Columbia Journal Publishing
Journal of Continuing Education and Professional Development
(2016) Vol. 3 No. 1 pp. 39-48
doi:10.7726/jcepd.2016.1004
Research Article

Examining Pharmacists' Knowledge, Skills and Self-efficacy when Counseling the Patient with Respiratory Disease

Eric C. Buxton[1*], Ruth H. Bruskiewitz[1], Karen J. Kopacek[1]

Received: 4 May 2016; Published online: 1 October 2016

Abstract

Objectives. Inadequate counseling may lead to poor adherence in patients with respiratory disease. This study was designed to examine the impact of a professional development program on pharmacist's knowledge, skills and self-efficacy to provide inhaler counseling.

Methods. Pharmacists participated in a live day long professional development activity consisting of morning lectures and an afternoon hands-on training session. Primary outcome measures included pre- and post-video critiques assessing the participant's knowledge, skills and self-efficacy with aspects of providing counseling to patients with respiratory conditions.

Results. Pharmacist knowledge, self-efficacy and perceived ability to counsel patients in the proper techniques for inhaler use significantly improved after the activity, suggesting value in using a combination of teaching strategies.

Conclusions. This program improved pharmacists' knowledge, skills and self-efficacy to counsel patients on inhaler use, with pharmacists indicating their commitment to make changes to their methods of counseling.

Practice Implications. A combination of teaching strategies for continuing professional development can lead to improved pharmacist knowledge, skills and self-efficacy, with pharmacists committed to improving their patient counseling techniques. Improvements in patient counseling will result in better adherence rates in their patients, thus leading to improved health care outcomes.

Key Words: Self-Efficacy; Counseling; Respiratory Disease; Continuing Professional Development; Pharmacy Continuing Education

1. Introduction

*Corresponding email: eric.buxton@wisc.edu
1 University of Wisconsin School of Pharmacy, Madison, Wisconsin

Asthma is a chronic inflammatory airway disease common in children and adults associated with significant morbidity and mortality (National Heart, Lung, and Blood Institute, 2007; Akinbami, 2016). The prevalence of asthma in the United States (U.S.) continues to increase, from 7.3% in 2001 to 8.4% in 2010, affecting approximately 25.7 million people (Akinbami, 2016). While there is no cure for asthma, effective treatments are available for acute and long-term control (National Heart, Lung, and Blood Institute, 2007; Global Initiative for Asthma, 2015). Evidence-based guidelines recommend daily use of controller medications to control symptoms and prevent exacerbations in patients with persistent asthma and the use of short-acting bronchodilators as needed for symptom relief, with both therapies delivered mainly by pressurized metered-dose inhalers (pMDIs) and dry powder inhalers (DPIs) (National Heart, Lung, and Blood Institute, 2007; Global Initiative for Asthma, 2015). In this patient population, medication adherence rates are reported to be no better than 50%, and poor adherence has been correlated with a decline in lung function, severe exacerbations, emergency department (ED) visits and hospitalizations, increased treatment costs, and mortality (Williams, 2004; Gillissen, 2007; Williams, 2011; Sumino, 2013; Engelkes, 2015; Barnes, 2015; Global Initiative for Asthma, 2015). Schlender et al. (2012) found that improving adherence to controller therapy could prevent up to 9 million unscheduled physician visits, 4 million ED visits, and 1 million asthma-related hospitalizations in the U.S. per year.

Another common respiratory disease that is preventable, treatable and progressive is chronic obstructive pulmonary disease (COPD) (Global strategy for diagnosis, management and prevention of COPD, 2016). A 2011 Center for Disease Control survey found that 6.3% of adults (approximately 15 million people) in the U.S. reported they had been diagnosed with COPD by a physician (Chronic obstructive pulmonary disease among adults-United States, 2012). Inhaled therapies are also useful in the treatment of COPD to reduce symptoms as well as the frequency and severity of exacerbations (Global strategy for diagnosis, management and prevention of COPD, 2016). Medication adherence in COPD may also be problematic; underuse of medications by patients may be due to forgetfulness, cost, or improper use of the inhaler devices.

There are multiple reasons for poor adherence to therapy but a patient's inability to use inhalers correctly is an important one. Despite the evolution and development of pressurized and breath actuated inhalers, there has not been a corresponding improvement in the patient's ability to use them (Fink, 2005; Dalcin, 2011). An estimated $25 billion is spent annually on inhalers; unfortunately 30-60% of doses are lost due to improper use (Fink, 2005). Asthma guidelines recommend that healthcare providers check inhaler technique at every visit by asking patients to demonstrate how they use the device and promptly correcting any errors in technique (National Heart, Lung, and Blood Institute, 2007; Global Initiative for Asthma, 2015). Research has demonstrated that patient adherence with inhaler use can be improved by education (Fink, 2005; National Heart, Lung, and Blood Institute, 2007; Lavorini, 2014; Global Initiative for Asthma, 2016), and pharmacists play a vital role as educators despite practice-based obstacles to counseling patients (Calis, 2004; Dalcin, 2011; Axelsson, 2012; Rifaat, 2013). Pharmacists are uniquely positioned to educate patients with respiratory disease because often they are the last healthcare provider seen by the patient before the inhaler is used. Furthermore, pharmacists see these patients on a more frequent basis. In one study, brief patient inhaler training (lasting an average of 2.5 minutes) completed by community pharmacists improved peak expiratory flow values and asthma-related quality of life (Basheti, 2007). Cain et al. (2001) demonstrated that a single

pharmacist training session can dramatically improve a community pharmacist's ability to demonstrate correct inhaler actuation. Basheti et al. (2009) further demonstrated that pharmacists who participated in a single workshop on proper inhaler technique could maintain their competency 2 years after training by continuing to provide inhaler technique education to patients. Pradel et al. (2007) examined factors affecting pediatric asthma counseling by pharmacists and reported that the majority of surveyed pharmacists did not take advantage of counseling opportunities even when they reported a positive attitude towards it. Primary obstacles encountered were lack of time, lack of parents' interest, and lack of placebo inhalers (Pradel, 2007). Another potential obstacle to providing inhaler education is the pharmacist who lacks the self-efficacy needed to counsel patients (Farris, 1999). Odedina et al. (1997) found that while self-efficacy was influenced in part through current behavior and attitude, periodic "refresher" courses could help pharmacists feel more confident in their general counseling abilities.

