence among patients with persistent asthma. Additionally, statewide Medicaid pilot programs plan to implement MTM for various disease states, including asthma. Barner found that

pharmacists needed additional skills to identify and resolve patient-specific barriers related to medication adherence[85].

Several adherence intervention strategies have been implemented, and yielded significant improvements in adherence and/or outcomes. However, most of the studies were conducted outside of the US. Also, when programs were effective, they tended to be complex and labor-intensive, limiting their implementation in practice [86]. In other chronic conditions, multifaceted and tailored interventions were more effective than generalized interventions [87]. Bårnes and Ulrik confirmed that one reason interventions aimed to improve asthma outcomes were ineffective was due to their failure to address patients' individual needs [83]. Without a clear understanding of patients' adherence barriers, it is difficult to address the challenges patients face in asthma self-management. We designed a project with the potential to significantly enhance adherence to controller therapy among nonadherent patients with persistent asthma. It focused on developing a patient–pharmacist counseling program for adherence improvement with an individualized implementation plan. The research increases scientific knowledge about patient–pharmacist partnerships and the methods of effective collaboration for asthma management improvement. Additionally, this project presented the impact a patient-tailored intervention can have on adherence and asthma control. Results from this study can be scaled to larger populations known to be at increased risk for asthma exacerbations due to poor adherence to asthma therapy. Additionally, study results may be used to develop programs for another lung condition where inhaler use is prevalent

(i.e., COPD). Lastly, findings may further be adapted for use with children and adolescents with asthma.

2. CHAPTER TWO

2.1 APPROACH

Overview

The study employed a mixed methods study design, and was conducted over a course of 10 months to develop and pilot-test the tools for the patient-pharmacist program in order to improve adherence to asthma controller medication. First, we created an asthma-specific instrument, that allows pharmacists to identify barriers to asthma adherence. Two tools were developed: the “Asthma Conversation Starter” booklet for pharmacists and the “Breathe Easier” pamphlet for patients. The “Asthma Conversation Starter” booklet for pharmacists includes common adherence barriers, along with the suggested actions, so that pharmacists are able to quickly identify and address patient-specific barriers. The “Breath Easier” pamphlet for patients addresses common barriers that lead to patients’ nonadherence with the actions and educational recommendations for patients. After developing the tools, feedback from community pharmacists was obtained via one-on-one interviews to solicit their input regarding: 1) developed instruments, and 2) feasibility of implementation of these instruments (as part of the asthma adherence intervention) into their practice settings. Lastly, we conducted a pilot-test of the intervention in community pharmacies with patients who have persistent asthma and assessed the impact of the intervention on adherence and asthma control.

Target population

Participants are represented by two groups: 1) community pharmacists (Aims 2, 3 and 4) and 2) adult (≥18 years) persistent asthma patients who fill their asthma medications in community pharmacies (Aims 3 and 4). Community pharmacists (total N=8) from independent pharmacies (N=2), Randall's grocery store chain stores (N=4) and CommUnityCare outpatient pharmacies (N=2) participated in the study. These pharmacies were chosen primarily because they are in community pharmacy settings and because of previously established relationships with the UT Austin College of Pharmacy.

Adult patients with persistent asthma were recruited from two sources to comprise the intervention and control groups. Patients in the intervention group were recruited by study pharmacists. No active pharmacist recruitment occurred for the control group. Instead, a historical cohort of patients with persistent asthma who used community pharmacies were utilized. Third-year pharmacy students enrolled in a required MTM course during Spring 2015 began assessing adherence and asthma control among patients with persistent asthma as part of the course requirements. The instructor, Professor Sharon Rush, agreed to make the data available for study purposes. Currently, 28 asthma patient assessment forms (control group) have been completed. Additional inclusion criteria are described in the next section.

In order to identify patients with persistent asthma, two approaches were applied. First, a pharmacist asked two screening questions while assessing eligibility: "Has your doctor suggested that you use your inhaler regularly?" and "Do you have asthma symptoms most of the time or is it just a seasonal condition?" (Appendix A: Pharmacist

Script and Action Plan for the Appointment #1). If the response to these questions is "Yes" or "I don't know/Not sure", then a pharmacist can proceed with the patient. Second, we were able to confirm whether a patient has persistent asthma based on the EPR-3 criteria (discussed previously). The first four yes/no questions from the persistency questionnaire ask about the same measures as the Asthma Control Test (ACT) questionnaire with the difference in response scale. For example, EPR-3 persistency question: "Over the past 30 days, have you had asthma symptoms at least 3 times per week?" (Response: Yes, No); ACT question: "During the past 4 weeks, how often have you had shortness of breath?" (Response: More than once a day, Once a day, 3 to 6 times a week, Once or twice a week, Not at all). As it can be seen, these two questions are compatible and the answer to the EPR-3 persistence questionnaire can be derived from the ACT questionnaire (Appendix B: Survey #1, questions 2, 5, 7, 8). The fifth EPR-3 persistence question regarding the use of oral corticosteroids was added to the Survey #1 (Appendix B, question 12).

Inclusion criteria

Pharmacist inclusion criteria were that they must work full time in community settings and willing to participate, recruit at least 5 patients, and follow up with them over a period of 3-4 months. Patient inclusion criteria were: a) 18 years or older, b) have persistent asthma (identified from screening questions, and then confirmed based on the EPR-3 definition during the data analysis stage), c) had a prescription for an asthma control inhaler, d) were willing to provide consent and personal contact information,

including mobile phone number to the pharmacist, and e) were willing to be contacted via telephone by the pharmacist for the 1-month post-initial follow-up and willing to meet with the pharmacist in-person for the 3-month post-initial follow-up.

Recruitment and retention

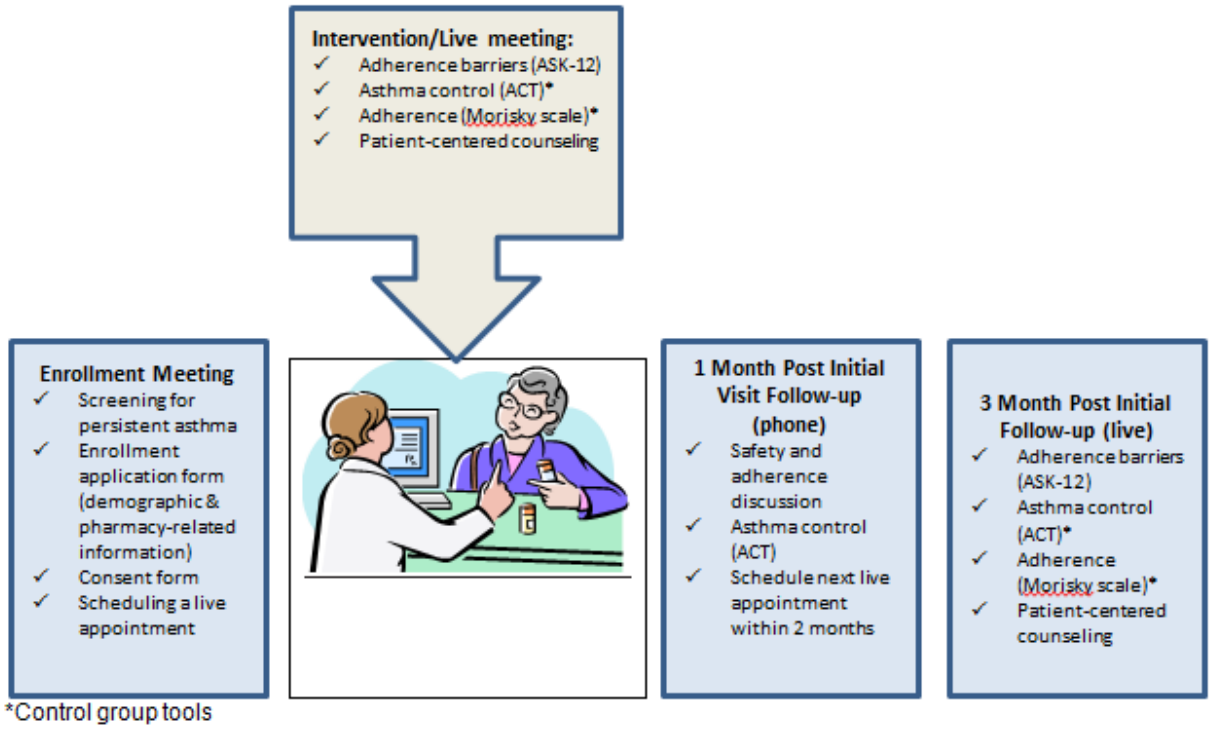
Recruitment of participating pharmacists (N=8) was accomplished through previous relationships with research studies. Recruitment of the patients in the intervention group was done by participating pharmacists. Pharmacists targeted patients as they picked up their asthma controller inhaler, included signs in the pharmacy, as well as included fliers in bags of asthma patients. Once the potential participant was identified, a pharmacist briefly explained the study and asked the patient if s/he was interested in participating. If the response was positive, a pharmacist asked two screening questions: whether a physician prescribed a controller inhaler for regular use and whether asthma is chronic vs. seasonal (Appendix A: Pharmacist Script and Action Plan for the Appointment #1). If a patient qualified, then a consent form was read and signed, followed by a Survey #1 (Appendix B: Survey #1). Once the patient completed the survey, a pharmacist provided a patient with the counseling services using the pharmacist booklet (Appendix C) and the patient pamphlet (Appendix D). After the first live appointment with the pharmacist, the patient participated in two follow-ups: 1) via telephone in 1 month post-initial appointment and 2) in-person appointment in 3 months post-initial appointment. In order to encourage retention, patients receive two gift cards: 1) $25 at the first in-person appointment and 2) $25 at the third in-person appointment. In

addition to being present at the appointments, surveys had to be completed for the patient to receive the gift cards.

Data Collection

Data were collected from pharmacists and patients (Figure 4). Data from the pharmacists were collected during the interview sessions prior to the study intervention via audio recording. The data were transcribed and categorized into topics and themes (details and the Interview guide are discussed under Aim 2). Data from the patients were collected via surveys during the 3 sessions with the pharmacists: 1st in-person initial meeting, 2nd telephone 1 month post-initial visit follow-up, and 3rd in-person 3 month post-initial visit follow-up (details and the surveys will be discussed under Aim 4). Once all three surveys were completed, the data were consolidated into an Excel spreadsheet using a codebook.

Figure 2.1 Data collection process



Measures

The outcomes measures (dependent variables) for this study are adherence to controller inhaler, asthma control and adherence barriers score. Independent variables are represented by the "Group": Intervention vs. Control and by the "Time": pre-intervention vs. post-intervention (for the intervention group only). Covariates include demographic information (gender, age, race/ethnicity, education), pharmacy, and chronic conditions. Lastly, data were collected on the following for descriptive purposes only: whether patients have and use an Asthma action plan and a peak flow meter and number of adherence barriers. See Table 2.1 for operational definitions and variable characteristics.

Table 2.1 Proposed study measures

Measure	Operational definition	Type/Scoring
Dependent variables		
Adherence* (Appendix B, Questions 4, 13-15)	Adherence score measured by Morisky scale (MMAS-4): Morisky et al. (1986) 1. Do you ever forget to use your inhaler? 2. Are you having problems remembering to use your inhaler? 3. Sometimes if you feel worse when you use your inhaler, do you stop using it? 4. When you feel better do you sometimes stop using your inhaler? *For Aim 4, Hypotheses 3a, 3b, 4a, 4b adherence will serve as an independent variable	**Continuous** 0=No; 1=Yes <u>Score range:</u> 0-4 *Adherence* 4=very low 3=low 2=medium 1=moderate 0=high
Asthma control (Appendix E, Appendix B Questions 2, 5-8)	Asthma control test (ACT) score measured by ACT scale: Nathan et al. (2004) *(See Appendix E for original scale and Appendix B, Questions 7-11 for study items)* 1. In the past **4 weeks**, how much of the time did your **asthma** keep you from getting as much done at work, school or at home? 2. During the past **4 weeks**, how often have you had shortness of breath? 3. During the past **4 weeks**, how often did your **asthma** symptoms (wheezing, coughing, shortness of breath, chest tightness or pain) wake you up at night or earlier than usual in the morning? 4. During the past **4 weeks**, how often have you used your rescue inhaler or nebulizer medication (such as albuterol)? 5. How would you rate your **asthma** control during the **past 4 weeks**? Each question has a different response scale ranging from 1 (poor control) to 5 (good control)	**Continuous** Scale continuum 1=poor control 5=good control <u>Score range:</u> 5-25 *Asthma control* ≥20=controlled ≤19=not controlled

Table 2.1 (continued)

Adherence barrier score** (Appendix F, Appendix B-Questions 17-30)	Modified ASK-12 score: Matza et al. (2009) ASK-12 modified items to make asthma specific Domains: inconvenience/forgetfulness; treatment beliefs, behavior 1 item was modified: I have an Asthma Action Plan and know if I am reaching my goals 2 additional items added by researchers: 1. I know how to use my inhaler correctly 2. I only use my inhaler when I am having symptoms such as shortness of breath, coughing, wheezing, or chest tightness **For Aim 4, Hypotheses 2a, 2b, 3a, 3b adherence barriers score will serve as an independent variable	**Continuous** 9 items: 1=strongly agree; 5=strongly disagree 5 items[a] 1=in the last week; 5=never <u>Score range</u>: 14-70 *Higher scores=fewer barriers*
Independent Variables		
Group	Intervention, Control	**Categorical**
Time	Pre- and Post-intervention	**Categorical**
Covariates		
Gender	Male, female	**Categorical**
Age	18-39; 40-49; 50-59; 60-69; ≥70	**Ordinal**
Race/Ethnicity	Caucasian, African American, Hispanic, Other	**Categorical**
Education	Less than high school, High school, Some college, College degree, Graduate/Post-graduate/Professional degree	**Ordinal**
Pharmacy	Randall's, CommUnityCare, Independent	**Categorical**
Chronic conditions	Hypertension, Diabetes, High cholesterol, Other Total number will be summed	**Continuous**
Variables for descriptive analysis		
Having difficulty using inhaler(s)	I have difficulties using my inhaler(s)	**Continuous** 1=strongly agree; 5=strongly disagree
Being ever hospitalized due to asthma	Have you even been hospitalized (at least overnight) due to your asthma?	**Dichotomous** 0=No; 1=Yes
Number of hospitalizations in the past 12 months	In the past <u>12 months</u>, how many times have you been hospitalized (at least overnight) for an asthma attack?	**Continuous**

Table 2.1 (continued)

Number of acute asthma attacks in the past 12 months	In the past 12 months, how many times did you get treatment for an acute asthma attack at a doctor's office, urgent care facility or emergency department (ER)?	**Continuous**
Number of exacerbations, requiring OCS use in the past 12 months	In the past 12 months, how many times have you been given oral corticosteroids (such as prednisone, methylprednisolone, Medrol®) for a flare up of your asthma?	**Continuous**
Having and using Asthma action plan	Do you have an Asthma Action Plan? I have an Asthma Action Plan and know if I am reaching my goals	**Dichotomous** 0=No; 1=Yes **Continuous** 1=strongly agree; 5=strongly disagree
Having and using peak flow meter	How often do you use your peak flow meter? (5 options: every day, once a week, once a month, when my asthma getting worse, I don't have it).	**Continuous** 1=I do not have one 2=when my asthma gets worse 3=once/month 4=once/week 5=every day
Number of barriers to adherence	Number of items in modified ASK-12 questionnaire indicative of a barrier	**Continuous** Number of barriers (items) where 1 or 2 was selected

[a]1=in the last week; 2=in the last month; 4=in the last 3 months; 5=never

Data management and quality control

For Aim 2, which employed one-on-one pharmacist interviews, audio files of the interview sessions did not contain any identity information about the interviewees. For Aims 3 and 4, completed surveys provided to the researchers had no identifying information. The pharmacist retained the contact document which included patient name and phone number. All documents (patient contact information and surveys) included a

unique code to facilitate data aggregation, but researchers were blinded to the identity of the patient. Audio files, transcriptions and completed surveys were securely stored in the locked cabinets at the UT Austin College of Pharmacy.

Data analysis

This section includes the statistical tests and test assumptions. Aims 1 and 2 do not involve assumptions, whereas for Aim 3 (bivariate analyses) and Aim 4 (multiple linear regressions) assumptions will need to be met. For Aim 3 the following assumptions were required: 1) a normal distribution; 2) homogeneity of variance; 3) linearity; 4) independence. If the assumption for normality is not met, nonparametric tests will be used. For Aim 4 the following assumptions were required: 1) a linear relationship between the dependent and independent variables; 2) a normal distribution and constant variance of the errors; 3) independent observations; 4) homoscedasticity of variance; and 5) lack of correlation between predictor variables (variance inflation factor values are expected to be less than 10). Dependent variables that were measured continuously in Aim 4 included adherence to asthma controller medications, asthma control score and adherence barrier score. For all multivariate analyses below, parsimonious models were used if sample size was suboptimal. Bivariate analyses were run to determine which independent variables were significant and should be included in the regression model (Table 2.2).

Table 2.2 Summary of aims, hypotheses and statistical analysis

AIM 3		
Hypothesis	**Variables**	**Analysis**
H1: There is no significant difference between patients receiving asthma-specific counseling (Intervention group) and patients who did not receive asthma-specific counseling (Control group) on the baseline characteristics	Adherence score Asthma control test score Barriers to adherence score Presence of chronic conditions Gender Race Age Education	t-test, chi-squared test
AIM 4		
Hypothesis	**Variables**	**Analysis**
Hypothesis 2a: Change in asthma controller inhaler **adherence** (from baseline to 3-month follow-up) will show significantly higher improvement for patients in the intervention group compared to the control group, while controlling for covariates.	DV: Change in Morisky scale adherence (from baseline to 3-month follow-up) IV: Group (Intervention vs. Control); Barriers to adherence score; Covariates	Multivariate linear regression
Hypothesis 2b: Among patients in the intervention group, **adherence** to asthma controller inhaler will increase significantly from baseline to 3-month follow-up, while controlling for covariates.	DV: Morisky scale adherence IV: Time (Pre vs. Post); Barriers to adherence score; Covariates	Multivariate linear regression
Hypothesis 3a: Change in **asthma control** (from baseline to 3-month follow-up) will show significantly higher improvement for patients in the intervention group compared to the control group, while controlling for covariates.	DV: Change in ACT score (from baseline to 3-month follow-up) IV: Group (Intervention vs. Control); Morisky scale adherence; Barriers to adherence score; Covariates	Multivariate linear regression
Hypothesis 3b: Among patients in the intervention group, **asthma control** will improve significantly from baseline to 3-month follow-up, while controlling for covariates.	DV: ACT score IV: Time (Pre vs. Post); Morisky scale adherence; Barriers to adherence score; Covariates	Multivariate linear regression
Hypothesis 4a: Change in **adherence barrier score** (from baseline to 3-month follow-up) will show significantly higher improvement for patients in the intervention group compared to the control group, while controlling for covariates	DV: Change in Adherence barrier score (from baseline to 3-month follow-up) IV: Group (Intervention vs. Control); Covariates	Multivariate linear regression
Hypothesis 4b: Among patients in the intervention group, **adherence barrier score** will decrease significantly from baseline to 3-month follow-up, while controlling for covariates.	DV: Adherence barrier score IV: Time (Pre vs. Post); Morisky scale adherence; Covariates	Multivariate linear regression

DV=dependent variable; IV=independent variable;
Covariates: gender, age, race/ethnicity, education, pharmacy, chronic conditions

Power analysis

Based on the published research we were able to identify effect size for two measures: Adherence (ES=0.5) and the ACT score (ES=0.75). Using the smallest effect size (0.5), with alpha of 0.05 and power of 0.8, G-Power software was used to calculate the needed sample size. For Aim 3 (bivariate comparisons of covariates and intervention/control groups) n=13/group is needed for independent samples t-tests and n=51/group for chi-square analysis. Regarding Aim 4 multivariate linear regression, n=41 is needed according to G-Power software. The maximum number of independent/covariates that will be included in the regression model is n=7. Using the following formula: N=(L/ $\gamma) + k + 1$; L = tabled value (14.35); K = number of predictors; γ = estimated effect size $R^2/(1-R^2)$; R^2 = percent of variance explained by the model. The estimated sample size is N=42, which is similar to the G-power calculation. Thus, the goal was to recruit 40 patients/group or 80 patients total.

Research design

Aim 1: Develop asthma-specific instruments to aid in identifying and resolving barriers to asthma medication adherence

Introduction. The objective was to develop asthma-specific instruments that will help pharmacists identify patient-specific barriers to adherence and address them with individualized patient-tailored interventions. To address this objective, we modified reliable and valid general instruments to make them asthma-specific. The successful

completion of this research step resulted in instruments that will help identify and resolve adherence barriers specific to asthma therapy.

Justification & Feasibility. Recent research shows that tailoring health behavior change (e.g., adherence) to individual patient-level factors is more efficient, because of personalized goal-setting [88]. Identification of barriers and targeting them during patient–pharmacist counseling sessions can improve adherence to asthma therapy and overall control of the condition. In addition to general barriers to adherence, there are asthma-specific barriers such as lack of knowledge about appropriate inhaler use and misconceptions about the chronicity of asthma [37]. Among healthcare professionals, community pharmacists are highly accessible and can communicate with and educate patients about effectively managing their asthma. As barriers to adherence can be diverse and complex, a partnership approach between patients and healthcare providers is vital in helping the patient build effective self-management skills. However, because pharmacists have time and workflow barriers in providing extensive patient-focused education [67], it is critical to **provide pharmacists with tools that will enhance patient–provider encounters.** In addition to the critical first steps of screening for and understanding patient barriers to adherence [55], it is also essential to establish an effective pharmacist-led program that will enhance asthma therapy adherence through patient-tailored strategies to address barriers, which, in turn, will likely reduce the burden of asthma.

From a limited number of instruments that focus on adherence assessment and on revealing and addressing underlying barriers to adherence, two have emerged: ASK-12 (Appendix F: ASK-12) and the DRug Adherence Work-up (DRAW) tool (Appendix G:

DRAW tool). As was presented previously, ASK-12 is a feasible, valid, and reliable (Cronbach's alpha = 0.75) instrument designed to identify current medication adherence and patient-specific barriers [80]. It is a 12-item survey that a patient or a pharmacist can complete and it focuses on subdomains that represent the most salient barriers to adherence: 1) inconvenience/forgetfulness, 2) treatment beliefs, and 3) behavior. The survey items are scored and responses to each item signal where the patient experiences the most problems with adherence. Once the barriers have been identified using ASK-12, pharmacists may need guidance on how to discuss and resolve medication-related issues. The DRAW tool was recently developed to address this need [81]. It was found to be instrumental in helping pharmacists address patients' barriers related to nonadherence by providing practical approaches and suggestions [67]. For example, if the main barrier identified with ASK-12 was 'forgetfulness' then the DRAW tool provides several strategies (e.g., set alarm on cell phone) to use to help resolve the problem(s). Since there is no instrument available for barrier identification or resolution of barriers specific to asthma, these two general instruments served as an initial framework for developing our asthma-specific instruments with the goal of providing more effective patient-tailored services aimed at improving adherence.

Research Design. The objective of this aim is the modification of existing instruments and the development of asthma-specific instruments by incorporating the datafrom the literature.

Instrument modification. The ASK-12 and DRAW tools, which are not disease-specific, served as the initial framework for developing our asthma-specific instruments. To

modify the ASK-12 instrument, all available asthma-specific instruments pertaining to adherence were identified, along with qualitative studies exploring adherence to asthma medication. The most relevant items were then, aggregated and incorporated into the ASK-12 instrument. Based on the modified asthma-specific ASK-12 instrument, we developed a corresponding instrument for pharmacists that facilitated counseling with a patient by linking barrier(s) identified through ASK-12 to a suggested action (strategy) for overcoming this barrier. The goal of using this second instrument was to simplify and facilitate communication between a patient and a pharmacist. This instrument built upon and modified the DRAW tool by incorporating asthma-specific strategies for enhancing adherence. Also, we developed a complementary pamphlet for patients to help them overcome their barriers to adherence and educate them on the asthma management key points, misunderstanding of which are often associated with lack of adherence and poor asthma management.

We develop a survey instrument that included the most salient reasons for asthma therapy nonadherence so that pharmacists were able to identify these barriers and use their guiding tool (asthma-specific DRAW) to facilitate conversations with the patient on how to overcome this barrier and improve adherence. Also, an informative pamphlet was developed for patients. Accomplishment of this aim yielded instruments to be used in the next stage of the study - the patient-pharmacist partnership intervention for asthma management improvement.

Aim 2: Describe pharmacists' opinions on the developed instruments and identify effective methods for patient-centered counseling implementation in pharmacy practice through a series of interviews with practicing community pharmacists

Introduction. The objective was to identify the experiences and perspectives of community pharmacists regarding the developed instruments and best practices for implementing a patient–pharmacist partnership adherence program in practice. To address this objective, we conducted five interview sessions with practicing community pharmacists to identify their opinions on the advantages/disadvantages of the instruments, effectiveness, feasibility, and challenges of program implementation. The successful completion of this objective provided information considered for further instrument modification and when implementing the patient-centered counseling program in practice settings where issues such as workflow and time constraints can greatly impact patient–pharmacist encounters.

Justification and Feasibility. Because the planned intervention using the developed instruments (Aim 1) involved patient–provider interactions, it was crucial to obtain pharmacists' feedback on the developed instruments, pharmacists' experiences and suggestions for program implementation, as their comfort level and motivation was essential to an effective use of the proposed instruments. A recent analysis of intervention programs for enhancing adherence for a number of chronic conditions strongly recommended assessment of feasibility and practice implications for such programs [89]. Since the use of tools and instruments to promote adherence is limited, there is a great need to better understand how to implement the use of asthma-specific instruments so

that it becomes a part of routine activities. A recent study identified benefits and concerns regarding the use of two generic adherence instruments (the DRAW and Adherence estimator) for prevalent chronic conditions and found that even though the instruments were useful in understanding reasons for nonadherence, pharmacists identified time and workflow as the most common barriers to implementing the instruments into practice [67]. Presumably, if the researchers would have solicited pharmacists' feedback before implementing the instruments into practice, they may have been able to avoid these issues. In fact, the study authors recommended this specifically, and it is congruent with this aim, as the pharmacists recruited for interviews will also participate in our pilot project (Aims 3 and 4) focused on implementing the program in their practices.

Research Design. Once the initial instruments were developed, 5 interviews were held on separate days with 5 community pharmacists from the Austin, TX area. The primary investigator lead these sessions and employed open-ended questions focused on (1) pharmacists' experience in addressing adherence for patients with asthma, barriers, special concerns and perceptions regarding the proposed instruments, and (2) implementation, benefits, barriers, strategies to overcome challenges, and how to sustain a continuous patient-pharmacist partnership (see Appendix H for interview guide). The goal of the interview sessions was to uncover any asthma adherence problems not already addressed in the proposed instruments and to identify pharmacists' suggestions for implementing these instruments in practice, as well as potential concerns and how to overcome them. The interviews were audio-taped with note-taking and lasted approximately 1 hour. The data were transcribed, content analyzed, and coded to

facilitate identification of patterns and themes. An independent consultant (expert validity check) also categorized the data; the degree of agreement between the consultant and the researchers was determined and any disagreements were resolved through discussion. We then incorporated the emerging themes and concepts noted by pharmacists into the developed instruments if needed.

Accomplishment of this aim yielded a revised asthma-specific instrument derived from the acquisition of important knowledge from pharmacists so that the program could be integrated into practice in the most efficient and sustainable way. Pharmacies in diverse practice settings with variations in prescription volume, setting type (independent, chain, grocery store, community health center outpatient pharmacy), and capabilities (private counseling area, access to software to facilitate documentation of patient encounters) were recruited. However, from the faculty sponsor's (Barner) previous experience with statewide Medicaid pilot projects, in this study, we chose to recruit pharmacists who are already engaged in service provision who would be motivated to elevate their level of service. Thus, our project may be generalizable to a variety of pharmacy settings, but limited to pharmacists who are committed to providing sustainable patient–pharmacist partnerships.

Aim 3: Determine if baseline characteristics differ between Intervention and Control groups

This aim is complimentary to Aim 4 (see below). As one of the main goals of the study was to evaluate the effectiveness of the adherence patient-centered counseling, the

baseline characteristics should not differ significantly between Intervention and Control group. Patients completed surveys at baseline, including questions regarding adherence, asthma control, barriers to adherence, presence of chronic conditions, gender, race, age and education and then these data were analyzed in order to identify any differences between Intervention and Control groups (bivariate analyses).

Aim 4: Determine if identification of adherence barriers and patient-centered counseling using the developed asthma-specific instruments leads to improved medication adherence and asthma control

Introduction: The objective was to evaluate the short-term effectiveness of this program. This will provide valuable information for the future larger scale intervention. To address this objective, five strategies were employed: 1) Recruit and train pharmacists; 2) Collect data from patients through pharmacists 3) Pharmacist provision of patient-centered counseling; 4) Data analysis to evaluate the effect of this program on adherence, barriers and asthma control; and 5) Post-study data collection from the participating pharmacists about their experience with tools and overall program value (Note: not part of the dissertation). The successful completion of this objective provided the preliminary results of the patient-centered adherence improvement program, whether it positively impacted adherence to long-term controller medications and overall asthma control. It also provided strategies and best practices for the implementation of this program based on the pharmacists' feedback.

Justification and Feasibility. To implement an asthma adherence intervention program benefiting patients' health outcomes and reducing healthcare costs, it should be evaluated on a smaller scale – pilot-tested for two main reasons: (1) to determine the effectiveness, and (2) to seek pharmacists feedback on the implementation, barriers and overall experience. One of the recent examples of pharmacist intervention that yielded improvement in medication adherence and reduction in healthcare costs is the Pennsylvania project, where over 500 pharmacists and almost 60,000 patients participated in the study [90]. The preliminary work that this team conducted involved a series of interviews with the community pharmacists that revealed a number of steps that should be taken before implementation of the targeted intervention [91]. This preliminary work plays a crucial role in successful implementation and effective execution of the intervention, which is why this pilot test is important and provides us with valuable information and strategies for the future implementation on a larger scale. The faculty sponsor (Barner) has been involved in the projects aiming to implement and evaluate the effectiveness of MTM pilot program within the community pharmacy setting. Another positive contributor is the pharmacists' motivation level in improving patient outcomes and experience with their asthma. In preliminary communications, some pharmacists demonstrated concerns regarding patient understanding of use of inhaler and the difference between the rescue and controller inhalers. Thus, we feel that that implementation of this program would be highly beneficial for the patients and pharmacists.

Research Design. After assessing pharmacists' opinions on the instruments and their implementation (Aim 2), we pilot tested the developed program in the community pharmacy settings. Two groups - Intervention and Control - were formed. Intervention Group: 1) During the in-person meeting, participating pharmacists were trained on survey administration, obtaining informed consent , administering the surveys and utilizing the developed counseling tools; 2) Pharmacists recruited at least 5 adult patients and determined whether a patient was eligible for the study with persistent asthma (using screening questions in Appendix A); 3) The first in-person appointment lasted for 30-40 minutes - including time for patients to review the informed consent, complete the survey (Appendix B) and receive pharmacist counseling. Pharmacists identified reasons for nonadherence based on the survey and provide patient-specific education to resolve adherence issues (using counseling tools-Appendices C and D). The action plan/recommendations were developed for each patient. At this appointment, the next follow-up telephone conference (5-10 minutes) was scheduled. 4) A pharmacist performed the follow-up phone appointment within the next month to confirm resolution of patient's adherence barriers, identify current asthma control and determine if there were any questions or concerns (Appendix I). The next in-person appointment (15-20 minutes) was scheduled 3 months from the initial appointment. 5) During the in-person follow-up a pharmacist assessed adherence, barriers to adherence and asthma control (using the same survey as was used during the first appointment, but without demographic, general health, persistency and 12-month exacerbations questions – Appendix J). Pharmacists also reinforced suggested recommendations regarding

medication taking behaviors, lifestyle, adherence and current asthma control (Appendix K). Control Group: 1) During the MTM course orientation, third-year pharmacy students were trained in administering the survey (Appendix B). 2) Pharmacy students were assigned to recruit 1 patient with persistent asthma within a month, identify whether a patient is eligible for the participation and if so – invite the patient to complete the survey and ask for the next phone follow-up in 3 months from the initial meeting; 3) A pharmacy student provided usual care. At this appointment, a patient was notified regarding a 5-10 minute phone follow-up in 3 months by the pharmacist or pharmacy student; 4) A pharmacist or pharmacy student (not required to be the same person who collected data during the first appointment) performed the follow-up phone appointment in 3 months to identify current asthma control and adherence.

Timeline

The proposed study was conducted over a 10-month period. The first 3 months were focused on pharmacist enrollment and instrument development based on literature review. The next 2 months were devoted to conducting interviews. The following 4 months were devoted to data transcription, data analyses, and additional instrument modification based on the results obtained from the one-on-one interviews. Report writing occurred throughout the last 3 months as analyses and interpretation are completed. See Figure 5 below for the timeline.

Figure 2.2 Study Timeline

	2015						2016			
	Jul	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**
IRB approval										
Pharmacist enrollment										
Aim 1: Develop asthma-specific instruments										
Literature review										
Instrument development										
Interviews										
Aim 2: Identify effective methods for patient-centered counseling implementation										
Interviews										
Aims 3 & 4: Program implementation and data collection										
Pharmacists training										
1st appointment										
2nd appointment										
3d appointment										
Post-mortem assessment										
Data acquisition and analysis										
Report writing										

Future Directions

Over the past 20 years, the healthcare community has agreed that nonadherence to asthma therapy significantly contributes to asthma burden, depriving patients of the asthma control that would afford them a better quality of life. It is also clear that helping patients understand the importance of continuous medication use is not a one-time intervention but rather, it must be a regular part of routine care for patients with persistent asthma. Logically, pharmacists are well positioned to identify and address patient nonadherence. Moreover, the profession of pharmacy is shifting from simply distributing medications to providing counseling services using MTM as a model, and it is evident

that a substantial number of asthma patients need these services. It is thus of utmost importance to provide pharmacists with effective and efficient methods to better incorporate patient–pharmacist partnership counseling into their practice settings. The present project will play an important role in the initial identification and modification of instruments that will be asthma-specific and will incorporate pharmacists' input. This project will yield important preliminary results of the program implementation. To develop these instruments and strategies, and then implement the program to the workload, pharmacists and researchers must work together collaboratively. In the future, our next step will be to conduct a larger scale study in which pharmacists will be trained using the e-learning modules and the modified instruments will be used with asthma patients in community pharmacy settings. We will then assess outcomes (medication adherence, asthma control test, use of oral corticosteroids, ED visits, hospitalizations) regarding the program's effectiveness. We expect that such a future study will show improvements in outcomes assessed. As a further step, we plan to conduct a collaborative project with health communication specialists, so that both patients and pharmacists can use an electronic online version of the assessment tools to facilitate data entry and automate patient responses. Ultimately, we would like to incorporate tailored text messages to patients to further enhance adherence. Our goal is for the program to be sustainable and ongoing. Only multifaceted and continuous models of communication with patients can improve adherence and reduce the burden of asthma. We believe that the proposed study is a vital and important step toward addressing this unsolved problem.

References

1. Carter BL, et al. Physician and pharmacist collaboration to improve blood pressure control. *Arch Intern Med*. 2009;169(21):1996-2002.
2. Hirsch JD, et al. Evaluation of the first year of a pilot program in community pharmacy: HIV/AIDS medication therapy management for Medi-Cal beneficiaries. *J Manag Care Pharm*. 2009;15(1):32-41.
3. Moore JM, et al. Impact of a patient-centered pharmacy program and intervention in a high-risk group. *J Manag Care Pharm.* 2013;19(3): 228-36.
4. Pindolia VK, et al. Mitigation of medication mishaps via medication therapy management. Ann Pharmacother. 2009;43(4): 611-20.
5. National Asthma Education and Prevention program. Expert Panel Report 3 (EPR-3): Guidelines for the Diagnosis and Management of Asthma-Summary Report 2007. *J Allergy Clin Immunol.* 2007;120(5 Suppl):S94-138.
6. Akinbami LJ, Moorman JE, Liu X. Asthma prevalence, health care use, and mortality: United States, 2005-2009. *Natl Health Stat Report*, 2011;32:1-14.
7. Centers for Disease Control and Prevention (CDC). National Center for Health Statistics. National Health Interview Survey (NHIS) 2009 data release. 2010; http://www.cdc.gov/nchs/nhis/nhis_2009_data_release.htm. Accessed Jan 21, 2016.

8. Asthma and Allergy Foundation of America. Cost of asthma. 2000. http://www.aafa.org/display.cfm?id=6&sub=63. Accessed Jan 21, 2016.

9. Barnett SB, Nurmagambetov TA. Costs of asthma in the United States: 2002-2007. *J Allergy Clin Immunol*. 2011;127(1):145-52.

10. Schatz M, et al. Persistent asthma defined using HEDIS versus survey criteria. Am J Manag Care, 2010;16(11):e281-8.

11. World Health Organization Report 2003: Adherence to Long-Term Therapies: Evidence for Action. Chapter 7, 2003, Geneva, Switzerland: World health Organization.

12. Avoidable costs in U.S. healthcare. 2013 IMS Health http://www.imshealth.com/deployedfiles/imshealth/Global/Content/Corporate/IMS%20Institute/RUOM-2013/IHII_Responsible_Use_Medicines_2013.pdf. Accessed Jan 21, 2016.

13. Krigsman K, Nilsson JLG, RingL. Adherence to multiple drug therapies: refill adherence to concomitant use of diabetes and asthma/COPD medication. *Pharmacoepidemiol Drug Saf*. 2007;16(10):1120-8.

14. Stern L, Berman J, Lumry W, et al. Medication compliance and disease exacerbation in patients with asthma: a retrospective study of managed care data. *Ann Allergy Asthma Immunol*. 2006;97(3):402-8.

15. Smith JR, et al. Clinician-assessed poor compliance identifies adults with severe asthma who are at risk of adverse outcomes. *J Asthma*. 2005;42(6): p.437-45.

16. Williams LK, Pladevall M, Xi H, et al. Relationship between adherence to inhaled corticosteroids and poor outcomes among adults with asthma. *J Allergy Clin Immunol.* 2004;114(6):1288-93.

17. Lasmar L, Camargos P, Champs NS, et al. Adherence rate to inhaled corticosteroids and their impact on asthma control. *Allergy*. 2009;64(5):784-9.

18. Williams LK, Joseph CL, Peterson EL, et al. Patients with asthma who do not fill their inhaled corticosteroids: a study of primary nonadherence. *J Allergy Clin Immunol.* 2007;120(5):1153-9..

19. Kandane-Rathnayake RK, Matheson MC, Simpson JA, et al. Adherence to asthma management guidelines by middle-aged adults with current asthma. *Thorax*. 2009;64(12):1025-31.

20. Bender BG, Pedan A, Varasteh LT. Adherence and persistence with fluticasone propionate/salmeterol combination therapy. *J Allergy Clin Immunol*. 2006;118(4):899-904.

21. Camargo CAJr, Ramachandran S, Ryskina KL, et al. Association between common asthma therapies and recurrent asthma exacerbations in children enrolled in a state Medicaid plan. *Am J Health Syst Pharm*. 2007;64(10):1054-61.

22. Herndon JB, Mattke S, Evans Cuellar A, et al. Anti-Inflammatory Medication Adherence, Healthcare Utilization and Expenditures among Medicaid and Children's Health Insurance Program Enrollees with Asthma. *Pharmacoeconomics*. 2012;30(5):397-412.

23. Gamble J, Stevenson M, McClean E, Heaney LG. The prevalence of nonadherence in difficult asthma. *Am J Respir Crit Care Med*. 2009;180(9):817-22.

24. Desai M, Oppenheimer JJ. Medication adherence in the asthmatic child and adolescent. *Curr Allergy Asthma Rep*. 2011;11(6):454-64.

25. Jentzsch NS, Camargos PA, Colosimo EA, Bousquet J. Monitoring adherence to beclomethasone in asthmatic children and adolescents through four different methods. *Allergy*. 2009;64(10):1458-62.

26. Bender BG, Bender SE. Patient-identified barriers to asthma treatment adherence: responses to interviews, focus groups, and questionnaires. *Immunol Allergy Clin North Am*. 2005;25(1):107-30.

27. Jones C, Santanello NC, Boccuzzi SJ, et al. Adherence to prescribed treatment for asthma: evidence from pharmacy benefits data. *J Asthma*. 2003;40(1):93-101.

28. Bozek A, Jarzab J. Adherence to asthma therapy in elderly patients. *J Asthma*. 2010;47(2):162-5.

29. Latry P, Pinet M, Labat A, et al. Adherence to anti-inflammatory treatment for asthma in clinical practice in France. *Clin Ther.* 2008;30 Spec No:1058-68.

30. Gellad WF, Grenard J, McGlynn EA. A Review of Barriers to Medication Adherence. A Framework for Driving Policy Options. RAND 2009 http://www.rand.org/content/dam/rand/pubs/technical_reports/2009/RAND_TR765.pdf. Accessed Jan 21, 2016.

31. Adherence to long-term therapies:evidence for action. 2003 http://whqlibdoc.who.int/publications/2003/9241545992.pdf. Accessed Jan 21, 2016.

32. Howell G. Nonadherence to medical therapy in asthma: risk factors, barriers, and strategies for improving. *J Asthma*. 2008;45(9):723-9.

33. Tamura G, OhtaK. Adherence to treatment by patients with asthma or COPD: comparison between inhaled drugs and transdermal patch. *Respir Med.* 2007; 101(9):1895-902.

34. Baiardini I, et al. *Adherence to treatment: assessment of an unmet need in asthma. J Investig Allergol Clin Immunol*. 2006;16(4):218-23.

35. Smith A, et al. Depressive symptoms and adherence to asthma therapy after hospital discharge. *Chest*, 2006;130(4):1034-8.

36. Hansson Scherman M, Lowhagen O. Drug compliance and identity: reasons for non-compliance. Experiences of medication from persons with asthma/allergy. *Patient Educ Couns*. 2004;54(1):3-9.

37. Ponieman D, et al. Impact of positive and negative beliefs about inhaled corticosteroids on adherence in inner-city asthmatic patients. *Ann Allergy Asthma Immunol*. 2009;103(1):38-42.

38. Halm EA, Mora P, Leventhal H. No symptoms, no asthma: the acute episodic disease belief is associated with poor self-management among inner-city adults with persistent asthma. *Chest*. 2006;129(3):573-80.

39. Lowe RA, et al. Association between primary care practice characteristics and emergency department use in a medicaid managed care organization. *Med Care*. 2005;43(8):792-800.

40. Aguilar KM, Hou Q, Miller RM. Impact of Employer-Sponsored Onsite Pharmacy and Condition Management Programs on Medication Adherence. *J Manag Care Spec Pharm*. 2015;21(8):670-7.

41. Mowrer JL, et al. Patients' and providers' perceptions of asthma and asthma care: a qualitative study. *J Asthma*. 2015;52(9):949-56.

42. Chernew ME, et al. Impact of decreasing copayments on medication adherence within a disease management environment. *Health Aff*. 2008;27(1):103-12.

43. Bender BG, et al. Factors influencing patient decisions about the use of asthma controller medication. *Ann Allergy Asthma Immunol*. 2007;98(4):322-8.

44. Wilson SR, et al. Shared treatment decision making improves adherence and outcomes in poorly controlled asthma. *Am J Respir Crit Care Med*. 2010;181(6): 566-77.

45. George M, et al. Qualitative research-enhanced understanding of patients' beliefs: results of focus groups with low-income, urban, African American adults with asthma. *J Allergy Clin Immunol*. 2003;111(5):967-73.

46. Krigsman K, et al. Refill adherence by the elderly for asthma/chronic obstructive pulmonary disease drugs dispensed over a 10-year period. *J Clin Pharm Ther*. 2007;32(6):603-11.

47. Blaiss MS. Part II: Inhaler technique and adherence to therapy. *Curr Med Res Opin.* 2007;23 Suppl 3:S13-20.

48. Weinstein AG. The potential of asthma adherence management to enhance asthma guidelines. *Ann Allergy Asthma Immunol*. 2011;106(4):283-91.

49. Weinstein AG. Improving adherence to asthma therapies. *Curr Opin Pulm Med*. 2015;21(1):86-94.

50. Laforest L, et al. Asthmatic patients' poor awareness of inadequate disease control: a pharmacy-based survey. *Ann Allergy Asthma Immunol*. 2007;98(2): 146-52.

51. Bereznicki BJ, et al. Uptake and effectiveness of a community pharmacy intervention programme to improve asthma management. *J Clin Pharm Ther*, 2013;38(3):212-8.

52. Smith L, et al. The contribution of goal specificity to goal achievement in collaborative goal setting for the management of asthma. *Res Social Adm Pharm*, 2013;9(6):918-29.

53. Mangiapane S, et al. Community pharmacy-based pharmaceutical care for asthma patients. *Ann Pharmacother*. 2005;39(11):1817-22.

54. Blais R, Laurier C, Pare M. Effect of feedback letters to physicians and pharmacists on the appropriate use of medication in the treatment of asthma. *J Asthma.* 2008;45(3):227-31.

55. Ulrik CS, et al. The patient's perspective: adherence or non-adherence to asthma controller therapy? *J Asthma*. 2006;43(9):701-4.

56. Raynor DK, et al. We are the experts: people with asthma talk about their medicine information needs. *Patient Educ Couns* 2004;53(2):167-74.

57. Garcia-Cardenas V, et al. Effect of a pharmacist intervention on asthma control. A cluster randomised trial. *Respir Med*. 2013;107(9):1346-55.

58. Saini B, et al. Asthma disease management-Australian pharmacists' interventions improve patients' asthma knowledge and this is sustained. *Patient Educ Couns.* 2011;83(3):295-302.

59. Armour C, et al. Pharmacy Asthma Care Program (PACP) improves outcomes for patients in the community. *Thorax*. 2007;62(6):496-502.

60. Goeman D, et al. Educational intervention for older people with asthma: a randomised controlled trial. *Patient Educ Couns.* 2013;93(3):586-95.

61. Mehuys E, et al. Effectiveness of pharmacist intervention for asthma control improvement. *Eur Respir J.* 2008;31(4):790-9.

62. Janson SL, et al. Individualized asthma self-management improves medication adherence and markers of asthma control. *J Allergy Clin Immunol.* 2009;123(4): 840-6.

63. Giraud V, Allaert FA, Roche N. Inhaler technique and asthma: feasability and acceptability of training by pharmacists. *Respir Med*. 2011;105(12):1815-22.

64. Axelsson M, Lotvall J. Recent educational interventions for improvement of asthma medication adherence. *Asia Pac Allergy*. 2012;2(1):67-75.

65. Bunting BA, Cranor CW. The Asheville Project: long-term clinical, humanistic, and economic outcomes of a community-based medication therapy management program for asthma. *J Am Pharm Assoc.* 2006;46(2):133-47.

66. McHorney CA. The Adherence Estimator: a brief, proximal screener for patient propensity to adhere to prescription medications for chronic disease. *Curr Med Res Opin*. 2009;25(1):215-38.

67. Witry MJ, et al. Multiple Adherence Tool Evaluation Study (MATES). *J Manag Care Pharm.* 2014;20(7):734-40.

68. Schatz M, et al. Development and preliminary validation of the Adult Asthma Adherence Questionnaire. *J Allergy Clin Immunol Pract.* 2013;1(3):280-8.

69. Horne R, Weinman J. Patients' beliefs about prescribed medicines and their role in adherence to treatment in chronic physical illness. *J Psychosom Res*. 1999; 47(6):555-67.

70. Horne R, Weinman J. Self-regulation and self-management in asthma: Exploring the role of illness perceptions and treatment beliefs in explaining non-adherence to preventer medication. *Psychology & Health*. 2002;17(1):17-32.

71. Menckeberg TT, et al. Beliefs about medicines predict refill adherence to inhaled corticosteroids. *J Psychosom Res*. 2008;64(1):47-54.

72. Cohen JL, et al. Assessing the validity of self-reported medication adherence among inner-city asthmatic adults: the Medication Adherence Report Scale for Asthma. *Ann Allergy Asthma Immunol.* 2009;103(4):325-31.

73. Morisky DE, Green LW, Levine DM. Concurrent and predictive validity of a self-reported measure of medication adherence. *Med Care.* 1986;24(1):67-74.

74. Morisky DE, et al. Predictive validity of a medication adherence measure in an outpatient setting. *J Clin Hypertens.* 2008;10(5):348-54.

75. Chiu KC, et al. Patients' beliefs and behaviors related to treatment adherence in patients with asthma requiring maintenance treatment in Asia. *J Asthma*. 2014; 51(6):652-9.

76. Tan X, Patel I, Chang J. Review of the four item Morisky Medication Adherence Scale (MMAS-4) and eight item Morisky Medication Scale (MMAS-8). *Innovations in pharmacy.* 2014;5(3):1-8.

77. Hahn SR, et al. Development of the ASK-20 adherence barrier survey. *Curr Med Res Opin*. 2008;24(7):2127-38.

78. Matza LS, et al. Further testing of the reliability and validity of the ASK-20 adherence barrier questionnaire in a medical center outpatient population. *Curr Med Res Opin* 2008;24(11):3197-206.

79. Park J, et al. Impact of an adherence intervention program on medication adherence barriers, asthma control, and productivity/daily activities in patients with asthma. *J Asthma.* 2010;47(10):1072-7.

80. Matza LS, et al. Derivation and validation of the ASK-12 adherence barrier survey. *Ann Pharmacother.* 2009;43(10):1621-30.

81. Doucette WR, et al. Development of the Drug Adherence Work-up (DRAW) tool. *J Am Pharm Assoc*. 2012;52(6):e199-204.

82. Tan H, et al. Impact of asthma controller medications on clinical, economic, and patient-reported outcomes. *Mayo Clin Proc.* 2009;84(8):675-84.

83. Barnes CB, Ulrik CS. Asthma and Adherence to Inhaled Corticosteroids: Current Status and Future Perspectives. *Respir Care*. 2015;60(3):455-468.

84. Makhinova T, et al. Asthma Controller Medication Adherence, Risk of Exacerbation, and Use of Rescue Agents among Texas Medicaid Patients with Persistent Asthma. *J Manag Care Spec Pharm*. 2015;21(12):1124-32.

85. Barner JC, Lawson K, Roberson K. Clinical and economic outcomes of the Texas Medicaid medication therapy management (MTM) pilot. 2012, Texas Health and Human Services Commission: Austin, TX.

86. McDonald HP, Garg AX, Haynes RB. Interventions to enhance patient adherence to medication prescriptions: scientific review. *JAMA*. 2002;288(22):2868-79.

87. van Eijken M, et al. Interventions to improve medication compliance in older patients living in the community: a systematic review of the literature. *Drugs Aging.* 2003;20(3):229-40.

88. Gatwood J, Bailey JE. Improving medication adherence in hypercholesterolemia: challenges and solutions. *Vasc Health Risk Manag.* 2014;10:615-25.

89. Nieuwlaat R, et al. Interventions for enhancing medication adherence. *Cochrane Database Syst Rev*. 2014;11:CD000011.

90. Pringle JL, et al. The Pennsylvania Project: pharmacist intervention improved medication adherence and reduced health care costs. *Health Aff.* 2014;33(8): 1444-52.

91. Bacci JL, et al. Implementation of targeted medication adherence interventions within a community chain pharmacy practice: The Pennsylvania Project. *J Am Pharm Assoc*. 2014;54(6):584-93.

3. CHAPTER THREE: Study 1

Adherence Enhancement for Patients with Asthma in Community Pharmacy Practice: Instruments Development and Pharmacists' Feedback

3.1 Abstract

BACKGROUND: With low adherence to asthma controller medications and the multifaceted nature of barriers to adherence, there is a critical need to establish an efficient and effective pharmacist-led program that will enhance asthma therapy adherence through identifying patient barriers and resolving them using patient-focused strategies in community pharmacy settings.

OBJECTIVES: The objectives of this study were: (1) to develop asthma-specific instruments to aid in identifying and resolving barriers to asthma medication adherence, (2) to assess pharmacists' perspectives on the use of the tools in the community pharmacy practice, and (3) to identify effective methods for patient-centered counseling implementation in pharmacy practice which, in turn, may reduce the burden of asthma.

METHODS: Development of the tools included two major activities: reviewing available tools/instruments in the literature and modifying available instruments to make them asthma-specific. Three asthma-specific instruments were developed by adapting the ASK-12 adherence tool and the Drug Adherence Workup tool and include: 1) patient questionnaire to identify asthma medication adherence barriers, 2) pharmacist 'Asthma Conversation Starter' to efficiently facilitate identification and resolution of barrier(s), and 3) patient pamphlet "Breathe Easier" to address and educate regarding identified barrier(s). To assess pharmacists' perspectives and feasibility of incorporating developed instruments into practice, semi-structured interviews were conducted with practicing community pharmacists using open-ended questions that focused on pharmacists' experiences in addressing adherence for patients with asthma, barriers, special concerns, and perceptions regarding the proposed instruments and its implementation in practice. Audio-recorded interviews were transcribed. Two independent researchers conducted a thematic analysis to describe pharmacists' feedback.

RESULTS: Pharmacists' (N=5) overall opinions about the approach and proposed tools were positive. All pharmacists acknowledged high patient need for asthma education and adherence support. Most of the interviewees agreed that common adherence barriers were

addressed in the instruments and that the main barrier regarding program implementation was time. However, pharmacists agreed that providing focused counseling by utilizing tools that identify specific patient issues and offer possible solutions may help overcome the time barrier.

CONCLUSIONS: Pharmacists agreed that identifying and addressing patient-specific barriers to asthma therapy adherence using the proposed tools would benefit patients and pharmacists also suggested implementation strategies. The proposed tools can enhance patient-pharmacist communication and they have the potential to improve adherence and overall asthma management, which can lead to decreased asthma burden.

3.2 Introduction

Lack of congruence between medical advice and patients' behavior contributes significantly to the prevalence of uncontrolled asthma, which is associated with emergency department (ED) visits, hospitalizations, decreased quality of life, and loss of productivity [1]. The prevalence of asthma attacks has not decreased over time and approximately 25% of all ED visits in the US are due to asthma-related events [2-3]. Overall, 24% of exacerbations and 60% of asthma-related hospitalizations can be attributed to poor adherence [4-6]. Medication adherence to controller therapy is consistently low, ranging from 30% to 40% in clinical practice [7-13]. In addition to medication adherence, other aspects of asthma management are important, including: using appropriate inhaler technique, avoiding asthma triggers, using a peak flow meter, having an Asthma Action Plan (AAP), and understanding medications and the disease state. In view of the multifaceted nature of adherence, reaching an optimal level of control poses a number of challenges that can be addressed when healthcare providers work with patients to identify and resolve patient-specific barriers to adherence. Pharmacists are in a key position to address these barriers, as they can identify nonadherent patients through medication refill history (both, those not filling a controller medication regularly and/or having excessive fills of asthma reliever inhalers) or via short questionnaires [14-15]. Data from refill histories and/or questionnaires can help guide pharmacists in providing targeted interventions.

Recent research shows that tailoring health behavior change (e.g., adherence) to individual patient-level factors is more efficient because it sets a personalized goal in the patient's mind [16]. In addition to general barriers to adherence, there are asthma-specific barriers such as lack of knowledge about appropriate inhaler use and misconceptions about asthma chronicity [17]. Identification of barriers and targeting them during patient–pharmacist counseling sessions can improve adherence to asthma therapy and overall control of the condition. This is in line with recent Australian studies, where community pharmacists identified patients' needs and then incorporated them into their counseling, which yielded significant improvement in asthma control and adherence compared to the control group [18-20]. However, because pharmacists have time and workflow barriers in providing extensive patient-focused education, it is important to equip pharmacists with brief tools that will enhance patient–provider encounters [21-22]. In addition to the screening for and understanding of patient barriers to adherence, it is also critical to provide pharmacists with guidance on how to address identified barriers [23].

A recent analysis of intervention programs for enhancing adherence for a number of chronic conditions strongly recommended assessment of feasibility and practice implications for such programs [24]. Since the use of tools and instruments to promote adherence is limited, there is a need to better understand how to implement use of asthma-specific instruments into the daily work routine. A 2014 study by Witry et al. identified benefits and concerns regarding the use of two generic adherence instruments (the Drug Adherence Work-up (DRAW) tool and Adherence estimator) for prevalent chronic conditions. The study showed that even though the instruments were useful in

understanding reasons for nonadherence, pharmacists identified time and workflow as the most common barriers to implementing the instruments into practice [21]. Soliciting pharmacists' feedback before implementing an intervention utilizing the instruments into practice was recommended.

The objectives of this study were: (1) to develop asthma-specific instruments to aid in identifying and resolving barriers to asthma medication adherence, (2) to assess pharmacists' perspectives on the use of the tools in the community pharmacy practice, and (3) to identify effective methods for patient-centered counseling implementation in pharmacy practice which, in turn, may reduce the burden of asthma.

Development of Asthma Adherence Tools

Development of the tools included two major activities: reviewing available tools/instruments in the literature and modifying available instruments to address asthma-specific issues. These activities resulted in the development of three asthma-specific tools: 1) Survey to identify patient-specific barriers to adherence, 2) "Asthma Conversation Starter" booklet for pharmacists addressing and resolving barriers with individualized patient-tailored approach, and 3) "Breath Easier" pamphlet for patients to provide educational recommendations.

Review of available tools/instruments

As identification of patient adherence barriers is one of the crucial steps in promoting adherence, it is important to have an instrument that will address this need. The following instruments that assess adherence and identify barriers to adherence were

reviewed: Adherence Estimator (AE), Adult Asthma Adherence Questionnaire™(AAAQ), Medication Adherence Report Scale for Asthma (MARS-A), Morisky scale (MMAS-8 and MMAS-4), Beliefs about Medicines Questionnaire (BMQ), Adherence Starts with Knowledge (ASK-20 and ASK-12) and the DRug Adherence Work-up (DRAW) tool [25]. The MMAS-4 and BMQ have been used as tools in pharmacist-provided asthma adherence improvement programs [19, 26-27]. Table 3.1 provides a brief description of the instruments regarding the number of items, adherence constructs, response scale and type of barriers to adherence that can be identified using the instrument. The World Health Organization (WHO) model purports that adherence is affected by five types of factors: patient-specific, health care team and health system-related, therapy-related, condition-related, and socioeconomic [28]. We were conceptually relying on the WHO model and used its' classification to categorize barriers (Table 3.1). All the aforementioned tools are instrumental in identifying patients at risk for nonadherence. However, they vary in addressing reasons for nonadherence. The majority of the tools include patient-related factors: forgetfulness (AAAQ, MMAS-8, ASK-20, ASK-12), fear of side effects (AE, AAAQ, BMQ, ASK-20, ASK-12), misperception about the need for a controller medication (AE, AAAQ, BMQ, MMAS-8, ASK-20, ASK-12), lack of support from others (ASK-20, ASK-12), and lifestyle habits (ASK-20). Also, other common barriers pertaining to the healthcare system and providers are cost (AE, AAAQ, ASK-20, ASK-12) and mistrust of healthcare providers/not working as a team (BMQ, ASK-20, ASK-12). Therapy-related factors include complexity of regimen (AAAQ, MMAS-8, ASK-20, ASK-12) and not having a plan or not knowing

health goals (ASK-20, ASK-12). Out of all the reviewed tools, the ASK-12 and ASK-20 questionnaires were most comprehensive regarding factors that may serve as reasons for being nonadherent. Since ASK-12 captures more barriers to adherence and is relatively brief, it was chosen for this study.

ASK-12 consists of three domains: Inconvenience/forgetfulness (3 items), treatment beliefs (4 items) and behavior (5 items) measured on a 5-point Likert scale. It demonstrated good internal validity (Cronbach's alpha = 0.75) and test-retest reliability (intraclass correlation = 0.79). Convergent validity was shown with the following correlations: Morisky Medication Adherence Scale ($r=-0.74$, $p<0.001$), Mini Asthma Quality of Life Questionnaire ($r=-0.33$, $p<0.001$), and SF-12 Mental Component Score ($r=-0.32$, $p<0.01$). ASK-12 may be useful in enhancing MTM service provision since it can help pharmacists identify the underlying barriers to adherence and address them. It may also help pharmacists with follow-up on previously addressed issues at subsequent appointment(s) (whether one-on-one, telephone, or mail interaction). This allows the intervention to be patient-tailored and potentially more informative and efficient.

Once adherence barriers are identified, pharmacists may need another tool to help them initiate counseling (i.e., "Asthma Conversation Starter"). Doucette et al. (2012) developed an instrument to guide pharmacists in addressing adherence – the Drug Adherence Work-up (DRAW) tool [25]. It consists of 11 items, and unlike other instruments discussed previously, it provides problem-solving recommendations. The DRAW tool consists of the following constructs: too many drugs/doses, forgetfulness, concerns about medications, beliefs about medication effectiveness, medication costs,

and presence of adverse events. The tool was field tested among seven community pharmacists who were providing MTM services. Pharmacists reported that the tool was easy to use and well organized and that it improved their focus on adherence during MTM counseling [25]. To our knowledge, only one study used this tool in community pharmacy practice after its development and one in the hospital setting [21, 29]. Pharmacists had positive feedback on the use of the instrument regarding the identification of the specific barriers to adherence, however the length of the DRAW tool along with the time to administer the tool and disruption of regular workflow were among concerns stated by participating pharmacists. Despite barriers, we selected the DRAW tool for use in this study.

In conclusion, a few instruments addressing adherence and its barriers are available. However, most of the tools and instruments were recently developed and they lack the evidence of use in practice. Moreover, most of the instruments are generic, while asthma has unique issues related to use of inhalers and may warrant special attention.

3.3 Methods

Modification of Selected Tools

The ASK-12 and DRAW tools, which are not disease-specific, served as the initial framework for developing our asthma-specific instruments. To modify the ASK-12 instrument, we reviewed asthma-specific instruments pertaining to adherence [30-33], along with studies exploring barriers to asthma medications adherence, and then aggregated and added the most relevant items into the ASK-12 instrument [10, 17, 34,

35]. This resulted in the addition of the following three content areas: (1) possession of asthma action plan and understanding whether the goals are achieved (Question 6), (2) symptom-based use of the controller inhaler (Question 9) and (3) possession and use of a peak flow meter (Question 15) (Figure 3.1). Additionally, the word "medication" in the original ASK-12 was changed to "inhaler". Based on the modified asthma-specific ASK-12 instrument, a corresponding tool for pharmacists was developed. The "Asthma Conversation Starter" changes the DRAW tool by incorporating asthma-specific strategies for enhancing adherence. The goal of this tool is to facilitate counseling with a patient by linking barrier(s) identified through ASK-12 to a suggested action (strategy) for overcoming this barrier, so the communication between a patient and a pharmacist is simplified and at the same time requires less time than interviewing with open-ended questions (Figure 3.2). With this in mind, the first page of the "Asthma Conversation Starter" has a shaded transparency page, where the completed survey is placed and "problematic" barriers are easily identified (Figure 3.3). Specifically, any items checked in the red shaded area indicate an adherence barrier. This section of the "Asthma Conversation Starter" Booklet follows with brief suggestions for the pharmacists, and the rest of the sections address adherence barriers in more detail. Over time, it is expected that the pharmacist will become familiar with a "Asthma Conversation Starter," resulting in a more efficient counseling session. We also developed a complementary pamphlet for patients, "Breath Easier," that reinforces the pharmacist's suggestions (see Appendix). Having a written document may help patients overcome their barriers to adherence and educate them on the asthma management key points, misunderstanding of which are

often associated with lack of adherence and asthma poor management. Accomplishment of the first aim yielded instruments that were used in the next study phase, which was to obtain pharmacists' feedback on the tools and feasibility of using them for asthma adherence improvement in practice.

Interview sessions with 5 community pharmacists were conducted to identify: (1) asthma adherence problems not addressed in the proposed tools, (2) pharmacists' suggestions for implementing these instruments in practice, and (3) potential concerns and how to overcome them. The semi-structured interview guide with open-ended questions focused on: (1) pharmacists' experience in addressing adherence in patients with asthma, (2) barriers, special concerns and perceptions regarding the proposed instruments and implementation, and (3) strategies to overcome challenges in implementation, and how to sustain a continuous patient-pharmacist partnership. The interviews were audio-taped with note taking and were approximately 40-60 minutes long. The data were transcribed, content analyzed, and coded to facilitate identification of patterns and themes. Two investigators independently read and coded the transcripts and later checked the themes for consistency.

3.4 Results

During the five semi-structured interviews with practicing community pharmacists, three main topics were identified: (1) use of tools and overall approach, (2) barriers to implementation, and (3) facilitators and suggestions for implementation (Table 3.2).

Use of tools and overall approach

All pharmacists acknowledged high patient need for asthma education and adherence support. Overall, four themes emerged during the interviews: (1) importance of identifying patients' needs, (2) tools' ability to capture common barriers, (3) ease of use, and (4) usefulness of patient pamphlet "Breathe Easier". Most of the pharmacists stated that it is important to explore patients' needs. Pharmacists reported that general questions regarding whether a patient knows how to use an inhaler or whether a patient has any questions pertaining to asthma management tend to be inefficient in uncovering problematic areas. Patients tend to reply positively to questions about adherence and use of inhalers, but the pharmacists felt that patients may have been unaware of their lack of disease management skills (see Table 3.2, Section 1A, e.g., quote "Asthma tends to be overlooked and often they say 'I know how to use it', but a lot of the times when you are taking time to investigate why are they escalating the dose, why are they switching inhaler to something stronger, it might be that they are not using it correctly.")

Pharmacists stated that from their experience the most common barriers to adherence were covered in the survey. Three pharmacists could not think of any other barriers that should be added. However, two pharmacists suggested adding two more potential barriers: not understanding how other factors might affect asthma control (e.g., allergies, smoking), and irregular appointments with primary care providers (which may lead to unscheduled ED visits) (see Table 3.2, Section 1B).

All pharmacists were very agreeable regarding the overall approach with the patient survey and the "Asthma Conversation Starter", and they thought the tools were

easy to use. Four pharmacists felt that the literacy level was appropriate. Two of the five pharmacists believed that it would be more appropriate for the pharmacist to incorporate the survey questions during counseling, whereas the others thought that patients should complete the questionnaire on their own. Three pharmacists elaborated on why using the "Asthma Conversation Starter" will be helpful in their practice. Even though time is an issue for counseling (discussed below), a quick identification of a patient's problem(s) and then having suggested action(s) were perceived as potential time savers during counseling ("I think it is nice to have this quick targeted intervention, to say "Okay, this is really important, let me mention this in counseling. I don't have to mention all these other things, but let me make sure I mention this"). The transparency page and the suggested actions provided for the pharmacists were acknowledged as helpful in the counseling process. One pharmacist thought that the "Asthma Conversation Starter" is not necessary, as pharmacists can easily identify the problem from the patient's survey. However, it may be beneficial for pharmacists lacking counseling experience (see Table 3.2, Section 1C).

Most pharmacists stated that the "Breathe Easier" pamphlet could be an important communication tool, as it (1) provides patients with simplistic salient information and (2) demonstrates that pharmacists care about them and their condition. One of the pharmacists mentioned that as patients tend to forget or not absorb the information while being counseled, it is important to supply them with a patient-friendly pamphlet with key messages that they can refer to later on. Another pharmacist mentioned that the fact that the pharmacist's name and the phone number are handwritten on this pamphlet

specifically for a patient makes a difference in the patient-pharmacist relationship and creates more trust. One of the pharmacists stated that distribution of this pamphlet would benefit every patient who fills any asthma medication. Three pharmacists mentioned that the section describing the difference between rescue and controller inhalers, as well as understanding control level of asthma are of high importance for their patients. However, another pharmacist noted that some patients may find the pamphlet too wordy (see Table 3.2, Section 1D).

Barriers to implementation

Implementation barriers identified by the pharmacists are represented by the following themes: (1) time and workflow, (2) patient's perception of the pharmacist's role, and (3) no reimbursement. All the interviewed pharmacists identified that they have multiple tasks and that volunteering any extra time on a regular basis even for a short additional counseling sessions, would be problematic (see Table 3.2, Section 2A). Two interviewees mentioned that some patients do not see a pharmacist as a healthcare team member (see Table 3.2, Section 2B). Several of them mentioned that reimbursement for this service would help facilitate its entry into routine practice. One of the pharmacists stated that if this additional service is not covered by insurance companies, then busy pharmacists would not be willing to volunteer much time for counseling patients using these tools (see Table 3.2, Section 2C).

Facilitators and suggestions for implementation

Overall, the pharmacists felt that the proposed tools can be incorporated into the counseling process and that they served as a good starting point. However, a number of facilitators are needed for ease of implementation. They can be grouped in four themes: (1) methods to identify patients, (2) role of technicians, (3) need for a dedicated pharmacist, and (4) self-recruitment strategies. As the workflow requires identifying patients who might benefit from this practice, two pharmacists recommended flagging filled prescriptions for controller inhalers, so that when the patient picks up a medication, the technician can refer the patient to the pharmacist for additional counseling. Another strategy was to identify patients with persistent asthma from the prescription database and invite them to participate in the program. Persistent asthma might be identified from the overuse of the rescue inhalers (i.e., short-acting beta-agonists) and underuse of a controller inhaler (see Table 3.2, Section 3A). The pharmacists stated that technicians could be very helpful in identifying patients in need of counseling (see Table 3.2, Section 3B). Another suggestion was that the presence of the dedicated pharmacist would be needed for provision of this intervention, for example a pharmacist who provides MTM services (see Table 3.2, Section 3C). In terms of the recruitment, displaying fliers at the intake and pick-up windows and conducting this program in conjunction with monthly health clinic/health fair events in the pharmacy were suggested strategies (see Table 3.2, Section 3D).

3.5 Discussion

A considerable amount of evidence regarding poor asthma management/adherence and a plethora of reasons underlying patients' beliefs and behavior necessitates development of strategies where health care providers can better understand patients' needs and provide targeted interventions to address them [25, 36, 37]. Pharmacists play a pivotal role in addressing patients' needs, however, the question of how effective interventions can be implemented into the community pharmacy workflow is still not well understood. One of the ways to address asthma poor management is to supply pharmacists with the tools to identify patients' barriers to adherence first and then to address those barriers efficiently and effectively.

In our study, practicing pharmacists asserted that patients with asthma are in need of additional counseling regarding appropriate inhaler use attention. Pharmacists reported that they often see patients with asthma who do not use their inhaler correctly, who do not understand the chronicity of asthma, or who do not know how to differentiate between maintenance and quick-relief inhalers, among other barriers. However, pharmacists are challenged to identify pertinent barriers due to the additional time and effort needed to investigate the issues. With the goal of addressing asthma patients' needs and the reality of pharmacists' time constraints, we proposed a structured approach for community pharmacists by using the developed tools to identify and address common barriers to asthma adherence. The developed asthma-specific tools are based on a thorough analysis of the literature and existing instruments for adherence improvement

counseling. We obtained feedback from community pharmacists, which was overwhelmingly positive regarding the ability of the proposed instruments to quickly identify and target barriers to adherence. Pharmacists felt the instruments were structured, easy to use, and geared to patients' needs. Pharmacists confirmed the need for supplying patients with important and brief information resources as patients often have difficulties retaining information received during counseling. This is consistent with evidence from the literature, where only 30% of patients on average can accurately recall provided information regarding their therapy [38-39]. The "Breathe Easier" pamphlet seemed to fulfill this need. Moreover, one pharmacist noted that certain areas can be highlighted, so that patients pay more attention; writing down a name and a phone number of the counseling pharmacist added an extra "personal touch" and signified to patients that pharmacists care.

In this study we were able to explore common barriers for implementation of these tools into pharmacy workflow, which can serve as a useful resource for other similar interventions. Not surprisingly, the most common barrier was finding extra time for a pharmacist and incorporating these tools smoothly into the workflow. This is in line with previously conducted research, where excessive workload and lack of time were found to be barriers for the provision of various pharmacy counseling services and asthma-specific services [21, 40-45]. Anecdotally, one of the pharmacists mentioned a successful community program helping patients with diabetes through collaborations among their chain pharmacists, the city, a large national health insurance company, and a large local health care system (e.g., outpatient clinics and inpatient facilities).

Pharmacists originally volunteered their time for this program. However, once a critical mass of patients was served and a positive impact was shown, pharmacists have been routinely providing this service to patients with additional reimbursement. This example demonstrates that even though the lack of time is a universal barrier, once pharmacists "prove" their role in counseling and overall improvement in chronic disease management, payers are incentivized to compensate pharmacists' time to make the service available for patients.

This is also in line with another barrier, lack of reimbursement for services, which is a deterrent for pharmacists to provide these "extra" services, which compete with their other required tasks. Lack of financial compensation was found to be a significant barrier in other studies [40, 43, 46-48]. One interesting finding regarding barriers was that pharmacists felt patients perceived their role as dispensers versus an integral part of the healthcare team and that these perceptions would critically impact the successful implementation of the tools in practice. However, continual provision of patient care services is likely to positively shift patients' perceptions of pharmacists as valuable to the health outcomes.

Pharmacists also were asked to provide their thoughts regarding facilitators of the implementation of the tools into practice, and how the previously mentioned barriers may go undetected. First, pharmacists firmly believed that one of the most important steps for successful implementation is to identify patients in need for adherence counseling *in advance* and invite them to be screened. Inviting patients "on the spot" (especially those using the drive-through window) may result in lower likelihood of patients' interest due

to their own time constraints. Pharmacists also mentioned that pharmacy technicians can be very instrumental in identifying patients who potentially might benefit from additional counseling. This is congruent with the recent calls for enhancing the roles of pharmacy technicians, so that pharmacists can focus more on clinical and counseling aspects, rather than dispensing [49]. Having a dedicated pharmacist in store, who would be in charge of this additional service (similar to the provision of MTM services) was acknowledged as a facilitating factor. Pharmacists also stated that an awareness campaign in the pharmacy should be implemented (e.g., fliers, display boards). Another possible approach for implementation could be the provision of enhanced counseling using these tools during community pharmacy health fairs and in community pharmacies with in-house clinics.

Limitations

One of the limitations of this study is that proposed barriers in tools were not validated with patients. Other barriers may have emerged that were not documented in the literature; however the impact of not having this may not be severe since barriers to adherence has been well studied in asthma. Another limitation was the small sample of interviewed community pharmacists, whose feedback may not represent broader community pharmacy network. The next step is to further validate the developed tools, their use in practice, and document relevant outcomes related to adherence and overall asthma management.

3.6 Conclusion

Low adherence to asthma controller medications and the multifaceted nature of barriers to adherence create the need for individualized pharmacist counseling. Based on established instruments for adherence improvement counseling, we developed modified patient-centered, asthma specific tools based on ASK-12 and DRAW for community pharmacy practice to address key asthma adherence barriers. Pharmacists acknowledged high need in providing care to patients with asthma in community settings and they also had overall positive feedback regarding the tools, their use during counseling, and the potential impact on patients' asthma control. To implement the routine use of the proposed tools into practice, a number of barriers need to be addressed. To overcome common barriers related to time, workflow, patient recruitment and reimbursement, pharmacists suggested strategies such as identifying patients upfront based on their refill history, flagging filled prescriptions, raising awareness among patients, involving technicians in the process of identifying patients, having a pharmacist on-board who is dedicated to medication management services, and adding the proposed approach into in-store health clinics/fairs.

The present study demonstrated that the use of the proposed tools facilitating individualized counseling is feasible and well accepted by interviewed community pharmacists. Identifying and addressing patient-specific adherence barriers have the potential for better asthma management and disease control, which in turn can decrease the burden of avoidable costly events related to uncontrolled asthma. Future studies need

to be conducted to evaluate feasibility and effectiveness of using these tools in real world community pharmacy practice, so the evidence-based pharmacy services can further promote high-quality care.

Acknowledgments

This study was supported by the Arlyn Kloesel Endowment Grant for Innovative Pharmacy Practice and Business Models (The University of Texas at Austin). The authors thank participating pharmacists for providing valuable input; Belinda Lehmkuhle, Vicki Matustik, Benita Bamgbade, Andrew Thach, Tania Bahamóndez and Daniel Moraga-Espinoza for their assistance in developing materials.

Table 3.1 Description of selected instruments measuring adherence and barriers to adherence

Instrument	Number of items	Adherence Constructs	Response scale	Type of Barriers to adherence
Adherence estimator (AE) [50]	3	Perceived concerns about medications, perceived need for medications, perceived affordability of medications	6-point Likert scale (Agree Completely – Disagree Completely)	✓ **Pt:** Fears about side effects ✓ **Pt:** Misperception (no need) ✓ **HC:** Cost of medication
Adult asthma adherence questionnaire (AAAQ) [30]	5	Following "my medication plan," forgetting, not "needing" the medications, side effects, cost	6-point Likert scale (I agree completely-I disagree completely)	✓ **Pt/HC:** Misperception /complexity of regimen ✓ **Pt:** Forgetfulness ✓ **Pt:** Misperception (no need) ✓ **Pt:** Fears about side effects ✓ **HC:** Cost of medication
Medication Adherence Report Scale for Asthma (MARS-A) [32]	10	Intentional and nonintentional adherence (No barriers or reasons for not taking ICS)	5-point Likert scale (Always-Never)	N/A

Table 3.1 (continued)

Beliefs about Medicines Questionnaire (BMQ) [31]	18	Two parts: specific (necessity, concerns) and general (overuse, harm)	5-point Likert scale (Always-Never)	✓ **Pt:** Misperception (no need, harm) ✓ **Pt:** Fears about side effects, long-term effects, becoming addicted ✓ **HC:** Mistrust to HC provider
Morisky (MMAS-8) [51]	8	Adherence + 3 items: perceived need, difficulties following the regimen, forgetfulness	Items 1-7 (Yes/No) Item 8 (5-point Likert scale Always-Never)	✓ **Pt:** Misperception (no need) ✓ **Pt:** Forgetfulness ✓ **Pt:** Fears about side effects ✓ **Therapy:** Complexity of regimen
Morisky (MMAS-4) [52] (76)	4	Adherence+ 2 items: perceived need	Yes/No	✓ **Pt:** Misperception (no need) ✓ **Pt:** Forgetfulness ✓ **Pt:** Fears about side effects
ASK-20 [53]	20	Inconvenience/forgetfulness, treatment beliefs, lifestyle/habits, help from others, collaboration with HC, side effects, cost	5-point Likert scale (Always-Never)	✓ **Pt:** Forgetfulness ✓ **Pt:** Misperception (no need) ✓ **Pt:** Not getting help from others ✓ **Pt:** Fears about side effects ✓ **Pt:** Lifestyle habits ✓ **HC:** Not working with HC team ✓ **HC:** Cost of medication ✓ **Therapy/HC:** Knowing health goals ✓ **Therapy:** Complexity of regimen/inconvenience
ASK-12 [54]	12	Inconvenience/forgetfulness, treatment beliefs, help from others, collaboration with HC, side effects, cost	5-point Likert scale (Always-Never)	✓ **Pt:** Forgetfulness ✓ **Pt:** Misperception (no need ✓ **Pt:** Not getting help from others ✓ **Pt:** Fears about side effects

Table 3.1 (continued)

				✓ **HC:** Not working with HC team ✓ **HC:** Cost of medication ✓ **Therapy/HC:** Knowing health goals ✓ **Therapy:** Complexity of regimen/inconvenience

HC=Healthcare/provider-related factor; Pt=Patient-related factor; Therapy=Therapy-related factor

Table 3.2 Themes and example quotes from pharmacist interviews

Themes	Quotes
1. Tools/Approach	
1A. Importance of identifying patients' needs	"Asthma tends to be overlooked and often they say 'I know how to use it', but a lot of the times when you are taking time to investigate why are they escalating the dose, why are they switching inhaler to something stronger, it might be that they are not using it correctly." "And everyone is going to tell you they have good control because they don't want to tell you that they don't. They don't want to admit that they're not taking their medication. They don't want to admit that they're not compliant. So this is a really good tool as you're talking to your patient." "I think they [pharmacists] will [benefit from the tools], just because as a retail pharmacist, you're doing about 40 things at once, and the way things are going, where companies I feel [they, management] are trying to do more with less labor. It's coming to a point where it's very time crunch and you have to prioritize what you can and can't do. So this is very easy to understand, very easy to go over. It identifies where the problems are, you can easily go to that section and review with the patient, and if the patient doesn't have time, you can do it over the phone. And just really go over, I think these would be beneficial for both the pharmacist and the patient." "I would say most of them would benefit from this. I can't think of anybody who is doing everything correctly."
1B. Tools' ability to capture common barriers	"I guess the only other question I would ask is if they understand how other types of disease states would affect their asthma control. I have a lot of patients who have asthma that can also be triggered by allergies. And how controlling that as well can improve managing their asthma." "Something about PCP [primary care provider]. There are ER doctors and primary care doctors. I would ask: 'How often do you go to see your PCP?' You've got diagnosed with chronic asthma, you have to get it maintained somehow. Unless you're going to the ER every so often." "I think you have most of them. I'm just trying to think is there any exceptions that we see here. I can't think of [any]." "I think number 5 [I know how to use my inhaler correctly] is a big one. I don't think a lot of people really know how to use their inhaler, because when I stop, and I always tell them how to do it, they seem surprised. They'll say 'oh my doctor showed me how,' and I'll quickly go through it with them anyway, you know: a breath, then another breath, and they seem surprised. Maybe what they got in the office was just a quick "put it to your mouth, inhale" that's it. So number 5 is a really good one, because I don't think they know how to use them correctly."

Table 3.2 (continued)

	"I think at least on the pharmacy end, knowing how to use their inhaler properly is a huge thing. I've seen patients that say they know how to use it and then when I ask them to show me they're using it completely wrong. So they're not getting any benefit or any effect out of the medication, because they do not use their inhaler correctly." "Cost is going to be one. I know a lot of people will balk when it's $105 for 3 months, which isn't really a lot but it's a big, $45 a month is a big output for people." "And the good thing is a lot of those [inhalers], except for the steroids, you can do autofill, which really helps, but some people don't pick them up. You know, they forget to pick it up. Or they decide they don't want it or don't need it or they have too much left because they're not using it properly." "And I don't know if any of my patients take it seriously enough really to have an asthma action plan. That might be something we ask them, as a pharmacist when we give out the medication." "I like the asthma action plan question. A lot of people have no clue about that, I know a lot of the pediatric doctors tend to give that to their pediatric patients, but I think that's still important for the older patients, too." "…I think the action plan is huge. I don't know how much it's utilized, but I think it should be utilized more. I think it would help a lot of patients if they actually use it."
1C. Ease of use	<u>Survey</u> "I think it's [survey] pretty adequate." "Yeah, I think the words are really [in] patient friendly language, there's nothing hard, which is really important for them." "I think for the most part most people would be able to do that without too much trouble." <u>"Asthma Conversation Starter"</u> "With the time constraints you have to prioritize what you can do and can't do. This [approach] is very easy to understand and go over." "I like the suggested actions being right here, where I don't have to go look for them. Because we are not lazy, we are busy." "I like this transparent thing – it tells you what box to check and what aspects are important for counseling."

Table 3.2 (continued)

	"The pharmacists do not need it - they can see the question [from the survey] and know the problem. The difference might be between the new pharmacist and the experienced one, who has been doing counseling for a while. It may be a little more helpful for somewhat recent graduate." <u>Overall</u> "And for me, to just look at something simple and for the patient to fill out simply. Because patients don't want to sit down and do a long questionnaire. But this is something that you could almost do for them. You could ask them these questions when you're counseling. And it would kind of be a nice counseling tool to start."
1D. Usefulness of patient pamphlet "Breathe Easier"	"..they might forget those questions, and sometimes they are reluctant to call." "..because we can tell them, but they forget by the time they walk out the door." "Because it's going home with a personalized something [pharmacist's and physician's names and phone numbers], and these little things – people are going to read it." "You write your name in there and your phone number, I mean that to me is like a personal touch, that you care." "…someone is caring if they take their medication."
2. Barriers	
2A. Time and workflow	"In all honesty I think that you are going to have barriers because we are asked to do so much already. We are asked to do vaccinations, prior authorizations, insurance issues. I mean we are asked to do an awful lot of stuff." "I definitely feel that it [time] would be one of your bigger challenges – the time factor. Especially in the community pharmacy setting, where corporate offices are constantly having demands to do more and more: gift cards and questionnaires. "Don't forget to tell them about this program or this vaccine." And so I feel that it would be definitely a challenge – time issue." "As far as working into the workflow just knowing when to take these steps would be the hard part. I don't necessarily think that asking all patients filling in the asthma meds, make them do these questions would necessarily work." "For major implementation my thing would be workflow – it would be something I do in addition to the counseling I do, so again depending on time. Rush hour we have a line. But the easier to implement when it is to our discretion. Because people come to pick up stuff and they should have time for this. Again, they should have time, but they just have other stuff going on."

Table 3.2 (continued)

	"I think time is going to be the biggest barrier for the patient and for the pharmacist. Sometimes it just gets so busy and they're in a rush you know how it can be sometimes."
2B. Patient's perception of pharmacist's role	"I don't really see like uh, a lower class people, or people who don't have as much education, they don't call as much. I don't know if they understand that we're there to help them. Even though, I ask them if they have any questions about your medications, even on refills. It just seems like, they don't understand them." "I feel like they don't understand pharmacists are there to help them with understanding the medications how to use it, what it's for, I feel like they're more… They believe it's more of a doctor issue and they go to their doctors. Some of them don't have the money to go see the doctor, I guess it's just they don't understand we're also there to help them. It's always the same people asking the same questions. It's usually the middle/upper class or who are educated." "Well, some of the patients they just see us as a "fast food" kind of thing. They don't see us as a tool that they can use for better management of their disease state. I just fill this, grab and go."
2C. No reimbursement	"They need to see that they are getting something in return as far as cost. Because if insurance doesn't cover it, it's kind of like an issue with monetary return on that. And if it's taking up time and pharmacist are not getting reimbursed then that would be an issue too, as far as involvement like this."
3. Facilitators/Suggestions	
3A. Identification of patients	"The only thing I can think of is running a report that.. now we have ways [to determine] who has gotten medications at certain times…" With every controller medication that you get, every one that you fill, you just put this in their basket. You put this pamphlet in their paperwork. You have to alert the pharmacists that counsel, and not all of them are marked for counsel, only new prescriptions or something where we definitely talk to them about. Mark it for counsel. The pharmacists would have to be trained to make sure they mark it for counsel. And then get to them and go over this." "You'd have to set aside some time and maybe like make a patient list. These are the patients that keep coming by and filling their inhalers. They are, you know, patients we can count on. Not just someone visiting. You know like a patient that you see pretty regularly."
3B. Role of a technician	"As far as for technicians – it's mainly based on how educated they are. I think that there are some technicians who can handle certain tasks, and there are others who wouldn't handle a task. So it would vary from technician to technician. I think it's about the comfort level between a pharmacist and a technician."

Table 3.2 (continued)

	"Feasibly, a tech could have a role as far as whenever a patient is picking up asthma medications. We are typically trying to do it with any medication, and ask them if they are having any issues, comments or concerns." "I think getting the technician involved is really good that helps us a lot with MTM. There're stores where I've been where the MTM is successful is usually where the technician does a lot of the leg work. And then you know we kind of help them with some recommendations. Some of them will kind of just tell you the tips on outcomes." "I think if we can get the technician involved that would be really good. Especially at drop off. Most times the pharmacist is not at drop off. So we don't see that prescription until maybe ten to fifteen minutes later after it's been typed and the patient's out shopping somewhere. So we can't really reach them. So if the technician knows hey this is a maintenance inhaler then we can hand them the survey. I think that could be really good. Especially if they're going to wait anyways. Let them just fill this out in the waiting room."
3C. Role of a dedicated pharmacist	"As far as a pharmacist who are dealing with MTM, it'd be great if they can handle it, but if it's based out of a volunteer – pharmacist volunteering to do work – it's something that they would have to be strongly motivated to do. I think if you left it to them – there might not be that many people to sign up for that."
3D. Self-recruitment strategies	"I would actually suggest rolling it out like a lot of the health clinics type things, a lot of pharmacists start doing health screenings, where they set the date once a month or whatever where the patient can come in and for a small fee they can get a quick cholesterol check, do diabetes screening. I know that the diabetes program is getting real big at this moment. I think that it would be easier to piggy back this program onto general health. If they are coming for diabetes you can ask them whether they are you using any breathing medications. To advertise for patients with asthma, not necessarily for cholesterol or cardiovascular. Basically, just taking advantage of this. Because patients who show up there are tend to be a little more motivated."

Figure 3.1 Modified Asthma specific ASK-12 items

Note: Inhaler below refers to **CONTROLLER** inhaler	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
1. I just forget to use my inhaler some of the time	☐	☐	☐	☐	☐
2. I run out of my inhaler because I don't get refills on time	☐	☐	☐	☐	☐
3. Using my inhaler more than once a day is inconvenient	☐	☐	☐	☐	☐
4. I feel confident that my inhaler will help me	☐	☐	☐	☐	☐
5. I know how to use my inhaler correctly	☐	☐	☐	☐	☐
6. I have an Asthma Action Plan and know if I am reaching my goals	☐	☐	☐	☐	☐
7. I have someone I can call with questions about my inhaler	☐	☐	☐	☐	☐
8. My doctor/nurse and I work together to make decisions	☐	☐	☐	☐	☐
9. I only use my inhaler when I am having symptoms such as shortness of breath, coughing, wheezing, or chest tightness	☐	☐	☐	☐	☐
Have you…	**In the last week**	**In the last month**	**In the last 3 months**	**> 3 months ago**	**Never**
10. Used your inhaler more or less often than prescribed?	☐	☐	☐	☐	☐
11. Skipped or stopped using your inhaler because you didn't think it was working?	☐	☐	☐	☐	☐
12. Skipped or stopped using your inhaler because it made you feel bad?	☐	☐	☐	☐	☐
13. Skipped, stopped, not refilled, or used less of inhaler because of the cost?	☐	☐	☐	☐	☐
14. Not had your inhaler with you when it was time to use it?	☐	☐	☐	☐	☐

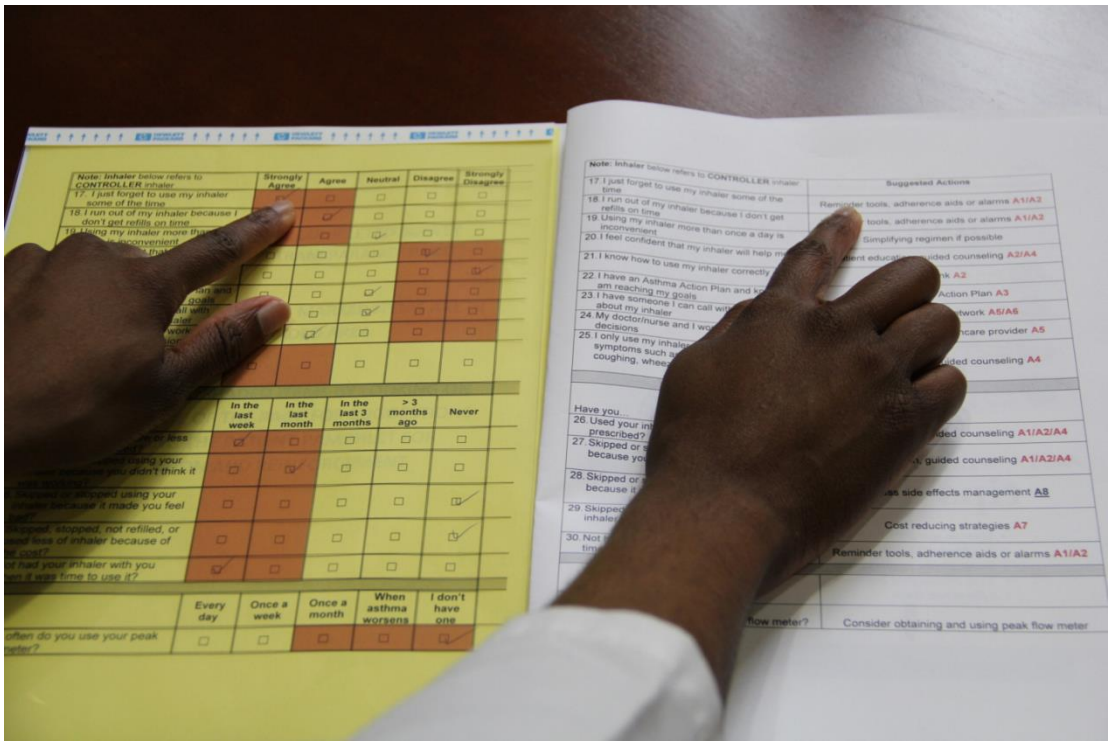
Bolded items reflect additions to the ASK-12 survey; "Medication" was replaced with "Inhaler"

Figure 3.2 "Asthma Conversation Starter" Pharmacist Counseling Booklet (Modified DRAW tool)

Note: Inhaler below refers to **CONTROLLER** inhaler	**Suggested Actions**
1. I just forget to use my inhaler some of the time	Reminder tools, adherence aids or alarms **A1/A2**
2. I run out of my inhaler because I don't get refills on time	Reminder tools, adherence aids or alarms **A1/A2**
3. Using my inhaler more than once a day is inconvenient	Simplifying regimen if possible
4. I feel confident that my inhaler will help me	Patient education, guided counseling **A2/A4**
5. I know how to use my inhaler correctly	Video link **A2**
6. I have an Asthma Action Plan and know if I am reaching my goals	Obtain Asthma Action Plan **A3**
7. I have someone I can call with questions about my inhaler	Building a support network **A5**
8. My doctor/nurse and I work together to make decisions	Partnering with your healthcare provider **A5**
9. I only use my inhaler when I am having symptoms such as shortness of breath, coughing, wheezing, or chest tightness	Patient education, guided counseling **A4**
Have you…	
10. Used your inhaler more or less often than prescribed?	Patient education, guided counseling **A1/A2/A4**
11. Skipped or stopped using your inhaler because you didn't think it was working?	Patient education, guided counseling **A1/A2/A4**
12. Skipped or stopped using your inhaler because it made you feel bad?	Discuss side effects management **A7**
13. Skipped, stopped, not refilled, or used less of inhaler because of the cost?	Cost reducing strategies **A6**
14. Not had your inhaler with you when it was time to use it?	Reminder tools, adherence aids or alarms **A1/A2**
15. How often do you use your peak flow meter?	Consider obtaining and using a peak flow meter

DRAW=Drug Adherence Work-up Tool© [81]
A1-A7 refer to more detailed information in the booklet

Figure 3.3 "Asthma Conversation Starter" Identification of barriers via shaded transparency



3.7 References

1. Tan H, et al. Impact of asthma controller medications on clinical, economic, and patient-reported outcomes. *Mayo Clin Proc.* 2009;84(8):675-84.
2. Trends in asthma morbidity and mortality 2012, American Lung Association.
3. Centers for Disease Control and Prevention (CDC). National Center for Health Statistics. National Health Interview Survey (NHIS) 2009 data release. 2010; http://www.cdc.gov/nchs/nhis/nhis_2009_data_release.htm. Accessed Jan 21, 2016.
4. Barnes CB, Ulrik CS. Asthma and Adherence to Inhaled Corticosteroids: Current Status and Future Perspectives. *Respir Care*. 2015;60(3):455-468.
5. Williams LK, Pladevall M, Xi H, et al. Relationship between adherence to inhaled corticosteroids and poor outcomes among adults with asthma. *J Allergy Clin Immunol.* 2004;114(6):1288-93.
6. Delea TE, et al. Association between adherence with fixed dose combination fluticasone propionate/salmeterol on asthma outcomes and costs. *Curr Med Res Opin*. 2008;24(12):3435-42.
7. Gamble J, Stevenson M, McClean E, Heaney LG. The prevalence of nonadherence in difficult asthma. *Am J Respir Crit Care Med*. 2009;180(9):817-22.
8. Desai M, Oppenheimer JJ. Medication adherence in the asthmatic child and adolescent. *Curr Allergy Asthma Rep*. 2011;11(6):454-64.

9. Jentzsch NS, Camargos PA, Colosimo EA, Bousquet J. Monitoring adherence to beclomethasone in asthmatic children and adolescents through four different methods. *Allergy*. 2009;64(10):1458-62.

10. Bender BG, Bender SE. Patient-identified barriers to asthma treatment adherence: responses to interviews, focus groups, and questionnaires. *Immunol Allergy Clin North Am*. 2005;25(1):107-30.

11. Jones C, Santanello NC, Boccuzzi SJ, et al. Adherence to prescribed treatment for asthma: evidence from pharmacy benefits data. *J Asthma*. 2003;40(1):93-101.

12. Bozek A, Jarzab J. Adherence to asthma therapy in elderly patients. *J Asthma*. 2010;47(2):162-5.

13. Latry P, Pinet M, Labat A, et al. Adherence to anti-inflammatory treatment for asthma in clinical practice in France. *Clin Ther.* 2008;30 Spec No:1058-68.

14. Laforest L, et al. Asthmatic patients' poor awareness of inadequate disease control: a pharmacy-based survey. *Ann Allergy Asthma Immunol*. 2007;98(2): 146-52.

15. Bereznicki BJ, et al. Uptake and effectiveness of a community pharmacy intervention programme to improve asthma management. *J Clin Pharm Ther*, 2013;38(3):212-8.

16. Gatwood J, Bailey JE. Improving medication adherence in hypercholesterolemia: challenges and solutions. *Vasc Health Risk Manag*. 2014;10:615-25.

17. Ponieman D, et al. Impact of positive and negative beliefs about inhaled corticosteroids on adherence in inner-city asthmatic patients. *Ann Allergy Asthma Immunol*. 2009;103(1):38-42.

18. Saini B, et al. Asthma disease management-Australian pharmacists' interventions improve patients' asthma knowledge and this is sustained. *Patient Educ Couns.* 2011;83(3):295-302.

19. Armour C, et al. Pharmacy Asthma Care Program (PACP) improves outcomes for patients in the community. *Thorax*. 2007;62(6):496-502.

20. Goeman D, et al. Educational intervention for older people with asthma: a randomised controlled trial. *Patient Educ Couns.* 2013;93(3):586-95.

21. Witry MJ, et al. Multiple Adherence Tool Evaluation Study (MATES). *J Manag Care Pharm.* 2014;20(7):734-40.

22. Berry TM, et al. Asthma friendly pharmacies: a model to improve communication and collaboration among pharmacists, patients, and healthcare providers. *J Urban Health.* 2011;88 Suppl 1:113-25.

23. Ulrik CS, et al. The patient's perspective: adherence or non-adherence to asthma controller therapy? *J Asthma.* 2006;43(9):701-4.

24. Nieuwlaat R, et al. Interventions for enhancing medication adherence. *Cochrane Database Syst Rev*. 2014;11:CD000011.

25. Doucette WR, et al. Development of the Drug Adherence Work-up (DRAW) tool. *J Am Pharm Assoc*. 2012;52(6):e199-204.

26. Garcia-Cardenas V, et al. Effect of a pharmacist intervention on asthma control. A cluster randomised trial. *Respir Med*. 2013;107(9):1346-55.

27. Giraud V, Allaert FA, Roche N. Inhaler technique and asthma: feasability and acceptability of training by pharmacists. *Respir Med*. 2011;105(12):1815-22.

28. World Health Organization Report 2003: Adherence to Long-Term Therapies: Evidence for Action. Chapter 7, 2003, Geneva, Switzerland: World health Organization.

29. Hedegaard U, et al. Process- and patient-reported outcomes of a multifaceted medication adherence intervention for hypertensive patients in secondary care. *Res Social Adm Pharm.* 2016;12(2):302-18.

30. Schatz M, et al. Development and preliminary validation of the Adult Asthma Adherence Questionnaire. *J Allergy Clin Immunol Pract.* 2013;1(3):280-8.

31. Horne R, Weinman J. Patients' beliefs about prescribed medicines and their role in adherence to treatment in chronic physical illness. *J Psychosom Res*. 1999; 47(6):555-67.

70. Horne R, Weinman J. Self-regulation and self-management in asthma: Exploring the role of illness perceptions and treatment beliefs in explaining non-adherence to preventer medication. *Psychology & Health*. 2002;17(1):17-32.

71. Menckeberg TT, et al. Beliefs about medicines predict refill adherence to inhaled corticosteroids. *J Psychosom Res*. 2008;64(1):47-54.

34. Howell G. Nonadherence to medical therapy in asthma: risk factors, barriers, and strategies for improving. *J Asthma*. 2008;45(9):723-9.

35. Halm EA, Mora P, Leventhal H. No symptoms, no asthma: the acute episodic disease belief is associated with poor self-management among inner-city adults with persistent asthma. *Chest*. 2006;129(3):573-80.

36. Sofianou A, et al. Asthma beliefs are associated with medication adherence in older asthmatics. *J Gen Intern Med.* 2013;28(1):67-73.

37. Weinstein AG. Asthma adherence management for the clinician. *J Allergy Clin Immunol Pract*. 2013;1(2):123-8.

38. Lam N, Muravez SN, Boyce RW. A comparison of the Indian Health Service counseling technique with traditional, lecture-style counseling. *J Am Pharm Assoc*. 2015;55(5):503-10.

39. Bayldon BW, et al. Exploring caregiver understanding of medications immediately after a pediatric primary care visit. *Patient Educ Couns*. 2013;91(2): 255-60.

40. Law AV, Okamoto MP, Chang PS. Prevalence and types of disease management programs in community pharmacies in California. *J Manag Care Pharm*. 2005; 11(6):505-12.

41. Herbert KE, et al. Prediction of pharmacist intention to provide Medicare medication therapy management services using the theory of planned behavior. *Res Social Adm Pharm.* 2006;2(3):299-314.

42. Blake KB, et al. Medication therapy management services in West Virginia: pharmacists' perceptions of educational and training needs. *Res Social Adm Pharm.* 2009;5(2):182-8.

43. Snyder ME, et al. Collaborative drug therapy management: case studies of three community-based models of care. *Prev Chronic Dis.* 2015;12:E39.

44. Kritikos VS, Reddel HK, Bosnic-Anticevich SZ. Pharmacists' perceptions of their role in asthma management and barriers to the provision of asthma services. *Int J Pharm Pract.* 2010;18(4):209-16.

45. Rene-Henri N, et al. Community pharmacists' interventions in asthma care: a descriptive study. *Ann Pharmacother.* 2009;43(1):104-11.

46. O'Donnell DC, Brown CM, Dastani HB. Barriers to counseling patients with obesity: a study of Texas community pharmacists. *J Am Pharm Assoc*. 2006; 46(4):465-71.

47. Kibicho J, Owczarzak J. Pharmacists' strategies for promoting medication adherence among patients with HIV. *J Am Pharm Assoc.* 2011;51(6):746-55.

48. Dunn SP, et al. The role of the clinical pharmacist in the care of patients with cardiovascular disease. *J Am Coll Cardiol*. 2015;66(19):2129-39.

49. Myers CE. Opportunities and challenges related to pharmacy technicians in supporting optimal pharmacy practice models in health systems. *Am J Health Syst Pharm.* 2011;68(12):1128-36.

50. McHorney CA. The Adherence Estimator: a brief, proximal screener for patient propensity to adhere to prescription medications for chronic disease. *Curr Med Res Opin* 2009;25(1):215-38.

51. Morisky DE, et al. Predictive validity of a medication adherence measure in an outpatient setting. *J Clin Hypertens*. 2008;10(5):348-54.

52. Morisky DE, Green LW, Levine DM. Concurrent and predictive validity of a self-reported measure of medication adherence. *Med Care.* 1986;24(1):67-74.

53. Hahn SR, et al. Development of the ASK-20 adherence barrier survey. *Curr Med Res Opin.* 2008;24(7):2127-38.

54. Matza LS, et al. Derivation and validation of the ASK-12 adherence barrier survey. *Ann Pharmacother.* 2009;43(10):1621-30.

3.8 Appendix

Patient Pamphlet "Breath Easier"

A5 ☐

Partner with your healthcare provider.

Ask questions to help make sure you

understand

each option.

- Ask if there are other providers who can help you address your concerns. For example, a nurse, nutritionist, or health coach can help you learn more about each option.
- Think about other people who can help support you in managing your asthma. For example, you may want to talk with a friend or family member.
- If you need more time, schedule a follow-up visit with your provider.

A6 ☐

Where can I go for

help?

Pharmacist Name:

Phone:

Physician Name:

Phone:

A7 ☐

Can I get help with

cost?

Ask your pharmacists about assistance programs and visit these websites for more information:

Needymeds.com
Pparx.org

Breathe easier

Controlling Your Asthma

A1 ☐

If you often forget to **use** your inhaler:

- Try to use it at the same time each day. Wear a watch. Set an alarm.
- Use a smartphone app or text message reminder.
- Leave yourself a note on the bathroom mirror.
- Keep your daily preventive asthma medicine in a place where you will see it every day.

A1 ☐

If you often forget to **refill** your medicine on time:

- Write "refill medicine" on your calendar about a week before your medicine will run out.
- If your asthma medicine has a dose counter, use it to help you keep track of the doses you have left.
- Make sure you have enough refills to last until your next provider visit.
- Ask your pharmacy to send you reminders to refill your prescription.

A2 ☐

Where can I get more **tips about:**

- How to use my inhaler and spacer
- Sticking with my medicine
- Smartphone applications
- Text Messaging Services
- Adherence tools

sites.utexas.edu/asthma-info

A3 ☐

Understanding your asthma **symptom control**

Good control	Partial control	Poor control
All of:	One or two of:	Three or more of:
Able to do all your usual activities	Less able to do your usual activities	Less able to do your usual activities
No asthma symptoms during night or on waking	Any asthma symptoms during night or on waking	Any asthma symptoms during night or on waking
Daytime symptoms no more than two days per week	Daytime symptoms more than two days per week	Daytime symptoms more than two days per week
Need reliever no more than two days per week*	Need reliever more than two days per week*	Need reliever more than two days per week*

(*Not including reliever puffer taken before exercise.)

Get a written asthma action plan!

A4 ☐

Understanding how your medications work

Asthma medicines come in two types—quick-relief (reliever/rescue) and long-term control (preventer/controller).

Quick-relief medicines control the symptoms of an asthma attack. If you need to use your quick-relief medicines more and more, you should visit your health-care provider to see if you need a different medicine.

Long-term control medicines help you have fewer and milder attacks, but they don't help you if you're having an asthma attack.

Reliever / Rescue Inhaler _____

Reliever	
What it does	Relaxes tight airways for up to 4 hours
How it works	Very quickly - In about 4 minutes
When to take it	- When you have symptoms - Emergency - Before exercise as prescribed
Helpful to know	Carry it with you always in case of symptoms

Preventer / Controller Inhaler _____

Preventer	
What it does	- Soothes airways - Decreases swelling - Reduces mucus
How it works	Slowly - days
When to take it	Every day as prescribed - even if you feel well
Helpful to know	Only works when used regularly and continuously

References:

http://www.healthcoach4me.com/dam/assets/hm4299.pdf

http://www.cdc.gov/asthma/pdfs/asthma_brochure.pdf

http://www.asthmaws.org.au/PageFiles/418/AA_Broch_Basic%20Facts_0614.pdf

4. CHAPTER FOUR: Study 2

Examination of Barriers to Medication Adherence, Asthma Management and Control Among Community Pharmacy Patients with Asthma

4.1 Abstract

BACKGROUND: Continuous medication use is vital for patients with persistent asthma. Reaching optimal adherence to asthma therapy poses a number of challenges which can be addressed when healthcare providers identify and resolve patient-specific adherence barriers. Pharmacists are in a key position to address these barriers; however, there is lack of evidence regarding the use of asthma-specific tools to identify and resolve common barriers to asthma adherence, and more research is needed to better understand the relationship between barriers, adherence and asthma control. A pilot study was previously conducted to better understand the feasibility of utilizing an asthma-specific tool in community pharmacy settings. Qualitative interviews with community pharmacists revealed that the instrument was user-friendly and conducive to counseling. The next step was to pilot test the tool with patients to examine preliminary outcomes.

OBJECTIVE: Utilizing a specialized asthma specific tool, we aimed to examine associations between patient-reported asthma controller adherence and: (1) asthma control, (2) adherence barriers, and (3) asthma management characteristics.

METHODS: A convenience sample of adult (≥18 years) patients with persistent asthma who were prescribed a controller inhaler were identified in community pharmacy settings by third-year pharmacy students enrolled in a required experiential community pharmacy medication therapy management (MTM) course. The study instrument assessed: a) demographic characteristics and comorbidities, b) adherence using the Morisky 4-item scale (0=high; 1-2=medium; 3-4=low); c) Asthma Control Test (ACT) where ACT score>19 represented asthma control, and d) asthma-modified ASK-12 adherence and barriers tool with two additional items focusing on: having an Asthma Action Plan (AAP)/knowing the goals of therapy and symptom-based use of controller inhalers. ASK-12 is a reliable and valid instrument designed to identify the following common adherence barriers via three subscales: inconvenience/forgetfulness, treatment beliefs and behavior, all of which were measured on a 5-point Likert scale (higher scores indicate more barriers). Lastly, the tool collected data on the following asthma management characteristics: having difficulties using a controller inhaler, need for urgent

care/medication, possession and use of an asthma action plan (AAP) and peak flow meter. Descriptive and inferential statistics were used to address the study objective.

RESULTS: The patients (N=93) were 45.4±17.2 years and 66.7% were female. Overall, asthma controller adherence was 2.0±1.4 on the Morisky scale with the majority having either low (40.7%) or medium (39.8%) adherence. Mean ACT score was 19.6±3.9 and 61.3% were controlled (ACT>19). There was no significant association between adherence and asthma control. The mean number of barriers for high, medium and low adherence groups differed significantly: 1.6±1.2, 3.8±1.7 and 6.2±2.5, respectively ($p<0.0001$). Similarly, all three barriers subscales' scores were negatively and significantly related to adherence ($p<0.0001$). Of the asthma management characteristics, only having an AAP was significantly related to adherence. Only 20.6% of patients with low adherence had an AAP, compared to 68.7% of patients with high adherence and 55.9% with medium adherence ($p=0.001$).

CONCLUSIONS: Reasons for not being adherent to asthma controller medications varied, but inconvenience, forgetfulness and treatment beliefs were most common and more barriers were associated with poorer adherence. Since having an AAP was significantly related to adherence, pharmacists can play an instrumental role in encouraging attainment and use of an AAP to help patients achieve their asthma-related goals. Improving asthma adherence requires patient-focused strategies. This brief specialized survey tool may lead to more effective, targeted counseling in community pharmacy settings.

4.2 Introduction

Despite the established association between low adherence and poor outcomes, asthma is a chronic condition in which nonadherence is widely prevalent [1-3]. Negative consequences due to controller therapy nonadherence include avoidable exacerbations, emergency department (ED) visits, hospitalizations, absenteeism, and higher total expenditures [4-5]. As medication adherence to controller therapy continues to be consistently low (< 50%), there is a need to develop an effective and sustainable approach that can be implemented and used in practice settings [6-12].

A personalized or patient–centered approach can positively impact patient experience and improve adherence and overall asthma care [13]. Once nonadherence is suspected or detected, the next important step is to understand patient-specific reason(s) for nonadherence so that the intervention can be targeted to address the identified issue(s). Barriers to adherence can be grouped into three categories: patient-related, provider-related, and health system-related factors [14-15]. Literature shows that barriers to adherence vary widely among patients with asthma. Bender et al. systematically analyzed 32 asthma studies and identified that the most common patient-related barriers to treatment among patients with asthma was lack of understanding of the asthma medication prescribed, followed by the fear of adverse effects [9]. Other patient-related barriers included: inconvenience, perception of intermittent need for controller medications, lack of knowledge regarding benefit of controller medications in prevention of symptom development and negative views regarding medication effectiveness.

Another review of 22 asthma studies revealed the following patient barriers: lack of patient education and understanding of goals, difficulty with mastery of necessary skills (e.g. use of devices such as an inhaler), fear of asthma therapy, and misperceptions that controller medications do not help prevent symptoms [16]. Hence, most of the barriers to asthma therapy adherence relate to understanding and education regarding side effects, convenience, beliefs about medication effectiveness, and importance of consistent use of inhaled corticosteroids. If healthcare providers can identify these barriers in a timely manner and address them through effective communication with patients, this may help improve adherence to asthma therapy and overall control of this condition. Among healthcare professionals, pharmacists are placed in a position where they are accessible and can effectively communicate with and educate patients about how to properly manage their asthma.

One method to initiate effective communication is to utilize tools to help facilitate the identification of barriers and to help promote counseling in an efficient manner. However, there is lack of evidence regarding the use of asthma-specific tools to identify and resolve common barriers to asthma adherence, as well as limited understanding of the relationship between barriers, adherence and asthma control. As part of a larger study, we conducted a pilot to better understand the feasibility of utilizing an asthma-specific tool in community pharmacy settings. Qualitative interviews with community pharmacists revealed that the instrument was user-friendly, conducive to counseling, and that it captured common asthma barriers (see Manuscript #1). The goal of the present study is to

examine associations between patient-reported asthma controller adherence and (1) asthma control, (2) adherence barriers and (3) asthma management characteristics.

4.3 Methods

Study Population and Inclusion Criteria

Patients were eligible if they were 18 years or older and had persistent asthma with a prescribed controller inhaler for continuous use and got their prescription(s) filled at study community pharmacy settings. Persistency of asthma was confirmed by positive responses to screening questions "Has you doctor suggested that you use your inhaler regularly?" and "Do you have asthma symptoms most of the time or is it just a seasonal condition?"

Study Variables and Instrument

In Phase I of this study, the asthma-specific patient survey was developed by the researchers and then evaluated by community pharmacists through series of in-person interviews. Detailed information regarding the development of the survey has been described elsewhere (Manuscript #1). Briefly, the survey instrument includes the following components: a) demographic characteristics and comorbidities (N=5); b) self-reported adherence using the Morisky 4-item scale; c) Asthma Control Test (ACT) (N=5), d) asthma-modified ASK-12 adherence tool (N=14) (Figure 1); and e) asthma management characteristics (N=7). Demographic characteristics included age, race, gender, and education. Patients were also asked whether they had the following comorbid conditions: hypertension, hyperlipidemia, diabetes and other chronic conditions. The

Morisky 4-item scale (MMAS-4) is a valid, reliable (Cronbach's alpha=0.61) and widely used generic scale for adherence assessment [17]. Every "Yes" response equals to 1 point and "No" yield 0 points. Based on total scale scores, patients are classified into high adherence (0), medium adherence (1-2), and low adherence (3-4) groups [18]. The ACT has five questions with a response scale ranging from 1 (poor control) to 5 (good control). Total scores >19 indicate controlled asthma, while scores of ≤19 indicate uncontrolled asthma [19].

ASK-12 (Adherence Starts with Knowledge) is a reliable and valid instrument designed to identify the following common adherence barriers via three subscales: inconvenience/forgetfulness, treatment beliefs and behavior, which are measured on a 5-point Likert scale (higher scores indicate more barriers) [20]. Even though the original scale was not asthma-specific, it addresses most of the common barriers to asthma adherence. ASK-12 demonstrated good internal validity (Cronbach's alpha = 0.75) and test-retest reliability (intraclass correlation = 0.79) and has been tested among patients with asthma [20]. Modification of the ASK-12 instrument included changing "medication" to "inhaler" and adding the following two items pertaining to: having an Asthma Action Plan (AAP)/knowing the goals of therapy and symptom-based use of controller inhalers. The following scoring was used in the modified ASK instrument (Figure 1): items 1-9 with 5-point Likert scale (1=strongly disagree; 5=strongly agree), items 10-14 with 5-point scale (1= in the last week; 5=never) and items 4–8 were reverse scored. Total score was calculated by summing responses to all items after applying

reverse coding. The asthma-specific ASK scale total scores ranged between 14 and 70 with higher scores representing more barriers to adherence.

Besides demographic characteristics, asthma adherence, asthma control and barriers to adherence, seven additional asthma management characteristics were included in the survey: having difficulties using a controller inhaler, ever been hospitalized, hospital or ED visit in the previous year, need for oral corticosteroids (OCS) in the previous year, and possession/ frequency of use of peak flow meter. The item regarding possession of an AAP was reported both – under asthma-specific ASK-12 barriers and as an asthma management characteristic.

Data Collection and Analysis

Third-year pharmacy students (N=120) enrolled in a required experiential community pharmacy medication therapy management (MTM) course invited patients who were picking up their controller inhalers to participate in the study. If the patient agreed, the student utilized the screening questions to determine eligibility and whether or not the patient had persistent asthma. Data were collected from September 2015 until May 2016. Descriptive statistics with means and frequencies were used to summarize participants' baseline demographic, comorbid conditions, adherence, asthma control, barriers to asthma medication adherence, and asthma management characteristics. To assess the association between adherence and variables of interest (asthma control, barriers to adherence score and asthma management characteristics) bivariate analyses (t-

test, chi-squared, ANOVA) were used, as well as Tukey's post-hoc means comparison analysis. SAS, Version 9.3 (Cary, NC) was used to conduct the analyses.

4.4 Results

From a total of 120 surveys received, 93 met the study inclusion criteria and had complete data. However, due to an omission in the survey instrument during the fall semester, demographic information was provided for surveys collected during the spring semester only (N=49). The mean age of participants (N=49) was 45.4±17.2 years old and 65.3% were female. Participants identified themselves mainly as Caucasian (44.9%) or Hispanic/Latino (40.8%), with African Americans comprising 8.2% and other race/ethnicity at 6.1%. A majority of the participants had at least a college degree (57.2%), while the remaining had some college (16.3%) or a high school degree or less (26.5%). Hypertension, diabetes, and dyslipidemia were reported by 32.6%, 24.5%, and 20.4%, respectively (Table 4.1).

The remaining results were captured for all participants (N=93). Table 4.2 shows overall descriptives for adherence and the outcomes variables (asthma control, adherence barriers, and asthma management characteristics) as well as stratified comparisons across three adherence groups based on the following Morisky scale adherence scores: low N=38 (40.9%), medium N=37 (39.8%) and high N=18 (19.3%) The Morisky scale mean adherence score was 2.0±1.4 (i.e., medium adherence), with approximately 80% (combined) having either low (40.9%) or medium (39.8%) adherence levels. The mean ACT score was 19.6±3.9, with 38.7% of patients having uncontrolled asthma. The overall

mean barriers score was 31.5±9.1 and the mean number of barriers was 4.3±2.6 with the following adjusted subscale mean scores: inconvenience/forgetfulness 2.9±1.0, treatment beliefs 2.2±0.7, and behavior 1.9±0.8. Regarding asthma management characteristics, Table 1.2 shows that only 23.7% had ever been hospitalized due to asthma and an even smaller proportion (6.4%) had been hospitalized within the last 12 months. Regarding emergent care, 17 (18.3%) had at least one ED visit due to asthma in the last 12 months, with a mean of 2.2±1.7 visits among those who had ED visit(s). Also, almost 30% had received OCS for asthma flares in the last 12 months. Positive responses regarding possession of AAP and peak flow meter were reported by 44.0% (37 of 84 replied) and 26.9% (25 of 93 replied), respectively. Lastly, only 15.0% reported having difficulties using their controller inhaler.

Comparisons of ACT scores, barriers scores and asthma management characteristics across the three adherence groups are also shown in Table 4.2. ACT was not significantly different across the three adherence groups. However, total adherence barriers scores were significantly higher in the low adherence group compared to medium and high adherence groups: 38.9±7.0 vs. 28.6±5.4 vs. 21.8±6.5 ($p<0.0001$ for overall model, $p<0.05$ for post-hoc analyses). Similarly, significant differences were observed regarding the mean number of barriers for high, medium and low adherence groups: 1.6±1.2, 3.8±1.7 and 6.2±2.5, respectively ($p<0.0001$). Post-hoc analyses confirmed significant difference across the three adherence groups ($p<0.05$). All three subscales' scores were negatively and significantly related to adherence as well ($p<0.0001$). In other words, as adherence decreased, the number of barriers increased. Post-hoc analyses

revealed that mean scores for forgetfulness/inconvenience and behavior subscales differed significantly ($p<0.05$) across three adherence groups. Mean scores for the treatment beliefs subscale were found to be significantly different between low and medium and low and high adherence groups ($p<0.05$), but not between medium and high adherence groups ($p>0.05$). Among asthma management characteristics, only one was found to be significantly different across adherence groups: possession of AAP. The majority of patients with low adherence did not have an AAP (79.4%), whereas 68.7% of patients with high and 55.9% with medium adherence did ($p=0.001$).

Table 4.3 shows that the barriers with the highest mean scores were related to forgetfulness (item 1; 3.1±1.3), inconvenience (item 3; 3.0±1.2) and AAP (item 6; 3.0±1.4). Figure 4.2 and Table 4.2 also show that among the three asthma-specific ASK-12 adherence subscales, inconvenience/forgetfulness had the highest barrier score. Table 4.4 displays the rank order of barriers according to decreasing prevalence among those with low adherence (Morisky score = 3 or 4). The most common barriers among this group were: forgetfulness (*Item 1 in Figure 4.1*) (76.3%), not knowing the goals of therapy (*Item 6 in Figure 4.1*) (71.0%), symptom-based use of controller inhaler (*Item 9 in Figure 4.1*) (65.8%), inconvenience (*Item 3 in Figure 4.1*) (60.5%) and irregular use of inhaler (*Item 10 in Figure 4.1*) (57.9%).

4.5 Discussion

The present study is a response to the call for patient-focused care to improve asthma self-management and consequently patient outcomes [21-23]. Development and

pilot testing practical tools in real-world settings is the next important step in translating this need into concrete actions. This study pilot-tested the proposed asthma-specific ASK-12 instrument to better understand barriers to asthma medication adherence and examine the relationship between adherence, asthma control, adherence barriers and asthma management characteristics.

The data collected from the participating patients revealed that forgetfulness and treatment beliefs were the most common reasons for not being adherent. This is in line with previously conducted studies, where a “no symptoms, no asthma” belief was significantly associated with poor adherence [24-25]. This erroneous belief was also reported as one of the commonly identified barriers to adherence in the review study by Bender [9]. The majority of participants with low adherence (79%) did not have an AAP and were not aware of their asthma goals. This barrier was also highlighted in a review conducted by Howell [16]. This is not surprising as a study that assessed provider adherence to current guidelines found that only 3% provided their patients with an AAP [26]. This topic is important to address with both patients and providers because having an AAP is one of the key components in asthma management and shown to be important in this study. Although the US and other countries’ guidelines reflect the need for AAPs, research from Canada and the UK also shows that physicians do not comply with these guidelines, and some even consider AAPs as unnecessary and not required [27-28]. Pharmacists are in a key position to work together with providers to encourage development of an AAP for patients. Once obtained, pharmacists can routinely review and educate patients on AAP use and in goal achievement. Notably, overall, only one-

quarter of patients used a peak flow meter. Pharmacists can also play an integral role by making these devices available in their pharmacies and by educating patients on their use, as it is an essential part of AAP development and routine use.

Study findings show a significant relationship between adherence and barrier scores; as adherence decreased, barriers increased. A study conducted by Young et al. differentiated between knowledge, belief and practical barriers, and those patients who had multiple types of barriers had worse asthma control [29]. In our study we did not find significant association between adherence and asthma control, whereas Young et al. reported significantly lower ACT score for those participants with belief barriers (and combination of belief and practical), but not for those with knowledge or practical barriers only. The discrepancy of this study's results with Young's is likely due to differences in studied populations, as well as in study design. Patients in Young's study were low-income and living in rural and medically underserved areas. Their overall asthma control was lower compared to our study (mean ACT: 16.4±4.6 vs. 19.6±3.9), and Young's participants had a lower education. Additionally, patients in our study picked up their asthma controller medication in the community pharmacy, which excluded those who did not fill the prescription, which may be indicative of lower adherence and less proactive patients.

More than half of patients agreed that using their inhaler more than once a day is inconvenient, confirming data from clinical trials where patients with once-daily controller inhaler had significantly higher adherence compared to twice-daily regimens [30]. Approximately one-quarter of patients with low adherence did not respond

positively about working together with nurse/physician to make decisions in asthma management. This echoes the findings from the large national US asthma survey study, where both physicians and patients responses were evaluated, and different opinions were found regarding asthma education: 90% of physicians reported that they spend up to 50% of the office visit discussing inhaler technique, individual plan and symptoms monitoring, whereas only 55% of patients reported that half of the office visit appointment time was spent on asthma education and 38% of patients reported that no time was spent on educational issues at all [31]. These findings indicate room for improvement in patient-physician partnership, and show that pharmacists can help close these gaps in the healthcare team-patient interactions.

Even though in our study a small proportion of patients with low adherence reported uncertainty regarding the correct use of their inhaler (5.3%), it is necessary that health care providers ask patients to demonstrate inhaler technique [32]. In the previous qualitative phase of this larger study (Manuscript #1), interviewed pharmacists indicated that quite often patients may be confident regarding correct inhaler use, but it may not hold true when their techniques are actually observed.

The proposed survey identified most common asthma controller adherence barriers. As we cannot know specific problems that patients experience with respect to asthma, it is important to screen patients for the presence of common adherence barriers. In Young's study, pharmacists used a communication tool with open-ended and probing questions, and then they electronically documented the barriers and classified them in three categories: knowledge, beliefs and practical barriers [29]. It was not clear how

many items were in the survey and how much time pharmacists spent counseling, entering the data and classifying barriers. In busy community pharmacy settings, a more structured and time saving tool may be needed. Our tool not only empowers the patient to take an active role in reporting their barriers, it is also efficient for the pharmacist since they do not have to spend as much time interviewing the patient.

This study has several limitations. The cross-sectional nature precludes examination of changes in asthma medications barriers, adherence and asthma control over time. However, this is a goal for the next phase of this larger study, where follow-up data will be provided. Second, all the collected data regarding asthma control (healthcare services utilization and medication use), adherence and barriers were self-reported, and thus might be affected by recall and social desirability biases. Patients may have under- or over-reported on all three of these parameters. However, when used in practice, the primary focus for pharmacist interventions will likely be related to barriers, which may have been less affected by the above biases. Additionally, linkage of patients' data to medical claims can be a valuable source for further identifying poorly controlled and nonadherent patients and targeting them for patient-centered counseling. Third, another study limitation is selection bias as this study examined adherence and barriers to adherence among patients who voluntarily agreed (i.e., convenience sample) to complete the survey while picking up their prescription for asthma medication. Results may be different if the administration of the survey becomes a common practice for all patients who use controller inhalers. Fourth, participants were from Travis county community pharmacies, where a high proportion had a college degree and low proportion reported

cost as a barrier to adherence. Thus generalizability may be limited to a broader population of asthma patients or those who are ethnically and geographically diverse, as well as to underserved groups. Finally, the proposed tool may not capture all possible barriers to adherence. The goal of the tool is to capture major reasons for nonadherence, which were identified through literature sources. However, we pretested the tool with practicing pharmacists, who confirmed that the most common barriers were represented (Manuscript #1). On a positive note, the instrument has a general question whether a patient used the inhaler more or less often than prescribed, which can indicate issues with adherence and signal a need to reveal underlying reasons for further investigation.

4.6 Conclusions

With low adherence to asthma controller medications and the multifaceted nature of barriers to adherence, individualized patient counseling approaches are needed for pharmacists. Based on established instruments for adherence improvement counseling, this study's modified asthma specific tool was pilot tested in community pharmacy settings. Overall, reasons for not being adherent to asthma controller medications varied, but inconvenience, forgetfulness and treatment beliefs were most common and more barriers were associated with poorer adherence. Since having an AAP was significantly related to adherence, pharmacists can play an instrumental role in encouraging attainment and use of an AAP to help patients achieve their asthma-related goals. Use of the proposed survey tool creates patient-focused approach to asthma adherence improvement and may lead to more effective, targeted counseling in community pharmacy settings.

Future steps will assess the effectiveness of the proposed tools for addressing and resolving specific barriers to asthma adherence.

Figure 4.1 Modified Asthma specific ASK-12 items

Note: Inhaler below refers to **CONTROLLER** inhaler	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
1. I just forget to use my inhaler some of the time	☐	☐	☐	☐	☐
2. I run out of my inhaler because I don't get refills on time	☐	☐	☐	☐	☐
3. Using my inhaler more than once a day is inconvenient	☐	☐	☐	☐	☐
4. I feel confident that my inhaler will help me	☐	☐	☐	☐	☐
5. I know how to use my inhaler correctly	☐	☐	☐	☐	☐
6. I have an Asthma Action Plan and know if I am reaching my goals	☐	☐	☐	☐	☐
7. I have someone I can call with questions about my inhaler	☐	☐	☐	☐	☐
8. My doctor/nurse and I work together to make decisions	☐	☐	☐	☐	☐
9. I only use my inhaler when I am having symptoms such as shortness of breath, coughing, wheezing, or chest tightness	☐	☐	☐	☐	☐
Have you…	**In the last week**	**In the last month**	**In the last 3 months**	**> 3 months ago**	**Never**
10. Used your inhaler more or less often than prescribed?	☐	☐	☐	☐	☐
11. Skipped or stopped using your inhaler because you didn't think it was working?	☐	☐	☐	☐	☐
12. Skipped or stopped using your inhaler because it made you feel bad?	☐	☐	☐	☐	☐
13. Skipped, stopped, not refilled, or used less of inhaler because of the cost?	☐	☐	☐	☐	☐
14. Not had your inhaler with you when it was time to use it?	☐	☐	☐	☐	☐

Bolded items reflect additions to the ASK-12 survey; "Medication" was replaced with "Inhaler"

Figure 4.2 Adjusted mean barrier to adherence subscale scores by adherence level (N=93)

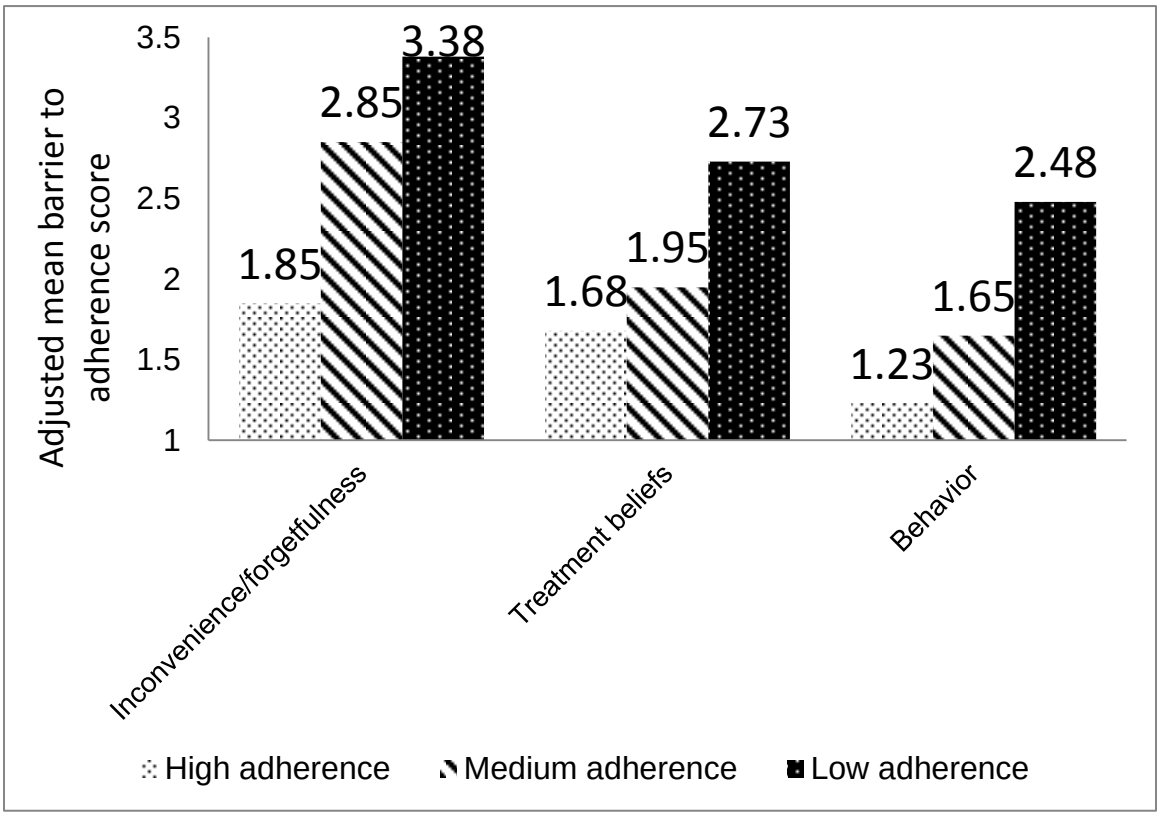


Table 4.1 Means and frequencies of participant demographic and comorbidity characteristics (N=49)

Variable[a]		
Age (years), mean (SD)	45.4	17.2
	N	**%**
Female	32	65.3
Race/Ethnicity		
Caucasian	22	44.9
African American	4	8.2
Hispanic/Latino	20	40.8
Other	3	6.1
Total	49	100.0
Level of education		
Primary	2	4.1
Some high school	1	2.0
High school	10	20.4
Some college	8	16.3
College	21	42.9
Postgraduate	7	14.3
Total	49	100.0
Chronic condition(s)[b]		
None[c]	17	34.7
Hypertension	16	32.7
Diabetes	12	24.5
Dyslipidemia	10	20.4
Other[d]	40	81.6

[a]Demographic and comorbidity characteristics were only captured for data collected during the spring semester
[b]Total is greater than 100% due to multiple chronic conditions
[c]Excluding asthma
[d]Depression, chronic pain, gastrointestinal disorder, thyroid disease, heart disease, arthritis, obesity, allergies, multiple sclerosis, osteoporosis

Table 4.2 Participants adherence, asthma control and asthma management characteristics by level of adherence

Variable		Adherence Levels			P-value
	Total N=93 100%	**Low N=38 (40.9%)**	**Medium N=37 (39.8%)**	**High N=18 (19.3%)**	
	N (%)	**N (%)**	**N (%)**	**N (%)**	
Adherence, mean (SD)[a]	2.0 (1.4)	3.4 (0.5)	1.5 (0.5)	0 (0)	**<0.0001**
Asthma control					
Asthma control test (ACT) score, mean (SD)[b]	19.6 (3.9)	19.4 (4.2)	19.8 (3.6)	19.6 (3.8)	0.8990
ACT ≤19 (uncontrolled), N(%)[b]	36 (38.7)	16 (42.1)	14 (37.8)	6 (33.3)	0.8123
Adherence barriers					
Total adherence barrier score, mean (SD)[c]	31.5 (9.1)	38.9* (7.0)	28.6** (5.4)	21.8*** (6.5)	**<0.0001**
Number of barriers, mean (SD)[d]	4.3 (2.6)	1.6* (1.2)	3.8** (1.7)	6.2*** (2.5)	**<0.0001**
Adherence barrier subscales, adjusted mean (SD)[e]					
Inconvenience/forgetfulness	2.9 (1.0)	3.4* (0.8)	2.9** (0.8)	1.9*** (0.9)	**<0.0001**
Treatment beliefs	2.2 (0.7)	2.7* (0.6)	2.0** (0.6)	1.7** (0.6)	**<0.0001**
Behavior	1.9 (0.8)	2.5* (0.7)	1.7** (0.5)	1.2*** (0.4)	**<0.0001**
Asthma management characteristics					
Ever been hospitalized[e] N(%)	22 (23.7%)	9 (23.7)	7 (18.9)	6 (33.3)	0.2082
At least one hospitalization due to asthma within 12 months	6 (6.4%)	3 (7.9%)	2 (5.4%)	1 (5.6%)	0.5699
At least one ER visit due to asthma within 12 months	17 (18.3%)	8 (21.0%)	7 (18.9%)	2 (11.1%)	0.7768
At least one OCS burst within 12 months	26 (28%)	9 (23.7%)	14 (37.8%)	3 (16.7%)	0.5112
Possession of Asthma Action Plan[d]	37 (44.0%)	7 (20.6)	19 (55.9)	11 (68.7)	**0.001**
Use of peak flow meter	25 (26.9%)	7 (18.4)	13 (35.1)	5 (27.8)	0.2627
Having difficulty using controller inhaler[g], N(%)	14 (15.0)	8 (21.0)	2 (5.4)	4 (22.2)	0.1061

ER-emergency room; OCS-oral corticosteroid
*Tukey's post-hoc analyses are represented by stars (*); like number of stars indicates nonsignificant difference
[a]0=High adherence; 1-2=Medium adherence; 3-4=Low adherence
[b]ACT=Asthma Control Test: >19 (controlled); ≤19 (uncontrolled)
[c]Barrier score range: 14-70; higher score = more barriers
[d]Likert scale response "4" or "5" for Items 4-8; or "1" or "2" for Items 1-3, 9-14 coded as barrier present
[e]Subscale scores were adjusted for number of items: range 1-5; higher scores = more barriers
[f]N=92
[g]N=84

Table 4.3 Participant characteristics: adherence, asthma control and barriers to adherence (N=93)

Barriers[a]	Mean	SD
1. I just forget to use my inhaler some of the time	3.1	1.3
2. I run out of my inhaler because I don't get refills on time	2.5	1.2
3. Using my inhaler more than once a day is inconvenient	3.0	1.2
4. I feel confident that my inhaler will help me	1.7	0.8
5. I know how to use my inhaler correctly	1.5	0.7
6. I have an Asthma Action Plan and know if I am reaching my goals	3.0	1.4
7. I have someone I can call with questions about my inhaler	2.0	1.0
8. My doctor/nurse and I work together to make decisions	2.2	1.2
9. I only use my inhaler when I am having symptoms such as shortness of breath, coughing, wheezing, or chest tightness	2.8	1.4
10. Used your inhaler more or less often than prescribed?	2.7	1.5
11. Skipped or stopped using your inhaler because you didn't think it was working?	1.6	1.2
12. Skipped or stopped using your inhaler because it made you feel bad?	1.5	1.0
13. Skipped, stopped, not refilled, or used less of inhaler because of the cost?	1.4	0.9
14. Not had your inhaler with you when it was time to use it?	2.3	1.4
Total Barriers Scale Score[b]	**31.5**	**9.1**
Scale Cronbach's Alpha		**0.86**

[a]Individual item range 1-5; higher scores = more barriers
[b]Barrier score range: 14-70; higher score = more barriers

Table 4.4 Frequency of barriers to adherence for participants with low adherence

Rank	Barrier	Patients with low adherence[a] (N=38)	
		N	%[b]
1	I just forget to use my inhaler some of the time	29	76.3
2	I have an Asthma Action Plan and know if I am reaching my goals	27	71.0
3	I only use my inhaler when I am having symptoms such as shortness of breath, coughing, wheezing, or chest tightness	25	65.8
4	Using my inhaler more than once a day is inconvenient	23	60.5
5	Used your inhaler more or less often than prescribed?	22	57.9
6	I run out of my inhaler because I don't get refills on time	15	39.5
7	Not had your inhaler with you when it was time to use it?	13	34.2
8	Skipped or stopped using your inhaler because you didn't think it was working?	11	28.9
9	My doctor/nurse and I work together to make decisions	10	26.3
10	I have someone I can call with questions about my inhaler	8	21.0
11	Skipped or stopped using your inhaler because it made you feel bad?	7	18.4
12	Skipped, stopped, not refilled, or used less of inhaler because of the cost?	5	13.2
13	I feel confident that my inhaler will help me	2	5.3
14	I know how to use my inhaler correctly	2	5.3

Inconvenience/forgetfulness subscale
Treatment beliefs subscale
Behavior subscale

[a]Morisky score = 3 or 4

[b]Proportion of barriers reported by participants with low adherence (N=38)

4.7 References

1. National Asthma Education and Prevention program. Expert Panel Report 3 (EPR-3): Guidelines for the Diagnosis and Management of Asthma-Summary Report 2007. *J Allergy Clin Immunol.* 2007;120(5 Suppl):S94-138.
2. Akinbami LJ, Moorman JE, Liu X. Asthma prevalence, health care use, and mortality: United States, 2005-2009. *Natl Health Stat Report*, 2011;32:1-14.
3. Krigsman K, Nilsson JLG, RingL. Adherence to multiple drug therapies: refill adherence to concomitant use of diabetes and asthma/COPD medication. *Pharmacoepidemiol Drug Saf.* 2007;16(10):1120-8.
4. Stern L, Berman J, Lumry W, et al. Medication compliance and disease exacerbation in patients with asthma: a retrospective study of managed care data. *Ann Allergy Asthma Immunol*. 2006;97(3):402-8.
5. Smith JR, et al. Clinician-assessed poor compliance identifies adults with severe asthma who are at risk of adverse outcomes. *J Asthma*. 2005;42(6): p.437-45.
6. Gamble J, Stevenson M, McClean E, Heaney LG. The prevalence of nonadherence in difficult asthma. *Am J Respir Crit Care Med*. 2009;180(9):817-22.
7. Desai M, Oppenheimer JJ. Medication adherence in the asthmatic child and adolescent. *Curr Allergy Asthma Rep*. 2011;11(6):454-64.

8. Jentzsch NS, Camargos PA, Colosimo EA, Bousquet J. Monitoring adherence to beclomethasone in asthmatic children and adolescents through four different methods. *Allergy*. 2009;64(10):1458-62.

10. Bender BG, Bender SE. Patient-identified barriers to asthma treatment adherence: responses to interviews, focus groups, and questionnaires. *Immunol Allergy Clin North Am*. 2005;25(1):107-30.

11. Jones C, Santanello NC, Boccuzzi SJ, et al. Adherence to prescribed treatment for asthma: evidence from pharmacy benefits data. *J Asthma*. 2003;40(1):93-101.

12. Bozek A, Jarzab J. Adherence to asthma therapy in elderly patients. *J Asthma*. 2010;47(2):162-5.

13. Latry P, Pinet M, Labat A, et al. Adherence to anti-inflammatory treatment for asthma in clinical practice in France. *Clin Ther.* 2008;30 Spec No:1058-68.

13. Gatwood J, Bailey JE. Improving medication adherence in hypercholesterolemia: challenges and solutions. *Vasc Health Risk Manag.* 2014;10:615-25.

14. World Health Organization Report 2003: Adherence to Long-Term Therapies: Evidence for Action. Chapter 7, 2003, Geneva, Switzerland: World health Organization.

15. Adherence to long-term therapies:evidence for action. 2003 http://whqlibdoc.who.int/publications/2003/9241545992.pdf. Accessed Jan 21, 2016.

16. Howell G. Nonadherence to medical therapy in asthma: risk factors, barriers, and strategies for improving. *J Asthma*. 2008;45(9):723-9.

17. Morisky DE, Green LW, Levine DM. Concurrent and predictive validity of a self-reported measure of medication adherence. *Med Care.* 1986;24(1):67-74.

18. Tan X, Patel I, Chang J. Review of the four item Morisky Medication Adherence Scale (MMAS-4) and eight item Morisky Medication Scale (MMAS-8). *Innovations in pharmacy.* 2014;5(3):1-8.

19. Nathan RA, et al. Development of the asthma control test: a survey for assessing asthma control. *J Allergy Clin Immunol.* 2004;113(1):59-65.

20. Matza LS, et al. Derivation and validation of the ASK-12 adherence barrier survey. *Ann Pharmacother.* 2009;43(10):1621-30.

21. Irwin RS, Richardson ND. Patient-focused care: using the right tools. *Chest.* 2006;130(1 Suppl):73S-82S.

22. Touchette D. Medication compliance,adherence, and persistence: current status of behavioral and educational interventions toimprove outcomes. *JMCP* 2008; 2008(14):S2-S10.

23. Bender B, Milgrom H, Apter A. Adherence intervention research: what have we learned and what do we do next? *J Allergy Clin Immunol*. 2003;112(3):489-94.

24. Sofianou A, et al. Asthma beliefs are associated with medication adherence in older asthmatics. *J Gen Intern Med.* 2013;28(1):67-73.

25. Halm EA, Mora P, Leventhal H. No symptoms, no asthma: the acute episodic disease belief is associated with poor self-management among inner-city adults with persistent asthma. *Chest*. 2006;129(3):573-80.

26. Yawn BP, et al. Adherence to Asthma Guidelines in Children, Tweens, and Adults in Primary Care Settings: A Practice-Based Network Assessment. *Mayo Clin Proc*. 2016;91(4):411-21.

27. Boulet LP, et al. Benefits of an asthma education program provided at primary care sites on asthma outcomes. *Respir Med.* 2015;109(8):991-1000.

28. Wiener-Ogilvie S, et al. Do practices comply with key recommendations of the British Asthma Guideline? If not, why not? *Prim Care Respir J*. 2007;16(6):369-77.

29. Young HN, et al. Barriers to medication use in rural underserved patients with asthma. *Res Social Adm Phar.* 2015;11(6):909-14.

30. Price D, et al. Improved adherence with once-daily versus twice-daily dosing of mometasone furoate administered via a dry powder inhaler: a randomized open-label study. *BMC Pulm Med.* 2010;10:1.

31. Blaiss MS, et al. Barriers to asthma treatment in the United States: results from the global asthma physician and patient survey. *World Allergy Organ J*. 2009; 2(12):303-13.

32. Basheti IA, et al. Improved asthma outcomes with a simple inhaler technique intervention by community pharmacists. *J Allergy Clin Immunol.* 2007;119(6): 1537-8.

5. CHAPTER FIVE: Study 3

Improving Asthma Management: Patient-Pharmacist Partnership Program in Enhancing Therapy Adherence

5.1 Abstract

Background: Adherence to asthma controller medications is often suboptimal. Community pharmacist interventions including patient-centered counseling based on identified barriers to adherence can assist in improving adherence in patients with asthma.

Objective: To determine if identification of adherence barriers and patient-centered counseling using the developed asthma-specific tools lead to improved medication adherence and asthma control.

Methods: Adult patients with persistent asthma were invited to participate in a 3-month pre-post intervention study involving community pharmacist-provided patient centered counseling. At the first appointment, patients completed a survey measuring: a) adherence using the Morisky 4-item scale (0=high; 1-2=medium; 3-4=low); b) barriers to adherence using the asthma-modified ASK-12 adherence and barriers tool, which utilized a 5-point Likert scale (higher scores indicate more barriers); c) asthma control test (ACT) where ACT score>19 represented asthma control, and d) demographics and comorbid conditions. Pharmacists provided patient-specific education to resolve identified adherence barriers (using previously developed counseling tools "Asthma Conversation Starter" and "Breath Easier") and recommendations were developed for each patient. At 3-month follow-up, adherence, barriers and asthma control were evaluated. Patients in the control group were invited to be evaluated for the same parameters as the intervention group, followed by provision of usual care and follow-up in 3 months. Paired bivariate analyses were conducted to determine whether there were changes in outcomes (adherence, asthma control, barriers score) from pre- to post-period in the intervention and control groups.

Results: At baseline, asthma specific parameters were significantly different between the intervention (N=17) and control (N=12) groups. Mean adherence was significantly higher in the intervention group compared to the control group (1.1±1.3 vs. 3.2±1.05,

respectively) and a significantly ($p<0.05$) higher proportion of patients had uncontrolled (ACT≤19) asthma in the intervention group compared to the control group (94% vs. 50%, respectively). Adherence and asthma control did not change significantly in either group. ACT score increased by 2.7 in intervention group, which was not statistically significant; however, it was clinically significant. Significant improvement in barriers to adherence resolution was observed in the intervention group: the average barriers score decreased by 3.9±6.9 ($p=0.035$).

Conclusions: A proposed counseling approach of identifying and addressing patient-specific barriers to adherence delivered by pharmacists was helpful in resolving barriers and it has potential in producing sustained improvement in asthma outcomes (asthma control).

5.2 Introduction

Lack of agreement between medical advice and patients' behavior contributes significantly to uncontrolled asthma, which is associated with emergency department (ED) visits, hospitalizations, decreased quality of life, and loss of productivity [1]. The prevalence of asthma attacks has not decreased over time and approximately 25% of all ED visits in the US are due to asthma-related events [2]. Overall, 24% of exacerbations and 60% of asthma-related hospitalizations can be attributed to poor adherence [3]. However, medication adherence to controller therapy is consistently low, ranging between 30% and 70% overall and from 30% to 40% in "real-world" practice settings [4-10]. Therefore, addressing adherence to controller medications is critical in asthma management.

Reasons for nonadherence vary greatly and in addition to general barriers to adherence (e.g., forgetfulness), there are asthma-specific barriers such as lack of knowledge about appropriate inhaler use and misconceptions about asthma chronicity [7, 11, 12]. Therefore, interventions to improve adherence to asthma medications need to be tailored to individual patient-level factors as it sets a personalized goal in the patient's mind [13]. Among healthcare professionals, community pharmacists are highly accessible and can communicate with and educate patients about effectively managing their asthma. Interventions conducted in pharmacy settings were successful and have positively impacted controller therapy adherence, however the interventions tended to be complex, labor-intensive and time consuming, which can limit implementation in

community pharmacies as well as other practice settings [3, 14-17]. Most of the patient-centered asthma programs with the goal of improving adherence were conducted in Europe or Australia, whereas few studies have been conducted in the US. Because pharmacists have time and workflow barriers in providing patient-focused education and counseling, there is a need to equip pharmacists with efficient tools that will enhance patient–provider encounters [18]. Little is known about effectiveness of the individualized counseling based on identified barriers to adherence in asthma conducted by pharmacists. The most common discussion points addressed in the counseling sessions were asthma action plan, medication assessment, inhaler technique and symptom frequency, whereas there is little evidence regarding inclusion of other adherence barriers such as those that are patient or provider-related [14, 16,19, 20-21].

Patient education can be delivered using a variety of strategies, but to be more efficient, patients' needs should be identified first. When patients' concerns and barriers are better understood, the intervention can be more tailored (as opposed to general counseling), which has been shown to positively impact effectiveness [22]. This highlights the importance of patient-tailored education, and as evidence of this, one study showed that patients were dissatisfied with education that was not individualized [23].

Therefore, there is a need for more evidence on effectiveness and feasibility of patient-centered asthma specific counseling provided by pharmacists. Establishing an effective pharmacist-led program that will enhance asthma therapy adherence through identifying patient barriers and resolving them using patient-focused strategies will be an important step in addressing this need. The specific objectives for this study were to: 1)

Determine if baseline characteristics differ between intervention and control groups and 2) Determine if identification of adherence barriers and patient-centered counseling using the developed asthma-specific instruments leads to improved medication adherence and asthma control**.**

5.3 Methods

Inclusion criteria and patient recruitment

Inclusion criteria

Adult patients (≥18 years) with persistent asthma who filled their asthma controller medications in community pharmacies in Travis county were invited to participate in the study. To identify patients with persistent asthma, pharmacists (intervention group)/pharmacy students (control group) asked patients two screening questions: "Has you doctor suggested that you use your inhaler regularly?" and "Do you have asthma symptoms most of the time or is it just a seasonal condition?" Patients who responded "Yes" to both were included. In addition to adult age and persistent asthma, other inclusion criteria were: a) having a prescription for an asthma control inhaler, b) willing to provide consent and personal contact information, c) willing to be contacted via phone by the pharmacist for a 1-month post-initial follow-up (intervention group) and d) willing to be contacted for the 3-month follow-up in-person with the pharmacist or via phone with the pharmacy student (control group). If all criteria were met, then a consent form was signed, followed by the intervention (intervention group only). The participants in the intervention group who completed the study received two $25 gift certificates

(baseline and 3-month follow-up). Participants in the control group did not receive compensation.

Recruitment

Patients in the intervention group were recruited by study pharmacists (N=7) who were chosen primarily because of previously established relationships with the University of Texas at Austin College of Pharmacy. No active pharmacist recruitment occurred for the control group. Instead, third-year pharmacy students (P3s) enrolled in a required community pharmacy experiential course assessed adherence and asthma control among patients with persistent asthma as part of course requirements. The course instructor agreed to make the data available for study purposes. To expedite recruitment of patients in the intervention group, pharmacists queried their database to target patients who were due to pick up their asthma controller inhaler. Additionally, pharmacists advertised through signage in the pharmacy and fliers in bags of patients who used controller therapies.

Survey instrument and study variables

The survey instrument includes the following components: a) demographic characteristics and comorbidities (N=5); b) self-reported adherence using the Morisky 4-item scale; c) Asthma Control Test (ACT) (N=5), d) asthma-modified ASK-12 adherence tool (N=14) (Figure 5.1) and e) demographic characteristics and comorbid conditions.

The outcomes measures (dependent variables) for this study were adherence to controller inhaler, asthma control and adherence barriers score. The primary independent

variables are “Group”: Intervention vs. Control and “Time”: pre- vs. post-period. Covariates include demographic information (gender, age, race/ethnicity, education), and chronic conditions. Below is a description of the study variables.

Dependent variables

Adherence to controller inhaler was assessed using the Morisky 4-item scale (MMAS-4), which is a valid, reliable (Cronbach’s alpha=0.61) and widely used generic scale for adherence assessment. Every “Yes” response equals 1 point and “No” responses equal 0 points. Based on total scale scores, patients were classified as high adherence (0), medium adherence (1-2), and low adherence (3-4) [24]. *Asthma control* was assessed with the Asthma Control Test (ACT), which has five questions with a response scale ranging from 1 (poor control) to 5 (good control). Both continuous and dichotomous ACT scores [>19 (controlled) and ≤19 (uncontrolled)] were used [25]. *Adherence barriers* were assessed using a modified version of an established generic instrument that identifies barriers to adherence, ASK (Adherence Starts with Knowledge)-12 [26]. ASK-12 is a reliable and valid (Cronbach’s alpha = 0.75) instrument designed to identify current medication adherence and patient-specific barriers [26]. It is a 12-item patient survey that focuses on three subdomains that represent the most salient barriers to adherence: 1) inconvenience/forgetfulness, 2) treatment beliefs and 3) behavior. Modifications to the survey included changing “medication” to “inhaler” and adding two additional items pertaining to: having an Asthma Action Plan (AAP) and perceiving that controllers are for symptom-based use vs. continual use. The following scoring was used in modified ASK instrument: items 1-9 with 5-point Likert scale (1=strongly disagree;

5=strongly agree), items 10-14 with 5-point scale (1= in the last week; 5=never) and items 4–8 were reverse scored. The survey items were scored and responses to each item signal where the patient experiences the most problems with adherence. Subscale mean scores were created by taking the total subscale score and dividing it by the total number of items in the subscale. Likert scale responses of "4" or "5" for items 4-8 or "1" or "2" for items 1-3, 9-14) were assigned a "1" for barrier present, else they were assigned a "0." The total was summed to derive the total number of barriers.

Independent Variables

The independent variables were time (pre vs. post) and group (intervention vs. control). Below is a description of the intervention and control groups. Figure 5.2 shows a schematic of data collected and activities in the two groups.

Intervention tools

Two tools were developed specifically for use in the intervention group during Phase I of this project: "Asthma Conversation Starter" booklet for pharmacists (Appendix A) and "Breathe Easier" pamphlet for patients (Appendix B). Developed from the DRAW tool [81], the "Asthma Conversation Starter" provides pharmacists with guidance on how to discuss and resolve adherence-related issues. The DRAW tool was instrumental in helping pharmacists address patients' barriers related to nonadherence because for each barrier, the 'Work-up' tool provides practical approaches and suggestions to address the barrier [27]. Similarly, if the main barrier identified with ASK-12 was 'forgetfulness' then the "Asthma Conversation Starter" tool provides several strategies (e.g., set alarm on cell phone) to help resolve the problem(s). Additionally, to

ensure that the tools are patient-centered, once the barriers are identified, pharmacists further probe patients. For example, if patients have problems getting their refills on time, the “Asthma Conversation Starter” tool prompts pharmacists to inquire further regarding potential issues such as cost, access to primary care, transportation, or need for reminders. Since there is no instrument available for barrier identification or resolution of barriers specific to asthma, these two general instruments served as an initial framework for developing asthma-specific instruments with the goal of providing more effective patient-tailored services aimed at improving adherence specifically in asthma patients. Lastly, we worked with specialists to design the “Asthma Conversation Starter” so that it can quickly highlight the barriers, as well as strategies to overcome them. Essentially, the patient’s completed survey gets inserted under a shaded transparency that highlights problem areas. “Asthma Conversation starter” tips are on the adjacent side of the booklet in line with the specific barrier. A companion patient pamphlet (“Breath Easier”) includes easy tips to address common barriers to adherence with the actions and educational recommendations for patients, as well as a weblink for additional patient resources.

In Phase 2 we obtained feedback from 5 community pharmacists via one-on-one interviews to solicit their input regarding: 1) developed instruments, and 2) feasibility of implementation of these instruments (as part of the asthma adherence intervention) into their practice settings. This has also been described in Manuscript #1, but it is presented here briefly. These sessions employed open-ended questions that focused on: 1) pharmacists’ experience in addressing adherence for patients with asthma, barriers, special concerns and perceptions regarding the proposed instruments, and 2)

implementation, benefits, barriers, strategies to overcome challenges, and how to sustain a continuous patient-pharmacist partnership. The goal of the interview sessions was to uncover asthma adherence problems not addressed in the proposed instruments and to identify pharmacists' suggestions for implementing these instruments into practice, as well as potential concerns and how to overcome them. Accomplishment of Phase 2 yielded a revised asthma-specific instrument derived from the acquisition of important knowledge from pharmacists so that the program can be integrated into practice in the most efficient and sustainable way.

Intervention

Phase 3, the focus of the current manuscript, is a pilot study to assess the impact of the intervention on adherence and asthma control with patients who have persistent asthma and who use community pharmacies. The following are the activities of the intervention group. Intervention pharmacists were trained on survey administration, obtaining informed consent, administering the surveys and utilizing the developed counseling tools. Each pharmacist was asked to recruit at least 5 adult patients meeting the inclusion criteria. The first in-person appointment (30-40 minutes) included time (15-20 minutes) for patients to review the informed consent, complete the survey (identifying barriers to adherence, adherence, asthma control, demographics, and comorbid conditions) and to receive pharmacist counseling (15-20 minutes). Pharmacists identified reasons for nonadherence based on the survey and further probes, and provided patient-specific education to resolve adherence issues (using the counseling tools "Asthma Conversation Starter" and "Breath Easier"). Action plans and recommendations were

developed for each patient. At the 1-month telephone follow-up, the pharmacist inquired about resolution of patient's adherence barriers and asked if there were questions or concerns. During the 3-month in-person follow-up (15-20 minutes), a pharmacist assessed self-reported adherence, barriers to adherence and asthma control based on information from the patients' follow-up survey. Pharmacists also reinforced suggested recommendations regarding medication taking behaviors, lifestyle, adherence and asthma control.

Control

The control group consisted of ommunity pharmacies where P3s received experiential education. During the required course orientation, P3s were trained in identifying patients with persistent asthma and in administering the survey. As part of the course requirements, each student recruited at least 1 patient with persistent asthma and assessed barriers, adherence and asthma control via the baseline survey. Each student also conducted a telephone follow-up within 3 months to determine if issues were resolved via a short patient survey that assessed asthma control and adherence.

Covariates

Covariates included demographic information (gender, age, race/ethnicity, education) and chronic conditions.

Data collection and analysis

Data from patients in the intervention group were collected via surveys during the 2 sessions with the pharmacists: 1) in-person initial meeting and 2) in-person 3-month post-initial follow-up. Data from the control group were collected during 2 sessions: 1)

in-person meeting and 2) telephone 3-month post-initial follow-up. Note that only asthma adherence and control were collected. Barriers data were not collected because of P3 course time constraints. Once all surveys were completed, the data were consolidated into an Excel spreadsheet using a codebook. Table 5.1 shows the data collection time points and specific data elements collected. Completed surveys provided to the researchers had no identifying information. The pharmacist retained the contact document which included patient name and phone number. All surveys included a unique code to facilitate data aggregation, but researchers were blinded to the identity of the patient.

Descriptive statistics included means and frequencies. To address Objective 1, bivariate analyses (paired t-tests and chi-square tests) were used to compare intervention and control groups at baseline. To address objective 2, paired bivariate analyses (paired t-tests) were run to determine whether there were changes in outcomes from the pre- to post-period. For the intervention group, all outcomes variables were compared, while for the control group, only asthma adherence and control were collected and compared. Data were analyzed using SAS, Version 9.3 (Cary, NC).

5.4 Results

Of 36 patients who were recruited to participate in the study (intervention group), 17 patients completed both pre and post surveys and were eligible for analysis. Of the 49 patients who completed the baseline survey (control group), 12 provided information at follow-up. Table 5.2 displays a comparison of baseline patient characteristics between the intervention and control groups (Objective 1). Although baseline demographic

characteristics and comorbid conditions did not differ significantly between the two groups, there were significant ($p<0.05$) differences in the asthma outcomes (dependent variables) at baseline. Regarding demographics between the intervention and control groups, mean age was similar (41.7±16.6 vs. 37.7±11.4, respectively), as was the proportion of females (58.8% vs. 58.3%, respectively). Although not significantly ($p=0.059$) different, race/ethnicity in the control group was split between Caucasian (50%) and Hispanic/Latino (50%), while the intervention group was comprised of 41.2% Caucasian and only 17.6% Hispanic/Latino. The majority of participants had some college, college degree or higher: 64.7% (intervention) and 66.7% (control). Regarding chronic conditions, similar proportions reported asthma as their only chronic condition [35.3% (intervention) vs. 41.7% (control)]. Although the prevalence of other chronic conditions appeared to vary, small cell sizes precluded valid analyses.

Regarding asthma outcomes (dependent variables), the intervention and control groups differed significantly with adherence being higher in the intervention group compared to the control group (1.1±1.3 vs. 3.2±1.1, respectively). Almost half of participants in the intervention group (47.1%) had high adherence (Adherence score = 0), whereas most of the participants in the control group (75%) had low adherence (Adherence score = 3 or 4). Asthma control was significantly lower in the intervention group compared to the control group (15.1±3.5 vs.18.7±3.3, respectively), with 94.1% in the intervention group having uncontrolled asthma (ACT≤19) vs. only 50% in the control group. Barriers to adherence scores were significantly lower in the intervention group

compared to the control group (31.2±7.2 vs. 37.1±6.7, respectively), although the mean number of barriers were not significantly different (4.2±2.5 vs. 5.8±2.8, respectively).

Objective 2 was to determine if the intervention resulted in improved medication adherence and asthma control**.** Analyses were conducted separately between the intervention and control groups since they differed at baseline (as shown above). Also, barriers scores for the control group were not collected at follow-up; thus changes in barriers scores will only be presented for the intervention group. All the participants from the intervention group (N=17) had at least one barrier to adherence (i.e., responded "4" or "5" on the Likert scale for items 4-8 and "1" or "2" for items 1-3, 9-14) with 4.2±2.5 mean number of barriers in the pre-intervention period (Table 5.2). The following barriers were most commonly reported: Item 6: not having an AAP and not reaching goals (52.9%), Item 10: use of inhaler more or less often than prescribed (47.1%), Item 1: forgetfulness (41.2%), Item 9: use of controller inhaler when symptoms present (35.3%) and Item 14: not having an inhaler when it was time to use it (35.3%) (Table 5.3). Out of the three subscales, inconvenience/ forgetfulness had the highest mean subscale score (2.5±0.8), closely followed by treatment beliefs (2.4±0.6) which means that these were the most problematic barriers. Paired t-tests revealed that the following individual barriers decreased significantly from pre- to post-intervention: possession of AAP (3.6±0.9 to 2.5±1.1; frequency change of barrier being present 52.9% vs. 17.6%, respectively), and cooperative work with doctor/nurse (2.7±1.0 to 1.8±0.6; frequency change of barrier being present 23.5% vs. 0%, respectively). The other individual barriers

scores also decreased (12 items) even though not statistically significant, and one item stayed the same.

Table 5.4 shows that participants' adherence remained unchanged from pre to post (1.1±1.3 to 1.1±1.2) and while not significantly different (p=0.055), the ACT score increased from 15.1±3.5 (pre) to 17.8±4.9 (post). However, when examining the change in total barrier score from pre to post, barriers decreased significantly from 31.2±7.2 to 27.4±6.7 (p=0.035). When the scores for each of the three subscales were compared separately, treatment beliefs barriers scale score decreased significantly (p=0.008).

As mentioned previously, because baseline asthma characteristics differed significantly between the intervention and control groups, the change scores between the treatment and control groups were not directly compared. However, a comparison of adherence and asthma control change from pre to post period in intervention and control groups are presented (Table 5.4). These analyses demonstrated the following results: adherence did not change significantly, even though unlike in the intervention group where the adherence remained unchanged, participants in the control group had an almost 1 (0.9±1.7) point decrease in the Morisky score, which indicates improvement in adherence. When examining asthma control in the control group, there was a nonsignificant decrease of 0.3±5.3 points (p=0.832), whereas in the intervention group, there was an almost 3 (2.7±5.4) point improvement in asthma control (p=0.055). Multivariate analyses were originally planned, but due to the small sample sizes and insignificant bivariate results for adherence and asthma control from the pre to post periods these analyses were not conducted.

5.5 Discussion

This study was designed to help patients with persistent asthma who utilize controller medications with methods to improve adherence. Overall asthma management strategies in this study were implemented through a patient-centered approach of identifying and addressing barriers to adherence in community pharmacy settings. Utilizing the following developed intervention tools: patient survey to identify adherence barriers, pharmacist booklet "Asthma Conversation starter" to guide pharmacist-patient interactions and patient pamphlet "Breathe easier" to reinforce education provided, this study aimed to better understand whether the proposed intervention was effective. Thus, asthma adherence, barriers (intervention group only) and asthma control from pre to post period in both the intervention and control groups were compared.

The patient survey helped to reveal in a timely manner patient-specific barriers. We found that in both groups participants had at least one barrier, with the following means of 4.2±2.5 and 5.8±2.8 in the intervention and control groups, respectively. Higher number of barriers in the control group was congruent with significantly lower adherence compared to intervention group. At baseline, the reported barriers included items from all three domains, which signal variety of possible reasons for nonadherence, hence the recognition of specific barriers of patients may be an important step for implementing targeted counseling.

The most frequently reported adherence barriers item pertains to treatment beliefs subscale and refers to possession of AAP and knowing the goals of asthma management.

More than half of participants in the intervention group reported this barrier, which was also found in other studies [14, 28]. Surprisingly, several studies examining physicians' perceptions regarding the need for an AAP revealed that they felt the AAP was not required [29-31]. Perhaps lack of physician endorsement may lead to patients not receiving AAPs from providers, however, research indicates that setting goals for patients is an important step for asthma improvement [14]. Thus, encouraging patients to obtain an AAP and to set goals may lead to improvements in adherence.

Four additional prevalent barriers to adherence in this study were 1) forgetfulness, 2) symptom-based use of controller inhalers, 3) not using inhaler as prescribed and 4) not having the inhaler when needed. Although these were identified at baseline, there were no significant changes in the follow-up analysis. Forgetfulness is a common reason for nonadherence among patients with asthma, however in this study participants were encouraged to be proactive by taking actions on their own to overcome this barrier through suggested strategies (e.g., getting reminders apps or signing up for text messages reminders). Potentially, more advanced technologies, such as automated phone calls and audiovisual reminder devices, should be implemented as they have been shown to positively impact adherence [32]. The misconception of using controller inhalers only when symptoms are present is well documented [12, 33]. It is also evident that with provision of education by pharmacists, patients can better understand asthma as well as how to use their medications appropriately [20-21], but was not supported in this study. This should be addressed together with focus on understanding the difference between rescue and controller inhalers [7, 33-34]. The positive patients' response regarding "not

using inhaler as prescribed" reiterates the presence of the barrier to adherence, and pharmacists should probe further to determine specific causes if not addressed in the survey. When a patient's nonadherence is due to not having an inhaler when needed, pharmacists should work with the patient to collaboratively develop strategies for having access to an inhaler when needed.

Study findings demonstrate that two barriers were resolved over a course of 3 months after the intervention. Regarding the first barrier, two-thirds of participants without AAPs and awareness about their asthma management goals at the baseline (N=9) were found to report having an AAP and being aware of the goals at the 3-month follow-up (N=6). The pharmacists were proactive in providing patients with AAP or they referred patients to their primary care providers to obtain AAPs. In previously conducted studies, provision of written information and education was shown to improve controller inhaler adherence [35-36]. Regarding the second barrier, all the patients (N=4) who disagreed that they "work cooperatively with their doctor/nurse to make decisions" at the baseline, indicated that they do so at the final appointment. As nonadherent patients demonstrate lack of knowledge and misperceptions regarding medications [37], communication between health care providers and patients, together with a cooperative approach may result in improvements in knowledge and skills, which may lead to positive outcomes. Our approach seemed to be successful in promoting team-based care.

Even though we anticipated observing significant improvements in adherence and asthma control, in intervention group, this was not the case in our study. One of the reasons for no difference in adherence for pre and post measures in the intervention group

may be due to a ceiling effect. The intervention group scored 1.1±1.3 (medium adherence) on the Morisky scale at baseline, with the highest level of adherence being 0 (high adherence). Although the control group started with a lower adherence score of 3.3±1.1 (low adherence) and improved by 1 point to 2.3±1.2, the study may not have been powered to detect any significant differences. As for asthma control in the intervention group, the score increased by 2.8 points, which was not statistically significant, but clinically meaningful as the minimally important difference in ACT score is between 2 and 3 [38]. Conversely, the difference in ACT scores in control group was 0.3 points. The clinically meaningful change of ~3 points in the intervention group vs. relatively no change in the control group may lend support to the effectiveness of the patient-centered barrier resolution approach on asthma control compared to usual care. In another study evaluating the effectiveness of an integrated care program, asthma control improved significantly at 12 months follow-up [35]. Perhaps with a longer follow-up, our study results could be similar.

Study findings show significant improvement in adherence barriers scores between pre and post periods, which indicates, that pharmacists using a patient-centered barriers approach, were effective in resolving barriers. From the three separate subscales, “treatment beliefs” was the only one with significant improvement from pre to post period. This highlights the need to focus on beliefs in asthma management, as barriers related to beliefs are associated with problematic disease control [39]. The modified ASK instrument includes six items pertaining to “treatment beliefs”: believe that the inhaler will help, knowing how to use an inhaler (knowledge of medication), having an AAP and

knowing the goals (multiple), having someone to call with questions about an inhaler (social support), working together with doctor/nurse to make decisions (social support), and using a controller inhaler not when having symptoms only (knowledge of medications/concern beliefs) [40]. The most commonly reported patient health beliefs (necessity beliefs, concern beliefs, knowledge of medications) and social support that impact adherence are reflected in the ASK-12, which makes it a valuable tool to use [7, 11]. To our knowledge, this is the first study that used barrier adherence scores as an outcome, so the comparison of this parameter in asthma is precluded.

This study was subject to several limitations. First, this pilot study is ongoing and the data presented are preliminary. We anticipate that with larger sample sizes (which will increase power) for follow-up, the results may differ. Second, the comparison with the control group is informative in nature, rather than a measure of effectiveness of the intervention. Non-randomization and use of convenience sampling led to groups that were dissimilar on important asthma characteristics at baseline. Although 36 (intervention group) and 49 (control group) participants completed the baseline survey, only those who also completed the 3-month follow-up were included in this analyses. Third, self-reported adherence, persistency of asthma and asthma control may be a source of recall bias. This bias could be resolved with coupling self-reported measures with objective measures such as using pharmacy claims to calculate adherence using proportion of days covered or medical claims to verify asthma control. However, questions revealing barriers to adherence should not contribute to this bias as they ask about patient's experiences, beliefs and perceptions rather than recall of specific events or

frequencies. Additionally, adherence was measured with generic instrument MMAS-4, which is not asthma-specific; however, it was validated among patients with asthma. Fourth, another study limitation is selection bias as this study examined adherence and barriers to adherence among a convenience sample of patients who were picking up their prescription for asthma medication. High adherence at baseline in the intervention group may be representative of a more proactive patient population, whereas lower adherence in the control group may represent patients who have a higher need. Results may differ if use of the patient barriers tool becomes common practice in community pharmacies. Fifth, participants were from Travis County community pharmacies an only a low proportion were not college educated and reported cost as a barrier to adherence. Consequently, results from this patient sample may not be generalizable to a broader population of asthma patients or to specific ethnic, geographic or social groups, as well as the underserved. Sixth, in order to capture changes in asthma adherence and asthma control, a longer prospective observation and data collection period might be needed as 3 months may not be adequate to assess the impact of the intervention. Finally, we suggest using the more reliable and valid updated Morisky 8-item scale (MMAS-8), which may be more sensitive in capturing changes in adherence [41]. To reduce respondent burden, the 4-item scale was used in this study as opposed to the 8-item scale.

5.6 Conclusions

Preliminary results from this pilot study show that a proposed approach of identifying and addressing patient-specific barriers to adherence delivered by pharmacists

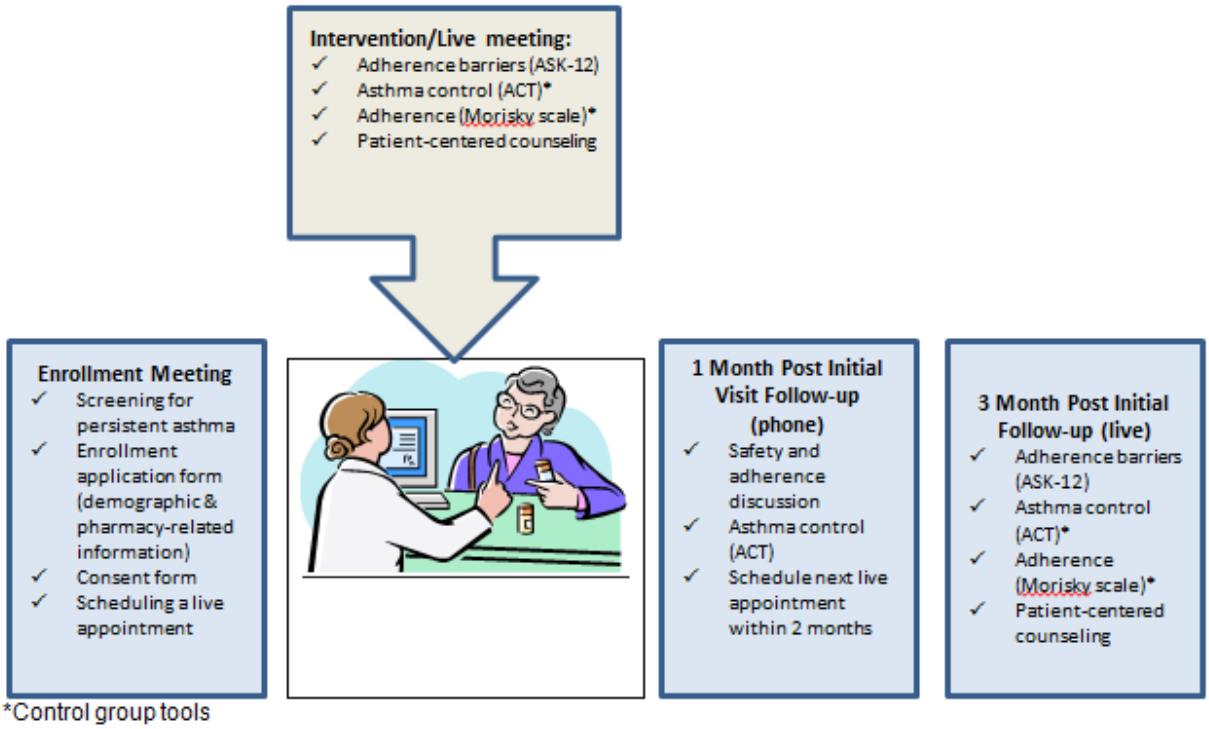
is efficient in resolving the barriers. It also has potential to improve asthma control as the ACT score changed by almost 3 points over a 3-month period, which is clinically significant. The findings support the need for targeted approach in asthma care, as reasons for nonadherence vary among patients. Individually targeting patient needs during counseling may yield improved outcomes. Future research will test the effectiveness of utilizing the tools in pharmacy practice on a larger scale.

Figure 5.1 Modified Asthma specific ASK-12 items

Note: Inhaler below refers to **CONTROLLER** inhaler	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
1. I just forget to use my inhaler some of the time	☐	☐	☐	☐	☐
2. I run out of my inhaler because I don't get refills on time	☐	☐	☐	☐	☐
3. Using my inhaler more than once a day is inconvenient	☐	☐	☐	☐	☐
4. I feel confident that my inhaler will help me	☐	☐	☐	☐	☐
5. I know how to use my inhaler correctly	☐	☐	☐	☐	☐
6. I have an Asthma Action Plan and know if I am reaching my goals	☐	☐	☐	☐	☐
7. I have someone I can call with questions about my inhaler	☐	☐	☐	☐	☐
8. My doctor/nurse and I work together to make decisions	☐	☐	☐	☐	☐
9. I only use my inhaler when I am having symptoms such as shortness of breath, coughing, wheezing, or chest tightness	☐	☐	☐	☐	☐
Have you…	**In the last week**	**In the last month**	**In the last 3 months**	**> 3 months ago**	**Never**
10. Used your inhaler more or less often than prescribed?	☐	☐	☐	☐	☐
11. Skipped or stopped using your inhaler because you didn't think it was working?	☐	☐	☐	☐	☐
12. Skipped or stopped using your inhaler because it made you feel bad?	☐	☐	☐	☐	☐
13. Skipped, stopped, not refilled, or used less of inhaler because of the cost?	☐	☐	☐	☐	☐
14. Not had your inhaler with you when it was time to use it?	☐	☐	☐	☐	☐

Bolded items reflect additions to the ASK-12 survey; "Medication" was replaced with "Inhaler"

Figure 5.2 Intervention and control group components and data collection process



ACT=Asthma Control Test

Table 5.1 Data collection elements throughout the study period for the control and intervention groups

	Baseline		3-month follow-up	
Dependent variables	INT	CNT	INT	CNT
Adherence	✓	✓	✓	✓
Asthma control	✓	✓	✓	✓
Barriers	✓	✓	✓	

INT-Intervention; CNT-Control

Table 5.2 T-test and chi-square comparison of baseline characteristics between intervention (N=17) and control groups (N=12)

	Intervention group		Control group		p-value
Variable	**N=17**	**%**	**N=12**	**%**	
Age (years), mean (SD)	41.7	16.6	37.7	11.4	0.482[a]
	N	**%**	**N**	**%**	
Female	10	58.8	7[b]	58.3	0.465[c]
Race/Ethnicity					0.059[c]
Caucasian	7	41.2	6	50.0	
African American	2	11.8	0	0	
Hispanic/Latino	3	17.6	6	50.0	
Other	5	29.4	0	0	
Level of education					0.227[c]
Some high school	3	17.6	1	8.3	
High school	3	17.6	3	25.0	
Some college	5	29.4	0	0	
College	4	23.5	6	50.0	
Postgraduate	2	11.8	2	16.7	
Chronic condition(s)					N/A[d]
None[e]	6	35.3	5	41.7	
Hypertension	4	23.5	1	8.3	
Diabetes	1	5.9	2	16.7	
Dyslipidemia	1	5.9	2	16.7	
Other[f]	8	47.1	6	50.0	
Adherence, mean (SD)[g]	1.1	1.3	3.2	1.05	<0.0001[a]
Adherence level					0.003[c]
High	8	47.1	0	0	
Medium	6	35.3	3	25.0	
Low	3	17.6	9	75.0	
ACT, mean (SD)	15.1	3.5	18.7	3.3	0.009[a]
Control level					0.006[c]
≤19 (uncontrolled)	16	94.1	6	50.0	
>19 (controlled)	1	5.9	6	50.0	
Barrier to adherence score, mean (SD)[h]	31.2	7.2	37.1	6.7	0.035[a]
Number of barriers, mean (SD)	4.2	2.5	5.8	2.8	0.113[a]

ACT=Asthma Control Test
[a]T-test
[b]One observation is missing

Table 5.2 (continued)

[c]Fisher's exact test
[d]Cell sizes too small for analysis
[e]Other than asthma
[f] Depression, chronic pain, gastrointestinal disorder, thyroid disease, heart disease, arthritis, obesity, allergies, multiple sclerosis, osteoporosis
[g]0=high; 1-2=medium; 3-4=low
[h]Barrier score range: 14-70; higher score = more barriers

Table 5.3 Paired t-test comparison of differences in barriers to adherence from pre to post period among the intervention group (N=17)

	Intervention group, N=17				
	Pre Period		Post Period		
Individual Barriers	**Mean[a] (SD)**	**Barrier present[b] N (%)**	**Mean[a] (SD)**	**Barrier present[b] N (%)**	**p-value[c]**
1. I just forget to use my inhaler some of the time	2.6 (1.4)	7 (41.2%)	2.6 (1.2)	6 (35.3%)	0.8637
2. I run out of my inhaler because I don't get refills on time	2.3 (1.1)	4 (23.5%)	2.3 (1.2)	4 (23.5%)	0.8592
3. Using my inhaler more than once a day is inconvenient	2.5 (1.2)	5 (29.4%)	2.5 (1.1)	5 (29.4%)	0.8348
4. I feel confident that my inhaler will help me	1.7 (0.8)	1 (5.9%)	1.6 (0.9)	1 (5.9%)	0.6830
5. I know how to use my inhaler correctly	1.5 (0.8)	1 (5.9%)	1.5 (0.8)	1 (5.9%)	1.0
6. I have an Asthma Action Plan and know if I am reaching my goals	3.6 (0.9)	9 (52.9%)	2.5 (1.1)	3 (17.6%)	**0.0016**
7. I have someone I can call with questions about my inhaler	2.4 (1.2)	3 (17.6%)	1.9 (0.7)	1 (5.9%)	0.0952
8. My doctor/nurse and I work together to make decisions	2.7 (1.0)	4 (23.5%)	1.8 (0.6)	0 (0%)	**0.0005**
9. I only use my inhaler when I am having symptoms such as shortness of breath, coughing, wheezing, or chest tightness	2.6 (1.5)	6 (35.3%)	2.6 (1.5)	6 (35.3%)	0.8892
10. Used your inhaler more or less often than prescribed?	2.9 (1.7)	8 (47.1%)	2.6 (1.8)	7 (41.2%)	0.5241
11. Skipped or stopped using your inhaler because you didn't think it was working?	1.2 (0.7)	1 (5.9%)	1.1 (0.2)	0 (0%)	0.3818
12. Skipped or stopped using your inhaler because it made you feel bad?	1.1 (0.2)	0 (0%)	1.0 (0)	0(0%)	0.3322
13. Skipped, stopped, not refilled, or used less of inhaler because of the cost?	1.3 (0.9)	1 (5.9%)	1.2 (0.5)	0 (0%)	0.4220
14. Not had your inhaler with you when it was time to use it?	2.5 (1.5)	6 (35.3%)	2.3 (1.7)	6 (35.3%)	0.7583
Total Barriers Scale Score[d]	31.2 (7.2)		27.3 (6.7)		**0.0349**

[a] Individual barrier score range: 1-5; higher score = more barriers
[b] Likert scale response "4" or "5" for Items 4-8; or "1" or "2" for Items 1-3, 9-14
[c] Paired t-test

Table 5.3 (continued)

[d] Barrier score range: 14-70; higher score = more barriers

Inconvenience/forgetfulness subscale
Treatment beliefs subscale
Behavior subscale

Table 5.4 Comparison of adherence, asthma control and barrier score between participants in pre and post groups

	Pre Mean (SD)	**3-Month post Mean (SD)**	**Mean difference pre to post**	**p-value**
Adherence				
Intervention	1.1 (1.3)	1.1 (1.2)	0 (1.2)	1.00
Control	3.2 (1.0)	2.3 (1.1)	0.9 (1.7)	0.08
ACT				
Intervention	15.1 (3.5)	17.8 (4.9)	-2.7 (5.4)	0.055
Control	18.7 (3.3)	18.4 (3.7)	0.3 (5.3)	0.832
Barriers score (Intervention only)[a]				
Overall[b]	31.2 (7.2)	27.3 (6.7)	3.9 (6.9)	**0.035**
Subscales[c]				
Behavior	1.8 (0.6)	1.6 (0.6)	0.2 (0.7)	0.318
Forgetfulness	2.5 (0.8)	2.4 (0.9)	0.1 (0.5)	0.764
Beliefs	2.4 (0.6)	2.0 (0.6)	0.5 (0.6)	**0.008**

ACT=Asthma Control Test: >19 (controlled); ≤19 (uncontrolled)
[a]Follow-up data not collected in control group
[b]Barrier score range: 14-70; higher score = more barriers
[c]Subscale scores were adjusted for number of items in the subscale

5.7 References

1. Tan H, et al. Impact of asthma controller medications on clinical, economic, and patient-reported outcomes. *Mayo Clin Proc.* 2009;84(8):675-84.
2. Trends in asthma morbidity and mortality 2012, American Lung Association. http://www.lung.org/finding-cures/our-research/trend-reports/asthma-trend-report.pdf. Accessed Jan 21, 2016.
3. Barnes CB, Ulrik CS. Asthma and Adherence to Inhaled Corticosteroids: Current Status and Future Perspectives. *Respir Care*. 2015;60(3):455-468.
4. Gamble J, Stevenson M, McClean E, Heaney LG. The prevalence of nonadherence in difficult asthma. *Am J Respir Crit Care Med*. 2009;180(9):817-22.
5. Desai M, Oppenheimer JJ. Medication adherence in the asthmatic child and adolescent. *Curr Allergy Asthma Rep*. 2011;11(6):454-64.
9. Jentzsch NS, Camargos PA, Colosimo EA, Bousquet J. Monitoring adherence to beclomethasone in asthmatic children and adolescents through four different methods. *Allergy*. 2009;64(10):1458-62.
10. Bender BG, Bender SE. Patient-identified barriers to asthma treatment adherence: responses to interviews, focus groups, and questionnaires. *Immunol Allergy Clin North Am*. 2005;25(1):107-30.
11. Jones C, Santanello NC, Boccuzzi SJ, et al. Adherence to prescribed treatment for asthma: evidence from pharmacy benefits data. *J Asthma*. 2003;40(1):93-101.

12. Bozek A, Jarzab J. Adherence to asthma therapy in elderly patients. *J Asthma*. 2010;47(2):162-5.

13. Latry P, Pinet M, Labat A, et al. Adherence to anti-inflammatory treatment for asthma in clinical practice in France. *Clin Ther.* 2008;30 Spec No:1058-68.

11. Howell G. Nonadherence to medical therapy in asthma: risk factors, barriers, and strategies for improving. *J Asthma*. 2008;45(9):723-9.

12. Ponieman D, et al. Impact of positive and negative beliefs about inhaled corticosteroids on adherence in inner-city asthmatic patients. *Ann Allergy Asthma Immunol*. 2009;103(1):38-42.

13. Gatwood J, Bailey JE. Improving medication adherence in hypercholesterolemia: challenges and solutions. *Vasc Health Risk Manag.* 2014;10:615-25.

14. Garcia-Cardenas V, et al. Effect of a pharmacist intervention on asthma control. A cluster randomised trial. *Respir Med*. 2013;107(9):1346-55.

15. Armour C, et al. Pharmacy Asthma Care Program (PACP) improves outcomes for patients in the community. *Thorax*. 2007;62(6):496-502.

16. Goeman D, et al. Educational intervention for older people with asthma: a randomised controlled trial. *Patient Educ Couns.* 2013;93(3):586-95.

17. McDonald HP, Garg AX, Haynes RB. Interventions to enhance patient adherence to medication prescriptions: scientific review. *JAMA*. 2002;288(22):2868-79.

18. Witry MJ, et al. Multiple Adherence Tool Evaluation Study (MATES). *J Manag Care Pharm.* 2014;20(7):734-40.

19. Giraud V, Allaert FA, Roche N. Inhaler technique and asthma: feasability and acceptability of training by pharmacists. *Respir Med*. 2011;105(12):1815-22.

20. Mehuys E, et al. Effectiveness of pharmacist intervention for asthma control improvement. *Eur Respir J.* 2008;31(4):790-9.

21. Saini B, et al. Asthma disease management-Australian pharmacists' interventions improve patients' asthma knowledge and this is sustained. *Patient Educ Couns.* 2011;83(3):295-302.

22. Ulrik CS, et al. The patient's perspective: adherence or non-adherence to asthma controller therapy? *J Asthma.* 2006;43(9):701-4.

23. Raynor DK, et al. We are the experts: people with asthma talk about their medicine information needs. *Patient Educ Couns* 2004;53(2):167-74.

24. Tan X, Patel I, Chang J. Review of the four item Morisky Medication Adherence Scale (MMAS-4) and eight item Morisky Medication Scale (MMAS-8). *Innovations in pharmacy.* 2014;5(3):1-8.

25. Nathan RA, et al. Development of the asthma control test: a survey for assessing asthma control. *J Allergy Clin Immunol.* 2004;113(1):59-65.

26. Matza LS, et al. Derivation and validation of the ASK-12 adherence barrier survey. *Ann Pharmacother.* 2009;43(10):1621-30.

27. Doucette WR, et al. Development of the Drug Adherence Work-up (DRAW) tool. *J Am Pharm Assoc*. 2012;52(6):e199-204.

28. Gaude GS, Hattiholi J, Chaudhury A. Role of health education and self-action plan in improving the drug compliance in bronchial asthma. *J Family Med Prim Care*. 2014; 3(1):33-8.

29. Yawn BP, et al. Adherence to Asthma Guidelines in Children, Tweens, and Adults in Primary Care Settings: A Practice-Based Network Assessment. *Mayo Clin Proc*. 2016;91(4):411-21.

30. Boulet LP, et al. Benefits of an asthma education program provided at primary care sites on asthma outcomes. *Respir Med.* 2015;109(8):991-1000.

31. Wiener-Ogilvie S, et al. Do practices comply with key recommendations of the British Asthma Guideline? If not, why not? *Prim Care Respir J*. 2007;16(6):369-77.

32. Tran N, et al. Patient reminder systems and asthma medication adherence: a systematic review. *J Asthma*. 2014;51(5):536-43.

33. Halm EA, Mora P, Leventhal H. No symptoms, no asthma: the acute episodic disease belief is associated with poor self-management among inner-city adults with persistent asthma. *Chest*. 2006;129(3):573-80.

34. Sofianou A, et al. Asthma beliefs are associated with medication adherence in older asthmatics. *J Gen Intern Med.* 2013;28(1):67-73.

35. Guenette L, et al. Effectiveness of an asthma integrated care program on asthma control and adherence to inhaled corticosteroids. *J Asthma*. 2015;52(6):638-45.

36. Schaffer SD, Tian L. Promoting adherence: effects of theory-based asthma education. *Clin Nurs Res.* 2004;13(1):69-89.

37. Price D, et al. Inhaler competence in asthma: common errors, barriers to use and recommended solutions. *Respir Med*. 2013;107(1):37-46.

38. Schatz M, et al. The minimally important difference of the Asthma Control Test. *J Allergy Clin Immunol*. 2009;124(4):719-23 e1.

39. Young HN, et al. Barriers to medication use in rural underserved patients with asthma. *Res Social Adm Phar.* 2015;11(6):909-14.

40. Unni E, Farris KB. Determinants of different types of medication non-adherence in cholesterol lowering and asthma maintenance medications: a theoretical approach. *Patient Educ Couns*. 2011;83(3):382-90.

41. Morisky DE, et al. Predictive validity of a medication adherence measure in an outpatient setting. *J Clin Hypertens.* 2008;10(5):348-54.

5.8 Appendices

Appendix A

Pharmacist's Booklet "Asthma Conversation Starter"

ADHERENCE ENHANCEMENT PROGRAM FOR PATIENTS WITH ASTHMA

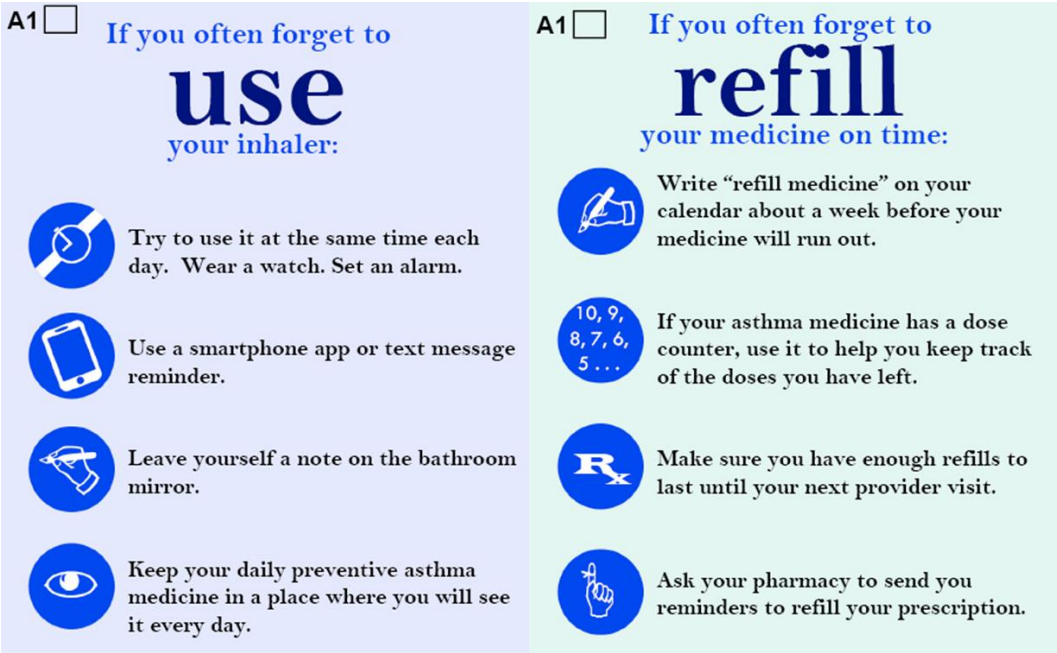
1. PUT PAGE 2 OF THE COMPLETED SURVEY UNDERNEATH THE TRANSPARANCY PAGE

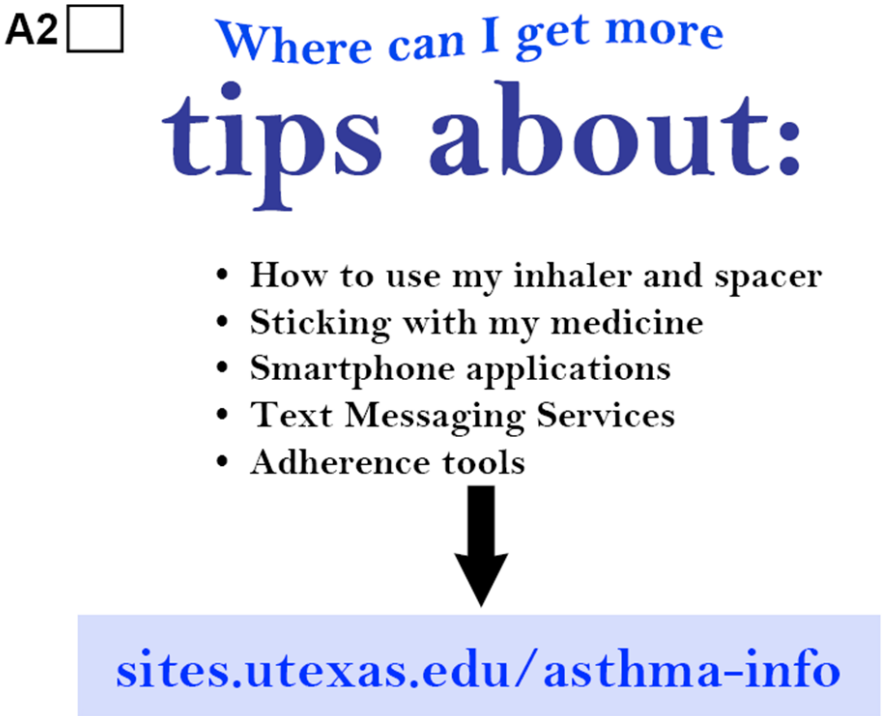
2. IDENTIFY WHICH OF THE MARKED ITEMS ARE IN THE RED SHADED AREA

3. ADDRESS THE SHADED ITEMS BY LOOKING ON THE RIGHT SIDE OF THE PAGE FOR SUGGESTIONS AND USING THE PATIENT PAMPHLET FOR EDUCATION AND REINFORCEMENT

Note: Inhaler below refers to **CONTROLLER** inhaler	**Suggested Actions**
1. I just forget to use my inhaler some of the time	Reminder tools, adherence aids or alarms **A1/A2**
2. I run out of my inhaler because I don't get refills on time	Reminder tools, adherence aids or alarms **A1/A2**
3. Using my inhaler more than once a day is inconvenient	Simplifying regimen if possible
4. I feel confident that my inhaler will help me	Patient education, guided counseling **A2/A4**
5. I know how to use my inhaler correctly	Video link **A2**
6. I have an Asthma Action Plan and know if I am reaching my goals	Obtain Asthma Action Plan **A3**
7. I have someone I can call with questions about my inhaler	Building a support network **A5**
8. My doctor/nurse and I work together to make decisions	Partnering with your healthcare provider **A5**
9. I only use my inhaler when I am having symptoms such as shortness of breath, coughing, wheezing, or chest tightness	Patient education, guided counseling **A4**
Have you…	
10. Used your inhaler more or less often than prescribed?	Patient education, guided counseling **A1/A2/A4**
11. Skipped or stopped using your inhaler because you didn't think it was working?	Patient education, guided counseling **A1/A2/A4**
12. Skipped or stopped using your inhaler because it made you feel bad?	Discuss side effects management **A7**
13. Skipped, stopped, not refilled, or used less of inhaler because of the cost?	Cost reducing strategies **A6**
14. Not had your inhaler with you when it was time to use it?	Reminder tools, adherence aids or alarms **A1/A2**
15. How often do you use your peak flow meter?	Consider obtaining and using a peak flow meter

A1/A2
Discuss the most suitable items and mark it in the pamphlet





A3
Discuss what a good-partial-poor control is and help to get and use Asthma Action Plan

A3 ☐

Understanding your asthma

symptom control

Good control	Partial control	Poor control
All of:	One or two of:	Three or more of:
Able to do all your usual activities	Less able to do your usual activities	Less able to do your usual activities
No asthma symptoms during night or on waking	Any asthma symptoms during night or on waking	Any asthma symptoms during night or on waking
Daytime symptoms no more than two days per week	Daytime symptoms more than two days per week	Daytime symptoms more than two days per week
Need reliever no more than two days per week*	Need reliever more than two days per week*	Need reliever more than two days per week*

(*Not including reliever puffer taken before exercise.)

Get a written asthma action plan!

A4
Provide a patient with general understanding of asthma and types of medications: when to take reliever, and how to use a controller (why adherence is important)

A4 ☐ **Understanding how your medications work**

Asthma medicines come in two types—quick-relief (reliever/rescue) and long-term control (preventer/controller).

Quick-relief medicines control the symptoms of an asthma attack. If you need to use your quick-relief medicines more and more, you should visit your health-care provider to see if you need a different medicine.

Long-term control medicines help you have fewer and milder attacks, but they don't help you if you're having an asthma attack.

Reliever / Rescue Inhaler _____

Reliever	
What it does	Relaxes tight airways for up to 4 hours
How it works	Very quickly - in about 4 minutes
When to take it	- When you have symptoms - Emergency - Before exercise as prescribed
Helpful to know	Carry it with you always in case of symptoms

Preventer / Controller Inhaler _____

Preventer	
What it does	- Soothes airways - Decreases swelling - Reduces mucus
How it works	Slowly - days
When to take it	Every day as prescribed - even if you feel well
Helpful to know	Only works when used regularly and continuously

A5
Making sure that a patient knows whom to address questions or concerns

- Ask if there are other providers who can help you make a decision. For example, a nurse, nutritionist, or health coach can help you learn more about each option.
- Think about other people who can help you decide. For example, you may want to talk with a friend or family member.
- If you need more time, schedule a follow-up visit with your provider.

A5 ☐

Partner with your healthcare provider.

Ask questions to help make sure

you

understand each option.

A6

Cost reducing strategies available for patients; For ex., Symbicort $25 Guarantee Program (AstraZeneca)

A7

If you use preventer medicine there is a small risk of having a sore tongue, sore throat, hoarseness of the voice and a mouth infection called thrush. To help prevent these side effects, rinse your mouth out and brush your teeth after using your preventer inhaler. Using a spacer will also help reduce the possibility of thrus

Appendix B

Patient Pamphlet "Breath Easier"

A5 ☐

Partner with your healthcare provider.

Ask questions to help make sure you

understand

each option.

- Ask if there are other providers who can help you address your concerns. For example, a nurse, nutritionist, or health coach can help you learn more about each option.
- Think about other people who can help support you in managing your asthma. For example, you may want to talk with a friend or family member.
- If you need more time, schedule a follow-up visit with your provider.

A6 ☐

Where can I go for

help?

Pharmacist Name:

Phone:

Physician Name:

Phone:

A7 ☐

Can I get help with

cost?

Ask your pharmacists about assistance programs and visit these websites for more information:

Needymeds.com
Pparx.org

Breathe easier

Controlling Your Asthma

A1 ☐

If you often forget to **use** your inhaler:

- Try to use it at the same time each day. Wear a watch. Set an alarm.
- Use a smartphone app or text message reminder.
- Leave yourself a note on the bathroom mirror.
- Keep your daily preventive asthma medicine in a place where you will see it every day.

A1 ☐

If you often forget to **refill** your medicine on time:

- Write "refill medicine" on your calendar about a week before your medicine will run out.
- If your asthma medicine has a dose counter, use it to help you keep track of the doses you have left.
- Make sure you have enough refills to last until your next provider visit.
- Ask your pharmacy to send you reminders to refill your prescription.

A2 ☐

Where can I get more **tips about:**

- How to use my inhaler and spacer
- Sticking with my medicine
- Smartphone applications
- Text Messaging Services
- Adherence tools

sites.utexas.edu/asthma-info

A3 ☐

Understanding your asthma **symptom control**

Good control	Partial control	Poor control
All of:	One or two of:	Three or more of:
Able to do all your usual activities	Less able to do your usual activities	Less able to do your usual activities
No asthma symptoms during night or on waking	Any asthma symptoms during night or on waking	Any asthma symptoms during night or on waking
Daytime symptoms no more than two days per week	Daytime symptoms more than two days per week	Daytime symptoms more than two days per week
Need reliever no more than two days per week*	Need reliever more than two days per week*	Need reliever more than two days per week*

(*Not including reliever puffer taken before exercise.)

Get a written asthma action plan!

A4 ☐

Understanding how your medications work

Asthma medicines come in two types—quick-relief (reliever/rescue) and long-term control (preventer/controller).

Quick-relief medicines control the symptoms of an asthma attack. If you need to use your quick-relief medicines more and more, you should visit your health-care provider to see if you need a different medicine.

Long-term control medicines help you have fewer and milder attacks, but they don't help you if you're having an asthma attack.

Reliever / Rescue Inhaler _____

Reliever	
What it does	Relaxes tight airways for up to 4 hours
How it works	Very quickly - In about 4 minutes
When to take it	- When you have symptoms - Emergency - Before exercise as prescribed
Helpful to know	Carry it with you always in case of symptoms

Preventer / Controller Inhaler _____

Preventer	
What it does	- Soothes airways - Decreases swelling - Reduces mucus
How it works	Slowly - days
When to take it	Every day as prescribed - even if you feel well
Helpful to know	Only works when used regularly and continuously

References:

http://www.healthcoach4me.com/dam/assets/hm4299.pdf

http://www.cdc.gov/asthma/pdfs/asthma_brochure.pdf

http://www.asthmaws.org.au/PageFiles/418/AA_Broch_Basic%20Facts_0614.pdf

6. CHAPTER SIX: Summary of Dissertation

A significant number of patients with asthma experience serious health difficulties because they do not take their asthma medications as prescribed. One of the approaches that may improve asthma care is provision of patient-centered counseling by pharmacists to enhance adherence and improve patient outcomes. In this three-study dissertation we used mixed-methods study design to develop tools for use in community pharmacy settings, pilot-test developed instruments, and provide preliminary results on effectiveness.

STUDY ONE: Adherence Enhancement for Patients with Asthma in Community Pharmacy Practice: Instruments Development and Pharmacists' Feedback

In the study one, we first conducted a literature review to identify common barriers to adherence for patients with asthma and instruments that address barriers to adherence. Based on the findings, we developed the following patient-centered, asthma specific tools for community pharmacy settings to address key asthma adherence barriers: 1) survey to identify patient-specific barriers to adherence, 2) "Asthma Conversation Starter" booklet for pharmacists, and 3) "Breathe Easier" pamphlet for patients to provide educational recommendations. Through a series of interviews with community pharmacists (N=5) three topics were identified. In the first topic "use of tools and overall approach", pharmacists reported that: 1) identifying patients' needs is important and 2) the proposed approach using the tools is capable of identifying and addressing specific patients' concerns, and 3) the tools were easy to use and helpful. In the second topic,

“barriers to implementation”, pharmacists indicated themes such as 1) time and workflow, 2) patients’ perception of the pharmacists and 3) absence of reimbursement. The last topic included “facilitators and suggestions for implementation” with pharmacists providing strategies such as: 1) identifying patients upfront based on their refill history, 2) flagging filled prescriptions, 3) raising awareness among patients, 4) involving technicians in the process of identifying patients, 5) having a dedicated pharmacist on-board, and 6) adding the proposed approach into in-store health clinics/fairs.

STUDY TWO: Examination of Barriers to Medication Adherence, Asthma Management and Control among Community Pharmacy Patients with Asthma

Study two was a pilot test of the developed tool for identification of patients’ barriers to adherence in community pharmacy settings. Overall, reasons for not being adherent to asthma controller medications varied, but inconvenience/forgetfulness and treatment beliefs were most common and presence of multiple barriers was associated with poorer adherence. We found no significant association between adherence and asthma control, which might be indicative of self-reported nature of these parameters and need for additional data, such as patient-level medical and pharmacy insurance claims. Significant association was found between Morisky adherence scale score and modified ASK-12 instrument barrier score, as well as with reported number of barriers. We also found that possession of asthma action plan was a significant predictor of better level of adherence, although less than half of patients had such plan. It signals that pharmacists

may play a role in encouraging attainment and use of an asthma action plan to help patients achieve their asthma-related goals.

STUDY THREE: Improving Asthma Management: Patient-Pharmacist Partnership Program in Enhancing Therapy Adherence

In study three, the developed tools were pilot-tested in community pharmacy settings with the goal of providing preliminary outcomes of the proposed strategy. The intervention included identifying patients with persistent asthma and evaluating them for asthma medication adherence, barriers to adherence and asthma control. The intervention consisted of patient-specific education and counseling pertaining to their adherence issues using counseling tools "Asthma Conversation Starter" (pharmacist) and "Breath Easier" (patient). After a 3 month period, patients' data on adherence, barriers and asthma control were collected and evaluated again. In the control group, patients were invited to be evaluated for the same parameters as the intervention group, followed by provision of usual care and follow-up in 3 months. Analyses of outcomes revealed significant improvement in barrier score between pre and post period (increase by 3.9±6.9, $p=0.035$) in intervention group and clinically meaningful increase in asthma control by 2.7 ACT score points. There were no significant changes in adherence pre to post in both the intervention and control groups.

One of the major challenges in this study was participant retention, which reduced the sample size due to follow-up attrition. Other issues included 1) significant difference of participants' adherence and asthma control in intervention vs. control group at

baseline, 2) almost half of the patients in intervention group had high adherence. With this, we were unable to observe significant improvement in adherence and asthma control when comparing pre-post data in intervention group, and were not able to compare changes in outcomes between intervention and control. However, the proposed intervention appeared to be effective in changing patients' treatment beliefs and reducing adherence barrier score.

CONCLUSIONS

Organizations, such as the World Allergy Organization, the American Academy of Asthma Allergy and Immunology and many others, declared the need for better adherence to asthma controller medications decades ago. Several strategies were implemented based on the results of studies supported by these organizations (e.g., Guidelines EPR-3 requires adherence evaluation before altering the medication dose). Nevertheless, at least half of the patients in need for regular use of controller medications continue to be non-adherent. We are still facing the challenge of finding a better strategy to help asthmatic patients. Pharmacists can be instrumental in this quest as they have access to personal health information and ability to have face-to-face communication with patients. Recent studies show that tailoring health behavior change (adherence) to individual patient-level factors is more efficient, due to personalized goal-setting. Thus, identifying barriers to adherence and targeting counseling during patient-pharmacist interaction may improve adherence to asthma therapy and overall control of asthma. With

this, it is critical to provide pharmacists with concise, effective and time-efficient tools that enhance encounters with patients.

In this three studies project, we were able to develop tools for use in community pharmacy settings, obtain pharmacists' opinions on such approach overall, as well as specific suggestions for the tools modifications and implementation of such approach into their practice. Then, we pilot-tested the proposed tools and found that such approach is instrumental for identifying patient specific issues that need to be addressed and that it was effective in resolving barriers to adherence. Even though we did not find significant improvement in adherence and asthma control, there is a potential in use of this approach as the effect on asthma management was positive. Data from a larger sample may change the results of the effectiveness of the proposed program.

This dissertation's findings provide insight into adherence behavior of patients with asthma and identify a multitude of reasons for nonadherence. Most common reasons are rooted in therapy beliefs and can be effectively targeted by pharmacists. In this study we found that pharmacists helped patients to obtain an asthma action plan and change patient therapy beliefs.

Overall, these studies emphasize the complex nature of asthma medication nonadherence. To improve adherence, it is important to establish team-work in addressing this problem and learn patient-specific issues to address them efficiently. Findings from these studies may be enriched by additional data and can be used by healthcare providers, especially pharmacists, and those who are planning to develop and implement patient-centered interventions for patients with asthma. With regards to

current research, results from this study are planned to be scaled to larger populations known to be at increased risk for asthma exacerbations due to poor adherence to asthma therapy. Study results may also be used to help develop programs for other lung condition where inhaler use is prevalent, such as chronic obstructive pulmonary disease (COPD). Lastly, findings may further be adapted for use among children and adolescents with asthma.

7. APPENDICES

Appendix A

Pharmacist Script and Action Plan for the Appointment #1

1. Please, identify a patient who is filling the prescription for one of the asthma controller inhalers.

2. Make sure that this inhaler was prescribed for asthma (not COPD)
   "Is this medication prescribed for your asthma?"
   If the inhaler is for asthma: please proceed
   If not, please say: "Thank you!" and do not proceed with further questions

3. Ask a patient whether s/he needs to take the inhaler regularly (not a seasonal/intermittent asthma)
   "Has you doctor suggested that you use your inhaler regularly?"
   If the answer is "yes" or "don't know": please proceed
   If not, please say: "Thank you!" and do not proceed with further questions

   "Do you have asthma symptoms most of the time or is it just a seasonal condition?"
   If the answer is "yes" or "don't know": please proceed
   If not, please say: "Thank you!" and do not proceed with further questions

4. Please, invite the patient to participate in the study
   "We have noticed that many patients with asthma have difficulties taking their medications and with all of the cedar and pollen in the air, we want to help patients better manage their asthma and invite you to participate in the study. The goal of this program is to better understand what difficulties you are facing with managing your asthma and to provide you with help addressing these challenges, so you know how to deal with your asthma and feel well.
   You will need to answer a brief questionnaire and then we will talk about your asthma. If you agree to participate and complete the questionnaire today, you will receive $25 gift card as a token of appreciation. We also would like to talk to you two more times (in a month via phone and in 3 months in-person). During the third appointment you will receive $25 gift card.
   Are you be interested participating in this program with the goal of improving how you take your medications for your asthma?"
   If the answer is "yes" or "don't know": please proceed
   If not, please say: "Thank you!" and do not proceed with further questions

5. Please provide a participant with 3 documents:
   a. Cover letter

   b. Two copies of Consent form (they need to sign both and keep one for their record, another – for the pharmacist)
   c. Survey #1

6. When the patient is done with the survey, take a signed copy of Consent form and the completed Survey.

7. Fill in the yellow page with the patient information: name, phone number, medication taken and whether the patient agrees to be contacted via phone in a month post-initial visit and show up for the 3 month post-initial follow-up.

8. Put page 3 of the survey under the transparency page using the Pharmacist's booklet (as instructed) and identify the items shaded in red. Please discuss these barriers with the patient providing him/her with the needed education, clarifying all the patient's questions.

9. Take the Patient pamphlet and mark and explain what information is pertinent to the patient's specific barriers. Provide your name and phone number at the designated area of the Pamphlet, as well as their doctor's information.

10. Hand the Pamphlet to the patient and emphasize what information should be reviewed again by the patient.

11. Notify a patient that s/he will be contacted via phone in a month for 5-10 minutes follow-up and also for scheduling an in-person appointment.

12. Give $25 gift card to the participant.

13. Mark your calendar for the phone follow-up discussion.

14. Provide any comments regarding the key issues discussed.

Comments:

_____

_____

_____

Thank You!

Appendix B

Survey #1: Your Asthma Experiences

The following questions ask about your asthma symptoms. Please answer each question by marking ONE box. If you are unsure about how to answer, please give the best answer you can.

1. Do you know the difference between your '**rescue**' and '**controller**' inhaler?
   ☐ Yes ☐ No, **STOP here *and ask a pharmacist to explain it to you. Then proceed answering the remaining questions.***

2. During the past **4 weeks**, how often have you used your **rescue** inhaler or nebulizer medication (such as Ventolin® or albuterol)?
   ☐ 3 or more times per day
   ☐ 1 or 2 times per day
   ☐ 2 or 3 times per week
   ☐ Once a week or less
   ☐ Not at all

3. I have difficulties using my inhaler(s).
   ☐ Strongly agree
   ☐ Agree
   ☐ Neutral
   ☐ Disagree
   ☐ Strongly disagree

4. When you feel better do you sometimes stop using your **controller** inhaler?
   ☐ Yes ☐ No

5. During the past **4 weeks**, how often did your **asthma** symptoms (wheezing, coughing, shortness of breath, chest tightness or pain) wake you up at night or earlier than usual in the morning?
   ☐ 4 or more nights a week
   ☐ 2 or 3 nights a week
   ☐ Once a week
   ☐ Once or twice a week
   ☐ Not at all

6. How would you rate your **asthma** control during the **past 4 weeks**?
   ☐ Not controlled at all
   ☐ Poorly controlled
   ☐ Somewhat controlled
   ☐ Well controlled
   ☐ Completely controlled

7. In the past **4 weeks**, how much of the time did your **asthma** keep you from getting as much done at work, school or at home?
   ☐ All of the time
   ☐ Most of the time
   ☐ Some of the time
   ☐ A little of the time
   ☐ None of the time

8. During the past **4 weeks**, how often have you had shortness of breath?
   ☐ More than once a day
   ☐ Once a day
   ☐ 3 to 6 times a week
   ☐ Once or twice a week
   ☐ Not at all

9. Have you EVER been hospitalized (at least overnight) due to your asthma?
   ☐ Yes ☐ No

10. In the past 12 months, how many times have you been hospitalized (at least overnight) for an asthma attack?
    (IF NONE WRITE "0") _____

11. In the past 12 months, how many times did you get treatment for an acute asthma attack at a doctor's office, urgent care facility or emergency department (ER)?
    (IF NONE WRITE "0")_____

12. In the past 12 months, how many times have you been given oral corticosteroids (such as prednisone, methylprednisolone, Medrol®) for a flare up of your asthma?
    (IF NONE WRITE "0")_____

13. Do you ever forget to use your **controller** inhaler?
    ☐ Yes ☐ No

14. Are you having problems remembering to take your **controller** inhaler?
    ☐ Yes ☐ No

Note: Inhaler below refers to **CONTROLLER** inhaler	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
15. I just forget to use my inhaler some of the time	☐	☐	☐	☐	☐
16. I run out of my inhaler because I don't get refills on time	☐	☐	☐	☐	☐
17. Using my inhaler more than once a day is inconvenient	☐	☐	☐	☐	☐
18. I feel confident that my inhaler will help me	☐	☐	☐	☐	☐
19. I know how to use my inhaler correctly	☐	☐	☐	☐	☐
20. I have an Asthma Action Plan and know if I am reaching my goals	☐	☐	☐	☐	☐
21. I have someone I can call with questions about my inhaler	☐	☐	☐	☐	☐
22. My doctor/nurse and I work together to make decisions	☐	☐	☐	☐	☐
23. I only use my inhaler when I am having symptoms such as shortness of breath, coughing, wheezing, or chest tightness	☐	☐	☐	☐	☐
Have you…	**In the last week**	**In the last month**	**In the last 3 months**	**> 3 months ago**	**Never**
24. Used your inhaler more or less often than prescribed?	☐	☐	☐	☐	☐
25. Skipped or stopped using your inhaler because you didn't think it was working?	☐	☐	☐	☐	☐
26. Skipped or stopped using your inhaler because it made you feel bad?	☐	☐	☐	☐	☐
27. Skipped, stopped, not refilled, or used less of inhaler because of the cost?	☐	☐	☐	☐	☐
28. Not had your inhaler with you when it was time to use it?	☐	☐	☐	☐	☐

29. Sometimes if you feel worse when you use the **controller** inhaler, do you stop using it?
☐ Yes ☐ No

30. Do you have an Asthma Action Plan?
☐ Yes ☐ No

31. Do you have any other chronic conditions? Please check all that apply.

☐ Hypertension	☐ Dyslipidemia	☐ Diabetes	☐ Depression
☐ Chronic Pain	☐ Gastrointestinal disorder	☐ Thyroid disorder	☐ Heart disease
☐ Arthritis	☐ Obesity	☐ Other, Please specify_____	

32. What is your gender?
☐ Male ☐ Female

33. What is your race/ethnicity?
☐ Caucasian ☐ African American ☐ Hispanic/Latino ☐ Other

34. What year were you born?

_____

35. What is the highest level of education you have completed?
☐ Primary
☐ Some high school
☐ High school
☐ Some college
☐ College
☐ Postgraduate (MS, MA, MBA, etc.)

Please return to the pharmacy staff. THANK YOU!

Appendix C

Pharmacist's Booklet "Asthma Conversation Starter"

ADHERENCE ENHANCEMENT PROGRAM FOR PATIENTS WITH ASTHMA

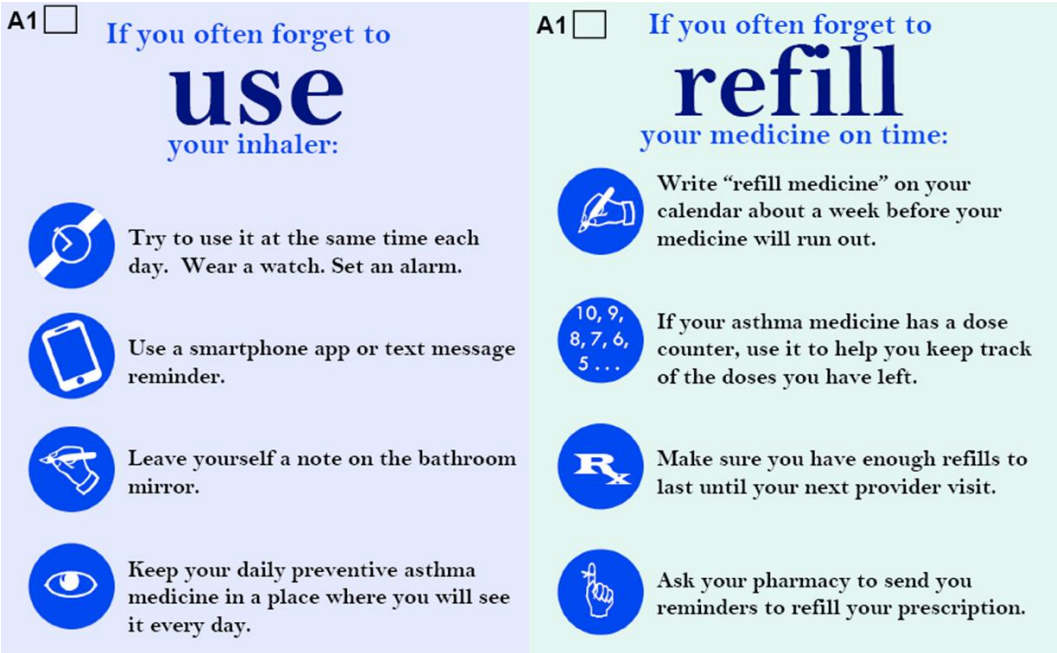
1. PUT PAGE 2 OF THE COMPLETED SURVEY UNDERNEATH THE TRANSPARANCY PAGE

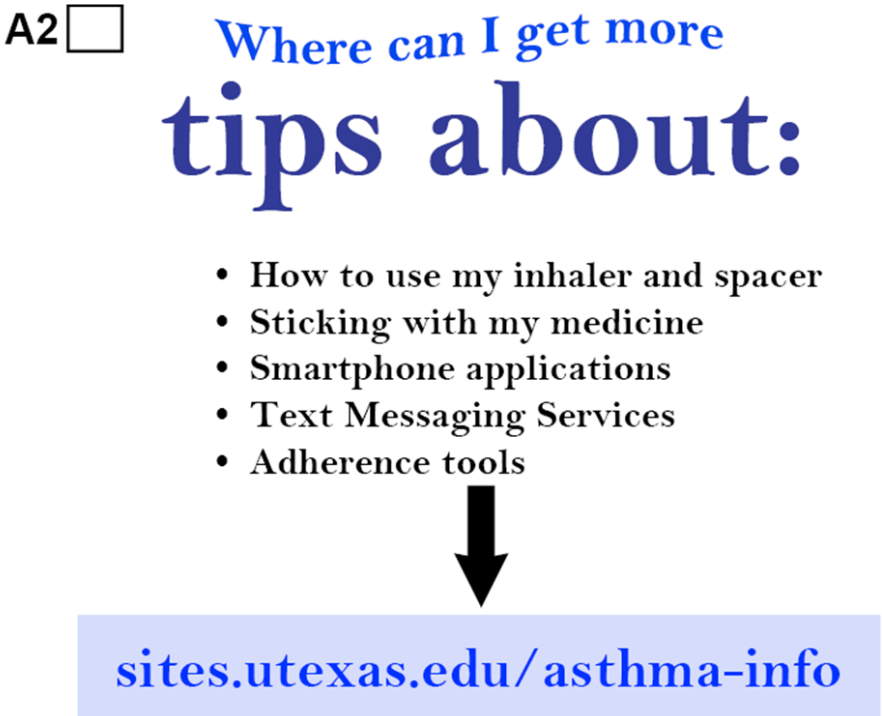
2. IDENTIFY WHICH OF THE MARKED ITEMS ARE IN THE RED SHADED AREA

3. ADDRESS THE SHADED ITEMS BY LOOKING ON THE RIGHT SIDE OF THE PAGE FOR SUGGESTIONS AND USING THE PATIENT PAMPHLET FOR EDUCATION AND REINFORCEMENT

Note: Inhaler below refers to **CONTROLLER** inhaler	**Suggested Actions**
1. I just forget to use my inhaler some of the time	Reminder tools, adherence aids or alarms **A1/A2**
2. I run out of my inhaler because I don't get refills on time	Reminder tools, adherence aids or alarms **A1/A2**
3. Using my inhaler more than once a day is inconvenient	Simplifying regimen if possible
4. I feel confident that my inhaler will help me	Patient education, guided counseling **A2/A4**
5. I know how to use my inhaler correctly	Video link **A2**
6. I have an Asthma Action Plan and know if I am reaching my goals	Obtain Asthma Action Plan **A3**
7. I have someone I can call with questions about my inhaler	Building a support network **A5**
8. My doctor/nurse and I work together to make decisions	Partnering with your healthcare provider **A5**
9. I only use my inhaler when I am having symptoms such as shortness of breath, coughing, wheezing, or chest tightness	Patient education, guided counseling **A4**
Have you…	
10. Used your inhaler more or less often than prescribed?	Patient education, guided counseling **A1/A2/A4**
11. Skipped or stopped using your inhaler because you didn't think it was working?	Patient education, guided counseling **A1/A2/A4**
12. Skipped or stopped using your inhaler because it made you feel bad?	Discuss side effects management **A7**
13. Skipped, stopped, not refilled, or used less of inhaler because of the cost?	Cost reducing strategies **A6**
14. Not had your inhaler with you when it was time to use it?	Reminder tools, adherence aids or alarms **A1/A2**
15. How often do you use your peak flow meter?	Consider obtaining and using a peak flow meter

A1/A2
Discuss the most suitable items and mark it in the pamphlet





A3
Discuss what a good-partial-poor control is and help to get and use Asthma Action Plan

A3 ☐

Understanding your asthma

symptom control

Good control	Partial control	Poor control
All of:	One or two of:	Three or more of:
Able to do all your usual activities	Less able to do your usual activities	Less able to do your usual activities
No asthma symptoms during night or on waking	Any asthma symptoms during night or on waking	Any asthma symptoms during night or on waking
Daytime symptoms no more than two days per week	Daytime symptoms more than two days per week	Daytime symptoms more than two days per week
Need reliever no more than two days per week*	Need reliever more than two days per week*	Need reliever more than two days per week*

(*Not including reliever puffer taken before exercise.)

Get a written asthma action plan!

A4

Provide a patient with general understanding of asthma and types of medications: when to take reliever, and how to use a controller (why adherence is important)

A4 ☐

Understanding how your medications work

Asthma medicines come in two types—quick-relief (reliever/rescue) and long-term control (preventer/controller).

Quick-relief medicines control the symptoms of an asthma attack. If you need to use your quick-relief medicines more and more, you should visit your health-care provider to see if you need a different medicine.

Long-term control medicines help you have fewer and milder attacks, but they don't help you if you're having an asthma attack.

Reliever / Rescue Inhaler _____

Reliever	
What it does	Relaxes tight airways for up to 4 hours
How it works	Very quickly - in about 4 minutes
When to take it	- When you have symptoms - Emergency - Before exercise as prescribed
Helpful to know	Carry it with you always in case of symptoms

Preventer / Controller Inhaler _____

Preventer	
What it does	- Soothes airways - Decreases swelling - Reduces mucus
How it works	Slowly - days
When to take it	Every day as prescribed - even if you feel well
Helpful to know	Only works when used regularly and continuously

A5
Making sure that a patient knows whom to address questions or concerns

- Ask if there are other providers who can help you make a decision. For example, a nurse, nutritionist, or health coach can help you learn more about each option.
- Think about other people who can help you decide. For example, you may want to talk with a friend or family member.
- If you need more time, schedule a follow-up visit with your provider.

A5 ☐

Partner with your healthcare provider.

Ask questions to help make sure

you

understand each option.

A6

Cost reducing strategies available for patients; For ex., Symbicort $25 Guarantee Program (AstraZeneca)

A7

If you use preventer medicine there is a small risk of having a sore tongue, sore throat, hoarseness of the voice and a mouth infection called thrush. To help prevent these side effects, rinse your mouth out and brush your teeth after using your preventer inhaler. Using a spacer will also help reduce the possibility of thrus

Appendix D

Patient Pamphlet "Breath Easier"

A5 ☐

Partner with your healthcare provider.

Ask questions to help make sure you

understand

each option.

- Ask if there are other providers who can help you address your concerns. For example, a nurse, nutritionist, or health coach can help you learn more about each option.
- Think about other people who can help support you in managing your asthma. For example, you may want to talk with a friend or family member.
- If you need more time, schedule a follow-up visit with your provider.

A6 ☐

Where can I go for

help?

Pharmacist Name:

Phone:

Physician Name:

Phone:

A7 ☐

Can I get help with

cost?

Ask your pharmacists about assistance programs and visit these websites for more information:

Needymeds.com
Pparx.org

Breathe easier

Controlling Your Asthma

A1 ☐

If you often forget to **use** your inhaler:

- Try to use it at the same time each day. Wear a watch. Set an alarm.
- Use a smartphone app or text message reminder.
- Leave yourself a note on the bathroom mirror.
- Keep your daily preventive asthma medicine in a place where you will see it every day.

A1 ☐

If you often forget to **refill** your medicine on time:

- Write "refill medicine" on your calendar about a week before your medicine will run out.
- If your asthma medicine has a dose counter, use it to help you keep track of the doses you have left.
- Make sure you have enough refills to last until your next provider visit.
- Ask your pharmacy to send you reminders to refill your prescription.

A2 ☐

Where can I get more **tips about:**

- How to use my inhaler and spacer
- Sticking with my medicine
- Smartphone applications
- Text Messaging Services
- Adherence tools

sites.utexas.edu/asthma-info

A3 ☐

Understanding your asthma **symptom control**

Good control	Partial control	Poor control
All of:	One or two of:	Three or more of:
Able to do all your usual activities	Less able to do your usual activities	Less able to do your usual activities
No asthma symptoms during night or on waking	Any asthma symptoms during night or on waking	Any asthma symptoms during night or on waking
Daytime symptoms no more than two days per week	Daytime symptoms more than two days per week	Daytime symptoms more than two days per week
Need reliever no more than two days per week*	Need reliever more than two days per week*	Need reliever more than two days per week*

(*Not including reliever puffer taken before exercise.)

Get a written asthma action plan!

A4 ☐

Understanding how your medications work

Asthma medicines come in two types—quick-relief (reliever/rescue) and long-term control (preventer/controller).

Quick-relief medicines control the symptoms of an asthma attack. If you need to use your quick-relief medicines more and more, you should visit your health-care provider to see if you need a different medicine.

Long-term control medicines help you have fewer and milder attacks, but they don't help you if you're having an asthma attack.

Reliever / Rescue Inhaler _____

Reliever	
What it does	Relaxes tight airways for up to 4 hours
How it works	Very quickly - In about 4 minutes
When to take it	- When you have symptoms - Emergency - Before exercise as prescribed
Helpful to know	Carry it with you always in case of symptoms

Preventer / Controller Inhaler _____

Preventer	
What it does	- Soothes airways - Decreases swelling - Reduces mucus
How it works	Slowly - days
When to take it	Every day as prescribed - even if you feel well
Helpful to know	Only works when used regularly and continuously

References:

http://www.healthcoach4me.com/dam/assets/hm4299.pdf

http://www.cdc.gov/asthma/pdfs/asthma_brochure.pdf

http://www.asthmawe.org.au/PageFiles/416/AA_Broch_Basic%20Facts_0614.pdf

Appendix E

Asthma Control Test

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

Appendix F

ASK-12

ask®-12

Taking Medicine—What Gets in the Way?

Think about all of the medicines you take. Mark one answer for each item below.

INCONVENIENCE/ FORGETFULNESS

Lifestyles	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1 I just forget to take my medicines some of the time.	○	○	○	○	○
2 I run out of my medicine because I don't get refills on time.	○	○	○	○	○
3 Taking medicines more than once a day is inconvenient.	○	○	○	○	○

TREATMENT BELIEFS

Attitudes and Beliefs	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
4 I feel confident that each one of my medicines will help me.	○	○	○	○	○
5 I know if I am reaching my health goals.	○	○	○	○	○
Help From Others					
6 I have someone I can call with questions about my medicines.	○	○	○	○	○
Talking With Healthcare Team					
7 My doctor/nurse and I work together to make decisions.	○	○	○	○	○

BEHAVIOR

Taking Medicines Have You...	In the last week	In the last month	In the last 3 months	More than 3 months ago	Never
8 Taken a medicine more or less often than prescribed?	○	○	○	○	○
9 Skipped or stopped taking a medicine because you didn't think it was working?	○	○	○	○	○
10 Skipped or stopped taking a medicine because it made you feel bad?	○	○	○	○	○
11 Skipped, stopped, not refilled, or taken less medicine because of the cost?	○	○	○	○	○
12 Not had medicine with you when it was time to take it?	○	○	○	○	○

If you checked any answers in the dark blue boxes, talk with your doctor or healthcare professional.

gsk GlaxoSmithKline

This material was developed by GlaxoSmithKline.

Appendix G

DRAW tool

Drug Adherence Work-up Tool (DRAW®)

Ask each question and note "YES" response. For each YES, consider the suggested actions and refer to the guide sections on the next page.

Patient Interview	Yes	Suggested actions & GUIDES
1) Please tell me how you take your medication every day.	N/A	Verify adherence; Identify any discrepancies; Add to their knowledge **A, B, E**
2) Do you feel like you have too many medications or too many doses per day?	☐	Reduce number of meds per day by stopping/changing medications; Simplify regimen **A, C, D**
3) Do you sometimes forget to take your medication on routine days? 4) Do you forget on non-routine days such as weekends or when traveling?	☐ ☐	Adherence aid, alarm or specialized packaging; Med calendar; Memory aid; Rule out anticholinergic meds **A, E**
5) Do you have a concern that your medication is not helping you? 6) Do you feel that you do not need this medication?	☐ ☐	Patient education; Guided counseling **B, C**
7) Have you had any side effects? 8) Are you concerned about side effects?	☐ ☐	Guided counseling; Switch medications; Symptom management; Adjust regimen **B, C**
9) Is the cost of this medication too much?	☐	Switch to less costly medication; cost reduction strategy **D**
Pharmacist: 10) At any time during this interview, did you sense an issue about decreased cognitive function? 11) Is there a limitation on instrumental activities of daily living to affect adherence and/or use of adherence aids?	☐ ☐	Rule out anticholinergics; Discuss with other area providers; Referral to assistance resource; Recommend or support medication assistance including aids and/or caregivers **A, E**
12) Do you plan to follow up with this patient?	☐	**Schedule follow-up date**

Appendix H

Interview Guide

Introduction

Hi, my name is [Name] and I'll be interviewing you today. Welcome to the Adherence to Asthma Therapy discussion.

Our interview is centered on identifying the most effective workflow and communication models for addressing patients' barriers to adherence in practice. We also will explore potential impediments for implementation of the patient-pharmacist partnership program and how they can be resolved. We are hopeful that the results will draw the map for a successful implementation of the adherence enhancement program in the pharmacy settings.

Confidentiality is important and in any publications or presentations, I will make sure that you will not be identified in any way, by department, etc. Also, whatever is said in this room will not be shared with anyone other than the researchers for whom this conversation is being recorded.

Here's a copy of the consent form, but you are not being asked to sign anything. I will have the tapes and a few notes of the interview, but I will not record anything identifiable. The tapes will be kept by the researchers, in a locked drawer, or by a person who will transcribe them. And finally, after these tapes have been transcribed, they will be destroyed, so that there will be no record. Can we agree to that?

Here are some guidelines for our interview. I want you to feel comfortable talking about your ideas and thoughts. There are no right or wrong answers.

We'll be talking for about 40 minutes - one hour and we have a lot to discuss.

Any questions? OK, let's get started…

Before we start the tape recording, let's get to know one another.

Now the interview and tape recording will start.

INSTRUMENTS

I would like to ask you about the barriers to adherence and how it can be addressed in the pharmacy setting. Take a few minutes and look at the two instruments: 1) ASK-12 identifying barriers to adherence and 2) "Asthma Conversation Starter" Tool helping to initiate communication with patients targeting specific barriers. (3 min) Let me ask your opinion on the first instrument (ASK-12). Do you think that all of the potential barriers listed are reasonable? Can you think of any other barriers that are not stated there?
Now let's discuss the "Asthma Conversation Starter" tool.
Would this instrument be helpful for you while working with asthmatic patient?
What do you like about this instrument?
What do you NOT like about this instrument?
What elements can be added/removed to/from this tool that will make its use easier/effective?

BENEFITS
Now as you envision the approach for patient-pharmacist collaboration with the goal of improving adherence, could you share the benefits of using these tools?

Probes: Understanding the specific reasons for nonadherence
Help initiate the conversation with a patient
Follow-up with a patient via phone and then in-person will ensure the compliance with the suggested plan
Establishment of personal relationship and developing trust between a pharmacist and a patient

IMPLEMENTATION
Now as we discussed the instruments and the benefits of the program, let's move to the implementation part. How can this program be incorporated into the workflow? Now you are welcome to share your suggestions.

Probes: Who should provide asthma adherence services?
Would it be possible for a special program-dedicated pharmacist only?
Can technicians be helpful at any point?

BARRIERS
Now, let's talk about barriers that you perceive you will encounter in using these tools to help resolve asthma-related nonadherence.

Probes: Time:
Resources:
Pharmacist training:
Stake holder support:
Physician-pharmacist interaction:
Other challenges

STRATEGIES

How do you think these challenges could be (or have been) overcome?

How do we start?

How do we sustain it?

Probes: Patient enrollment process
Administration of ASK-12 survey (patients)
Using "Asthma Conversation Starter" tool by pharmacists
Keeping track of the enrolled patients and scheduling follow-up with them
Sustaining awareness of the barriers s/he faces(ed) during following encounters
Keeping track of the patient's adherence level (Morisky scale)

CONCLUSION

Great! We've covered a lot of ground and identified a number of outstanding strategies. Do you have anything that you want to add, or anything you think was missed? Any final observations or comments? Now is a great time to say anything that was left unsaid.

Thank you again for your time, participation and excellent discussion.

Appendix I

Script for a Pharmacist for the Phone follow-up with the Patient

Hello, (patient's name). This is you're your pharmacist (your name). I am calling to you regarding our collaborative work on your asthma management. We have been discussing the questions pertaining to your asthma and I gave you the educational pamphlet for your review.

1. Since then, is there anything you would like to share with me or ask any questions?

   Comments:
   _____
   _____
   _____
   _____
   _____

2. Now I would like to ask you 5 questions

1. In the past **4 weeks**, how much of the time did your **asthma** keep you from getting as much done at work, school or at home?

☐ All of the time ☐ Most of the time ☐ Some of the time ☐ A little of the time ☐ None of the time

2. During the past **4 weeks**, how often have you had shortness of breath?

☐ More than once a day ☐ Once a day ☐ 3 to 6 times a week ☐ Once or twise a week ☐ Not at all

3. During the past **4 weeks**, how often did your **asthma** symptoms (wheezing, coughing, shortness of breath, chest tightness or pain) wake you up at night or earlier than usual in the morning?

☐ 4 or more nights a week ☐ 2 or 3 nights a week ☐ Once a week ☐ Once or twice ☐ Not at all

4. During the past **4 weeks**, how often have you used your rescue inhaler or nebulizer medication (such as albuterol)?

☐ 3 or more times per day ☐ 1or 2 times per day ☐ 2 or 3 times per week ☐ Once a week or less
☐ Not at all

5. How would you rate your **asthma** control during the **past 4 weeks**?

☐ Not controlled at all ☐ Poorly controlled ☐ Somewhat controlled ☐ Well controlled
☐ Completely controlled

3. We would like to schedule an appointment with you in **two months**, so we can go over your asthma management and the questions you might have, you will complete another short survey and will get your $25 gift card.

   Date scheduled: _____
   Date for reminder call scheduled: _____

Thank You!

Appendix J

YOUR ASTHMA EXPERIENCES (FOLLOW-UP)

The following questions ask about your asthma symptoms. Please answer each question by marking ONE box. If you are unsure about how to answer, please give the best answer you can.

1. Do you know the difference between your '**rescue**' and '**controller**' inhaler?
   ☐ Yes ☐ No, **STOP here *and ask a pharmacist to explain it to you. Then proceed answering the remaining questions.***

2. During the past **4 weeks**, how often have you used your **rescue** inhaler or nebulizer medication (such as Ventolin® or albuterol)?
   ☐ 3 or more times per day
   ☐ 1 or 2 times per day
   ☐ 2 or 3 times per week
   ☐ Once a week or less
   ☐ Not at all

3. I have difficulties using my inhaler(s).
   ☐ Strongly agree
   ☐ Agree
   ☐ Neutral
   ☐ Disagree
   ☐ Strongly disagree

4. When you feel better do you sometimes stop using your **controller** inhaler?
   ☐ Yes ☐ No

5. During the past **4 weeks**, how often did your **asthma** symptoms (wheezing, coughing, shortness of breath, chest tightness or pain) wake you up at night or earlier than usual in the morning?
   ☐ 4 or more nights a week
   ☐ 2 or 3 nights a week
   ☐ Once a week
   ☐ Once or twice a week
   ☐ Not at all

6. How would you rate your **asthma** control during the **past 4 weeks**?
   ☐ Not controlled at all
   ☐ Poorly controlled
   ☐ Somewhat controlled
   ☐ Well controlled
   ☐ Completely controlled
7. In the past **4 weeks**, how much of the time did your **asthma** keep you from getting as much done at work, school or at home?
   ☐ All of the time
   ☐ Most of the time
   ☐ Some of the time
   ☐ A little of the time
   ☐ None of the time

8. During the past **4 weeks**, how often have you had shortness of breath?
   ☐ More than once a day
   ☐ Once a day
   ☐ 3 to 6 times a week
   ☐ Once or twice a week
   ☐ Not at all

9. Do you ever forget to use your **controller** inhaler?
   ☐ Yes ☐ No

10. Are you having problems remembering to use your **controller** inhaler?
    ☐ Yes ☐ No

11. Sometimes if you feel worse when you use the **controller** inhaler, do you stop using it?
    ☐ Yes ☐ No

Note: Inhaler below refers to **CONTROLLER** inhaler	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
12. I just forget to use my inhaler some of the time	☐	☐	☐	☐	☐
13. I run out of my inhaler because I don't get refills on time	☐	☐	☐	☐	☐
14. Using my inhaler more than once a day is inconvenient	☐	☐	☐	☐	☐
15. I feel confident that my inhaler will help me	☐	☐	☐	☐	☐
16. I know how to use my inhaler correctly	☐	☐	☐	☐	☐
17. I have an Asthma Action Plan and know if I am reaching my goals	☐	☐	☐	☐	☐
18. I have someone I can call with questions about my inhaler	☐	☐	☐	☐	☐
19. My doctor/nurse and I work together to make decisions	☐	☐	☐	☐	☐
20. I only use my inhaler when I am having symptoms such as shortness of breath, coughing, wheezing, or chest tightness	☐	☐	☐	☐	☐
Have you…	**In the last week**	**In the last month**	**In the last 3 months**	**> 3 months ago**	**Never**
21. Used your inhaler more or less often than prescribed?	☐	☐	☐	☐	☐
22. Skipped or stopped using your inhaler because you didn't think it was working?	☐	☐	☐	☐	☐
23. Skipped or stopped using your inhaler because it made you feel bad?	☐	☐	☐	☐	☐
24. Skipped, stopped, not refilled, or used less of inhaler because of the cost?	☐	☐	☐	☐	☐
25. Not had your inhaler with you when it was time to use it?	☐	☐	☐	☐	☐
	Every day	**Once a week**	**Once a month**	**When asthma worsens**	**I don't have one**
26. How often do you use your peak flow meter?	☐	☐	☐	☐	☐

Please return to the pharmacy staff. THANK YOU!

Appendix K

Pharmacist Script and Action Plan for the Appointment #3

1. Please, have all the documents collected previously (for the discussion)

2. Provide the participant with the Survey#3 (the same questions as at the first appointment excluding demographic and chronic conditions questions)

3. Collect the completed survey from the patient

4. Put page 3 of the survey under the transparency page in the Pharmacist's booklet (as instructed) and identify and compare the items shaded in red. Please discuss previously and newly identified barriers with the patient providing him/her with the needed education, clarifying all the patient's questions

5. Give $25 gift card to the participant

6. Provide any comments regarding the key issues discussed

   Comments:
   _____
   _____
   _____
   _____
   _____
   _____

7. Please provide any comments regarding this program. Was it effective? Did you notice any progress in patient's knowledge, skills? Is there anything you would consider changing/adding/removing in this program?

   Comments:
   _____
   _____
   _____
   _____
   _____

Thank You!

Appendix L

Study Three Aims, Hypotheses, and Corresponding Statistical Tests and Conclusions

AIM 3			
Hypothesis	**Variables**	**Analysis**	**Conclusion**
H1: There is no significant difference between patients receiving asthma-specific counseling (Intervention group) and patients who did not receive asthma-specific counseling (Control group) on the baseline characteristics	Adherence score Asthma control test score Barriers to adherence score Presence of chronic conditions Gender Race Age Education	t-test, chi-squared test	Rejected
AIM 4			
Hypothesis	**Variables**	**Analysis**	**Conclusion**
Hypothesis 2a: Change in asthma controller inhaler **adherence** (from baseline to 3-month follow-up) will show significantly higher improvement for patients in the intervention group compared to the control group, while controlling for covariates.	DV: Change in Morisky scale adherence (from baseline to 3-month follow-up) IV: Group (Intervention vs. Control); Barriers to adherence score; Covariates	Multivariate linear regression	N/A, as groups were incomparable
Hypothesis 2b: Among patients in the intervention group, **adherence** to asthma controller inhaler will increase significantly from baseline to 3-month follow-up, while controlling for covariates.	DV: Morisky scale adherence IV: Time (Pre vs. Post); Barriers to adherence score; Covariates	Multivariate linear regression	Rejected; Bivariate analysis was conducted, and test insignificant
Hypothesis 3a: Change in **asthma control** (from baseline to 3-month follow-up) will show significantly higher improvement for patients in the intervention group compared to the control group, while controlling for covariates.	DV: Change in ACT score (from baseline to 3-month follow-up) IV: Group (Intervention vs. Control); Morisky scale adherence; Barriers to adherence score; Covariates	Multivariate linear regression	N/A, as groups were incomparable

Hypothesis 3b: Among patients in the intervention group, **asthma control** will improve significantly from baseline to 3-month follow-up, while controlling for covariates.	DV: ACT score IV: Time (Pre vs. Post); Morisky scale adherence; Barriers to adherence score; Covariates	Multivariate linear regression	Rejected; Bivariate analysis was conducted, and test insignificant, though clinically significant
Hypothesis 4a: Change in **adherence barrier score** (from baseline to 3-month follow-up) will show significantly higher improvement for patients in the intervention group compared to the control group, while controlling for covariates	DV: Change in Adherence barrier score (from baseline to 3-month follow-up) IV: Group (Intervention vs. Control); Covariates	Multivariate linear regression	N/A, as groups were incomparable
Hypothesis 4b: Among patients in the intervention group, **adherence barrier score** will decrease significantly from baseline to 3-month follow-up, while controlling for covariates.	DV: Adherence barrier score IV: Time (Pre vs. Post); Morisky scale adherence; Covariates	Multivariate linear regression	**Accepted**

Bibliography

- Adherence to long-term therapies:evidence for action. 2003 http://whqlibdoc.who.int/publications/2003/9241545992.pdf. Accessed Jan 21, 2016.
- Aguilar KM, Hou Q, Miller RM. Impact of Employer-Sponsored Onsite Pharmacy and Condition Management Programs on Medication Adherence. *J Manag Care Spec Pharm*. 2015;21(8):670-7.
- Akinbami LJ, Moorman JE, Liu X. Asthma prevalence, health care use, and mortality: United States, 2005-2009. *Natl Health Stat Report*, 2011;32:1-14.
- Armour C, et al. Pharmacy Asthma Care Program (PACP) improves outcomes for patients in the community. *Thorax*. 2007;62(6):496-502.
- Asthma and Allergy Foundation of America. Cost of asthma. 2000. http://www.aafa.org/display.cfm?id=6&sub=63. Accessed Jan 21, 2016.
- Avoidable costs in U.S. healthcare. 2013 IMS Health http://www.imshealth.com/deployedfiles/imshealth/Global/Content/Corporate/IMS%20Institute/RUOM-2013/IHII_Responsible_Use_Medicines_2013.pdf. Accessed Jan 21, 2016.
- Axelsson M, Lotvall J. Recent educational interventions for improvement of asthma medication adherence. *Asia Pac Allergy*. 2012;2(1):67-75.
- Bacci JL, et al. Implementation of targeted medication adherence interventions within a community chain pharmacy practice: The Pennsylvania Project. *J Am*

Pharm Assoc. 2014;54(6):584-93.

- Baiardini I, et al. *Adherence to treatment: assessment of an unmet need in asthma. J Investig Allergol Clin Immunol*. 2006;16(4):218-23.
- Barnes CB, Ulrik CS. Asthma and Adherence to Inhaled Corticosteroids: Current Status and Future Perspectives. *Respir Care*. 2015;60(3):455-468.
- Barner JC, Lawson K, Roberson K. Clinical and economic outcomes of the Texas Medicaid medication therapy management (MTM) pilot. 2012, Texas Health and Human Services Commission: Austin, TX.
- Barnett SB, Nurmagambetov TA. Costs of asthma in the United States: 2002-2007. *J Allergy Clin Immunol*. 2011;127(1):145-52.
- Basheti IA, et al. Improved asthma outcomes with a simple inhaler technique intervention by community pharmacists. *J Allergy Clin Immunol.* 2007;119(6): 1537-8.
- Bayldon BW, et al. Exploring caregiver understanding of medications immediately after a pediatric primary care visit. *Patient Educ Couns*. 2013;91(2): 255-60.
- Bender BG, et al. Factors influencing patient decisions about the use of asthma controller medication. *Ann Allergy Asthma Immunol*. 2007;98(4):322-8.
- Bender BG, Bender SE. Patient-identified barriers to asthma treatment adherence: responses to interviews, focus groups, and questionnaires. *Immunol Allergy Clin North Am*. 2005;25(1):107-30.
- Bender B, Milgrom H, Apter A. Adherence intervention research: what have we

learned and what do we do next? *J Allergy Clin Immunol*. 2003;112(3):489-94.

- Bender BG, Pedan A, Varasteh LT. Adherence and persistence with fluticasone propionate/salmeterol combination therapy. *J Allergy Clin Immunol*. 2006;118(4):899-904.
- Bereznicki BJ, et al. Uptake and effectiveness of a community pharmacy intervention programme to improve asthma management. *J Clin Pharm Ther*, 2013;38(3):212-8.
- Berry TM, et al. Asthma friendly pharmacies: a model to improve communication and collaboration among pharmacists, patients, and healthcare providers. *J Urban Health.* 2011;88 Suppl 1:113-25.
- Blais R, Laurier C, Pare M. Effect of feedback letters to physicians and pharmacists on the appropriate use of medication in the treatment of asthma. *J Asthma.* 2008;45(3):227-31.
- Blaiss MS. Part II: Inhaler technique and adherence to therapy. *Curr Med Res Opin.* 2007;23 Suppl 3:S13-20.
- Blaiss MS, et al. Barriers to asthma treatment in the United States: results from the global asthma physician and patient survey. *World Allergy Organ J*. 2009; 2(12):303-13.
- Blake KB, et al. Medication therapy management services in West Virginia: pharmacists' perceptions of educational and training needs. *Res Social Adm Pharm.* 2009;5(2):182-8.
- Boulet LP, et al. Benefits of an asthma education program provided at primary

care sites on asthma outcomes. *Respir Med.* 2015;109(8):991-1000.

- Bozek A., Jarzab J. Adherence to asthma therapy in elderly patients. *J Asthma*. 2010;47(2):162-5.
- Bunting BA, Cranor CW. The Asheville Project: long-term clinical, humanistic, and economic outcomes of a community-based medication therapy management program for asthma. *J Am Pharm Assoc.* 2006;46(2):133-47.
- Camargo CAJr, Ramachandran S, Ryskina KL, et al. Association between common asthma therapies and recurrent asthma exacerbations in children enrolled in a state Medicaid plan. *Am J Health Syst Pharm*. 2007;64(10):1054-61.
- Carter BL, et al. Physician and pharmacist collaboration to improve blood pressure control. *Arch Intern Med*. 2009;169(21):1996-2002.
- Centers for Disease Control and Prevention (CDC). National Center for Health Statistics. National Health Interview Survey (NHIS) 2009 data release. 2010; http://www.cdc.gov/nchs/nhis/nhis_2009_data_release.htm. Accessed Jan 21, 2016.
- Chernew ME, et al. Impact of decreasing copayments on medication adherence within a disease management environment. *Health Aff*. 2008;27(1):103-12.
- Chiu KC, et al. Patients' beliefs and behaviors related to treatment adherence in patients with asthma requiring maintenance treatment in Asia. *J Asthma*. 2014; 51(6):652-9.
- Cohen JL, et al. Assessing the validity of self-reported medication adherence among inner-city asthmatic adults: the Medication Adherence Report Scale for

Asthma. *Ann Allergy Asthma Immunol.* 2009;103(4):325-31.

- Delea TE, et al. Association between adherence with fixed dose combination fluticasone propionate/salmeterol on asthma outcomes and costs. *Curr Med Res Opin*. 2008;24(12):3435-42.
- Desai M, Oppenheimer JJ. Medication adherence in the asthmatic child and adolescent. *Curr Allergy Asthma Rep*. 2011;11(6):454-64.
- Doucette WR, et al. Development of the Drug Adherence Work-up (DRAW) tool. *J Am Pharm Assoc*. 2012;52(6):e199-204.
- Dunn SP, et al. The role of the clinical pharmacist in the care of patients with cardiovascular disease. *J Am Coll Cardiol*. 2015;66(19):2129-39.
- Gamble J, Stevenson M, McClean E, Heaney LG. The prevalence of nonadherence in difficult asthma. *Am J Respir Crit Care Med*. 2009;180(9):817-22.
- Garcia-Cardenas V, et al. Effect of a pharmacist intervention on asthma control. A cluster randomised trial. *Respir Med*. 2013;107(9):1346-55.
- Gatwood J, Bailey JE. Improving medication adherence in hypercholesterolemia: challenges and solutions. *Vasc Health Risk Manag.* 2014;10:615-25.
- Gaude GS, Hattiholi J, Chaudhury A. Role of health education and self-action plan in improving the drug compliance in bronchial asthma. *J Family Med Prim Care.* 2014; 3(1):33-8.
- Gellad WF, Grenard J, McGlynn EA. A Review of Barriers to Medication Adherence. A Framework for Driving Policy Options. RAND 2009

http://www.rand.org/content/dam/rand/pubs/technical_reports/2009/RAND_TR765.pdf. Accessed Jan 21, 2016.

- George M, et al. Qualitative research-enhanced understanding of patients' beliefs: results of focus groups with low-income, urban, African American adults with asthma. *J Allergy Clin Immunol*. 2003;111(5):967-73.
- Giraud V, Allaert FA, Roche N. Inhaler technique and asthma: feasability and acceptability of training by pharmacists. *Respir Med*. 2011;105(12):1815-22.
- Goeman D, et al. Educational intervention for older people with asthma: a randomised controlled trial. *Patient Educ Couns.* 2013;93(3):586-95.
- Guenette L, et al. Effectiveness of an asthma integrated care program on asthma control and adherence to inhaled corticosteroids. *J Asthma*. 2015;52(6):638-45.
- Hahn SR, et al. Development of the ASK-20 adherence barrier survey. *Curr Med Res Opin*. 2008;24(7):2127-38.
- Halm EA, Mora P, Leventhal H. No symptoms, no asthma: the acute episodic disease belief is associated with poor self-management among inner-city adults with persistent asthma. *Chest*. 2006;129(3):573-80.
- Hansson Scherman M, Lowhagen O. Drug compliance and identity: reasons for non-compliance. Experiences of medication from persons with asthma/allergy. *Patient Educ Couns*. 2004;54(1):3-9.
- Hedegaard U, et al. Process- and patient-reported outcomes of a multifaceted medication adherence intervention for hypertensive patients in secondary care. *Res Social Adm Pharm.* 2016;12(2):302-18.

- Herbert KE, et al. Prediction of pharmacist intention to provide Medicare medication therapy management services using the theory of planned behavior. *Res Social Adm Pharm.* 2006;2(3):299-314.
- Herndon JB, Mattke S, Evans Cuellar A, et al. Anti-Inflammatory Medication Adherence, Healthcare Utilization and Expenditures among Medicaid and Children's Health Insurance Program Enrollees with Asthma. *Pharmacoeconomics*. 2012;30(5):397-412.
- Hirsch JD, et al. Evaluation of the first year of a pilot program in community pharmacy: HIV/AIDS medication therapy management for Medi-Cal beneficiaries. *J Manag Care Pharm*. 2009;15(1):32-41.
- Horne R, Weinman J. Patients' beliefs about prescribed medicines and their role in adherence to treatment in chronic physical illness. *J Psychosom Res*. 1999; 47(6):555-67.
- Horne R, Weinman J. Self-regulation and self-management in asthma: Exploring the role of illness perceptions and treatment beliefs in explaining non-adherence to preventer medication. *Psychology & Health*. 2002;17(1):17-32.
- Howell G. Nonadherence to medical therapy in asthma: risk factors, barriers, and strategies for improving. *J Asthma*. 2008;45(9):723-9.
- Irwin RS, Richardson ND. Patient-focused care: using the right tools. *Chest.* 2006;130(1 Suppl):73S-82S.
- Janson SL, et al. Individualized asthma self-management improves medication adherence and markers of asthma control. *J Allergy Clin Immunol.* 2009;123(4):

840-6.

- Jentzsch NS, Camargos PA, Colosimo EA, Bousquet J. Monitoring adherence to beclomethasone in asthmatic children and adolescents through four different methods. *Allergy*. 2009;64(10):1458-62.
- Jones C, Santanello NC, Boccuzzi SJ, et al. Adherence to prescribed treatment for asthma: evidence from pharmacy benefits data. *J Asthma*. 2003;40(1):93-101.
- Kandane-Rathnayake RK, Matheson MC, Simpson JA, et al. Adherence to asthma management guidelines by middle-aged adults with current asthma. *Thorax*. 2009;64(12):1025-31.
- Kibicho J, Owczarzak J. Pharmacists' strategies for promoting medication adherence among patients with HIV. *J Am Pharm Assoc.* 2011;51(6):746-55.
- Krigsman K, et al. Refill adherence by the elderly for asthma/chronic obstructive pulmonary disease drugs dispensed over a 10-year period. *J Clin Pharm Ther*. 2007;32(6):603-11.
- Krigsman K, Nilsson JLG, RingL. Adherence to multiple drug therapies: refill adherence to concomitant use of diabetes and asthma/COPD medication. *Pharmacoepidemiol Drug Saf.* 2007;16(10):1120-8.
- Kritikos VS, Reddel HK, Bosnic-Anticevich SZ. Pharmacists' perceptions of their role in asthma management and barriers to the provision of asthma services. *Int J Pharm Pract.* 2010;18(4):209-16.
- Laforest L, et al. Asthmatic patients' poor awareness of inadequate disease control: a pharmacy-based survey. *Ann Allergy Asthma Immunol*. 2007;98(2):

146-52.

- Lam N, Muravez SN, Boyce RW. A comparison of the Indian Health Service counseling technique with traditional, lecture-style counseling. *J Am Pharm Assoc.* 2015;55(5):503-10.
- Lasmar L, Camargos P, Champs NS, et al. Adherence rate to inhaled corticosteroids and their impact on asthma control. *Allergy*. 2009;64(5):784-9.
- Latry P, Pinet M, Labat A, et al. Adherence to anti-inflammatory treatment for asthma in clinical practice in France. *Clin Ther.* 2008;30 Spec No:1058-68.
- Law AV, Okamoto MP, Chang PS. Prevalence and types of disease management programs in community pharmacies in California. *J Manag Care Pharm*. 2005; 11(6):505-12.
- Lowe RA, et al. Association between primary care practice characteristics and emergency department use in a medicaid managed care organization. *Med Care*. 2005;43(8):792-800.
- Makhinova T, et al. Asthma Controller Medication Adherence, Risk of Exacerbation, and Use of Rescue Agents among Texas Medicaid Patients with Persistent Asthma. *J Manag Care Spec Pharm*. 2015;21(12):1124-32.
- Mangiapane S, et al. Community pharmacy-based pharmaceutical care for asthma patients. *Ann Pharmacother*. 2005;39(11):1817-22.
- Matza LS, et al. Derivation and validation of the ASK-12 adherence barrier survey. *Ann Pharmacother.* 2009;43(10):1621-30.
- Matza LS, et al. Further testing of the reliability and validity of the ASK-20

adherence barrier questionnaire in a medical center outpatient population. *Curr Med Res Opin* 2008;24(11):3197-206.

- McDonald HP, Garg AX, Haynes RB. Interventions to enhance patient adherence to medication prescriptions: scientific review. *JAMA*. 2002;288(22):2868-79.
- McHorney CA. The Adherence Estimator: a brief, proximal screener for patient propensity to adhere to prescription medications for chronic disease. *Curr Med Res Opin*. 2009;25(1):215-38.
- Mehuys E, et al. Effectiveness of pharmacist intervention for asthma control improvement. *Eur Respir J.* 2008;31(4):790-9.
- Menckeberg TT, et al. Beliefs about medicines predict refill adherence to inhaled corticosteroids. *J Psychosom Res*. 2008;64(1):47-54.
- Moore JM, et al. Impact of a patient-centered pharmacy program and intervention in a high-risk group. *J Manag Care Pharm.* 2013;19(3): 228-36.
- Morisky DE, et al. Predictive validity of a medication adherence measure in an outpatient setting. *J Clin Hypertens.* 2008;10(5):348-54.
- Morisky DE, Green LW, Levine DM. Concurrent and predictive validity of a self-reported measure of medication adherence. *Med Care.* 1986;24(1):67-74.
- Mowrer JL, et al. Patients' and providers' perceptions of asthma and asthma care: a qualitative study. *J Asthma*. 2015;52(9):949-56.
- Myers CE. Opportunities and challenges related to pharmacy technicians in supporting optimal pharmacy practice models in health systems. *Am J Health Syst Pharm.* 2011;68(12):1128-36.

- Nathan RA, et al. Development of the asthma control test: a survey for assessing asthma control. *J Allergy Clin Immunol.* 2004;113(1):59-65.
- National Asthma Education and Prevention program. Expert Panel Report 3 (EPR-3): Guidelines for the Diagnosis and Management of Asthma-Summary Report 2007. *J Allergy Clin Immunol.* 2007;120(5 Suppl):S94-138.
- Nieuwlaat R, et al. Interventions for enhancing medication adherence. *Cochrane Database Syst Rev*. 2014;11:CD000011.
- O'Donnell DC, Brown CM, Dastani HB. Barriers to counseling patients with obesity: a study of Texas community pharmacists. *J Am Pharm Assoc*. 2006; 46(4):465-71.
- Park J, et al. Impact of an adherence intervention program on medication adherence barriers, asthma control, and productivity/daily activities in patients with asthma. *J Asthma.* 2010;47(10):1072-7.
- Pindolia VK, et al. Mitigation of medication mishaps via medication therapy management. Ann Pharmacother. 2009;43(4): 611-20.
- Price D, et al. Improved adherence with once-daily versus twice-daily dosing of mometasone furoate administered via a dry powder inhaler: a randomized open-label study. *BMC Pulm Med.* 2010;10:1.
- Price D, et al. Inhaler competence in asthma: common errors, barriers to use and recommended solutions. *Respir Med*. 2013;107(1):37-46.
- Pringle JL, et al. The Pennsylvania Project: pharmacist intervention improved medication adherence and reduced health care costs. *Health Aff.* 2014;33(8):

1444-52.

- Ponieman D, et al. Impact of positive and negative beliefs about inhaled corticosteroids on adherence in inner-city asthmatic patients. *Ann Allergy Asthma Immunol*. 2009;103(1):38-42.
- Raynor DK, et al. We are the experts: people with asthma talk about their medicine information needs. *Patient Educ Couns* 2004;53(2):167-74.
- Rene-Henri N, et al. Community pharmacists' interventions in asthma care: a descriptive study. *Ann Pharmacother.* 2009;43(1):104-11.
- Saini B, et al. Asthma disease management-Australian pharmacists' interventions improve patients' asthma knowledge and this is sustained. *Patient Educ Couns.* 2011;83(3):295-302.
- Schaffer SD, Tian L. Promoting adherence: effects of theory-based asthma education. *Clin Nurs Res.* 2004;13(1):69-89.
- Schatz M, et al. Development and preliminary validation of the Adult Asthma Adherence Questionnaire. *J Allergy Clin Immunol Pract.* 2013;1(3):280-8.
- Schatz M, et al. Persistent asthma defined using HEDIS versus survey criteria. Am J Manag Care, 2010;16(11):e281-8.
- Schatz M, et al. The minimally important difference of the Asthma Control Test. *J Allergy Clin Immunol*. 2009;124(4):719-23 e1.
- Smith A, et al. Depressive symptoms and adherence to asthma therapy after hospital discharge. *Chest*, 2006;130(4):1034-8.

- Smith JR, et al. Clinician-assessed poor compliance identifies adults with severe asthma who are at risk of adverse outcomes. *J Asthma*. 2005;42(6): p.437-45.
- Smith L, et al. The contribution of goal specificity to goal achievement in collaborative goal setting for the management of asthma. *Res Social Adm Pharm*, 2013;9(6):918-29.
- Snyder ME, et al. Collaborative drug therapy management: case studies of three community-based models of care. *Prev Chronic Dis.* 2015;12:E39.
- Sofianou A, et al. Asthma beliefs are associated with medication adherence in older asthmatics. *J Gen Intern Med.* 2013;28(1):67-73.
- Stern L, Berman J, Lumry W, et al. Medication compliance and disease exacerbation in patients with asthma: a retrospective study of managed care data. *Ann Allergy Asthma Immunol*. 2006;97(3):402-8.
- Tamura G, OhtaK. Adherence to treatment by patients with asthma or COPD: comparison between inhaled drugs and transdermal patch. *Respir Med.* 2007; 101(9):1895-902.
- Tan H, et al. Impact of asthma controller medications on clinical, economic, and patient-reported outcomes. *Mayo Clin Proc.* 2009;84(8):675-84.
- Tan X, Patel I, Chang J. Review of the four item Morisky Medication Adherence Scale (MMAS-4) and eight item Morisky Medication Scale (MMAS-8). *Innovations in pharmacy.* 2014;5(3):1-8.
- Touchette D. Medication compliance,adherence, and persistence: current status of behavioral and educational interventions toimprove outcomes. *JMCP* 2008;

2008(14):S2-S10.

- Tran N, et al. Patient reminder systems and asthma medication adherence: a systematic review. *J Asthma*. 2014;51(5):536-43.
- Trends in asthma morbidity and mortality 2012, American Lung Association.
- Ulrik CS, et al. The patient's perspective: adherence or non-adherence to asthma controller therapy? *J Asthma*. 2006;43(9):701-4.
- Unni E, Farris KB. Determinants of different types of medication non-adherence in cholesterol lowering and asthma maintenance medications: a theoretical approach. *Patient Educ Couns*. 2011;83(3):382-90.
- van Eijken M, et al. Interventions to improve medication compliance in older patients living in the community: a systematic review of the literature. *Drugs Aging.* 2003;20(3):229-40.
- Weinstein AG. Asthma adherence management for the clinician. *J Allergy Clin Immunol Pract*. 2013;1(2):123-8.
- Weinstein AG. Improving adherence to asthma therapies. *Curr Opin Pulm Med*. 2015;21(1):86-94.
- Weinstein AG. The potential of asthma adherence management to enhance asthma guidelines. *Ann Allergy Asthma Immunol*. 2011;106(4):283-91.
- Wiener-Ogilvie S, et al. Do practices comply with key recommendations of the British Asthma Guideline? If not, why not? *Prim Care Respir J*. 2007;16(6):369-77.

- Williams LK, Joseph CL, Peterson EL, et al. Patients with asthma who do not fill their inhaled corticosteroids: a study of primary nonadherence. *J Allergy Clin Immunol.* 2007;120(5):1153-9.
- Williams LK, Pladevall M, Xi H, et al. Relationship between adherence to inhaled corticosteroids and poor outcomes among adults with asthma. *J Allergy Clin Immunol.* 2004;114(6):1288-93.
- Wilson SR, et al. Shared treatment decision making improves adherence and outcomes in poorly controlled asthma. *Am J Respir Crit Care Med*. 2010;181(6): 566-77.
- Witry MJ, et al. Multiple Adherence Tool Evaluation Study (MATES). *J Manag Care Pharm.* 2014;20(7):734-40.
- World Health Organization Report 2003: Adherence to Long-Term Therapies: Evidence for Action. Chapter 7, 2003, Geneva, Switzerland: World health Organization.
- Yawn BP, et al. Adherence to Asthma Guidelines in Children, Tweens, and Adults in Primary Care Settings: A Practice-Based Network Assessment. *Mayo Clin Proc*. 2016;91(4):411-21.
- Young HN, et al. Barriers to medication use in rural underserved patients with asthma. *Res Social Adm Phar.* 2015;11(6):909-14.

Vita

Tatiana Makhinova was born in Potsdam, Germany. She received her Bachelor of Science in Pharmacy from Voronezh State University, Russia in June 2007. After working in the pharmaceutical industry and for the pharmacy chain, she decided to pursue an advanced degree in Health Outcomes and entered the Graduate School at The University of Texas at Austin. She received her Master's degree in 2014.

Permanent email: tatianamakh@gmail.com

This thesis was typed by Tatiana Makhinova.