The objective of this study was to evaluate the impact of a continuing professional development activity on pharmacist's knowledge, skills and perceived self-efficacy (or comfort level) regarding inhaler counseling with the transfer of this learning to their practice setting. To accomplish this, participation in a continuing professional development program was designed to enhance the participant's perceived self-efficacy in the skills required to perform the necessary inhaler counseling.

2. Methods

Pharmacists who attended a professional development program organized and facilitated by the Division of Pharmacy Professional Development at the University of Wisconsin-Madison School of Pharmacy participated in this study. The program was offered at two different sites in the State of Wisconsin during the spring and summer of 2013. This study was approved by the University of Wisconsin-Madison Institutional Review Board and was deemed exempt from review because it did not constitute research as defined by the U.S. Department of Health & Human Services Office for Human Research Protections.

The continuing professional development activity, "An Update on Respiratory Diseases: Guidelines and Beyond," was presented by Pharmacy Practice Division faculty from the University of Wisconsin-Madison School of Pharmacy. Since a didactic approach alone has not been shown to increase a learner's confidence in his or her ability to perform a desired skill, the program used a combination of didactic and hands-on instruction (Odedina et al., 1997). Three morning didactic sessions reviewed asthma, COPD, and community acquired pneumonia guidelines and emerging treatment trends, followed by "hands-on" inhaler training sessions in the afternoon. Participants watched a 5-minute video of a pharmacist counseling a patient on the proper use of a pMDI, and were asked to critique the pharmacist's performance using a rubric to establish their baseline inhaler counseling skills and self-efficacy. Rubrics were collected after participants completed video #1, and hands-on instruction immediately followed. Pharmacists were instructed in small groups on the use of various pulmonary devices followed by a patient case study that required participants to apply clinical guidelines and inhaler teaching techniques. A total of six 20-minute stations allowed the pharmacists to practice using the pulmonary devices and to discuss important counseling tips associated with each device. Placebo inhalers and patient friendly handouts were provided for use during the training sessions and for future patient counseling. Table 1 provides a

brief description of each training station.

Table 1 Training Stations

Station	Pulmonary Delivery and Assessment Devices
1	pMDI, Respimat®, valved holding chambers
2	Diskus®, Flexhaler®, Pressair®, Twisthaler®
3	Aerolizer®, Handihaler®, Neohaler®
4	Nebulizers and compressors
5	Spirometry
6	Peak flow meters and asthma action plans

At the completion of the training sessions and patient case discussions, the participants were then shown a second video. The content of the two videos was identical; the only variation between the two videos was the use of a different set of actors. Participants used the same rubric to critique the inhaler training demonstrated in video #2, except that the second rubric included demographic and personal reflection questions.

After viewing each 5-minute video, participants ranked the pharmacist's performance on seven counseling points using a 5-point Likert scale (5 = Excellent and 1 = Poor). Aspects of patient counseling that were evaluated included conversation style and vocabulary, assessment of patient's baseline knowledge and understanding, instruction presented to the patient, and summary of key counseling points. Pharmacists were also asked to indicate their comfort level addressing four challenges in patient counseling using an 11-point Likert scale (10 = Extremely Comfortable and 0 = Not at All Comfortable). Challenges to patient counseling were time limitations, ability to use different teaching strategies to overcome learning barriers, patient disinterest in receiving counseling, and patient motivation to change. The pre- and post-video critiques were matched using the last four digits of the learner's phone number. The results were evaluated to identify changes in the learner's assessment of the counseling session and/or their self-efficacy with overcoming challenges to inhaler counseling.

The data were analyzed using Minitab 16 (Minitab Inc., State College, PA) with demographic information evaluated using chi square and two-sample t-tests. Because the evaluation responses represented an ordinal scale, a nonparametric procedure was used to evaluate the individual questions (De Muth, 2006). Results from the counseling assessment and comfort levels were analyzed using the Kruskal-Wallis test with adjustment for ties. All tests were performed with a 0.05 level of significance.

3. Results

A total of 40 pharmacists participated in the continuing professional development programs at the two offerings, with thirty-two participants (80%) completing the two video critiques. Several attendees did not attend the afternoon session (n = 1) or did not submit video critiques (n = 7). Of the 32 who submitted pre- and post-video critiques, the 15 males and 14 females (three did not indicate gender) were in pharmacy practice for an average of 30 years (range 8 to 55 years).

Study participants were asked to evaluate the two counseling videos using a rating scale rubric that included seven items. The pharmacist in each of the two videos made the same minor intentional mistakes while counseling the patient. Participants were not made aware that the content of the videos were the same; the mistakes made by the pharmacist in video #2 should have become more obvious to the participants following the device and patient counseling instruction. The results of the two pharmacist consultation critiques are summarized in Table 2. There were no significant differences in responses to any of the video critique questions.

Table 2 Comparison of video critique responses before and after instruction

Counseling Points [a]	**Video #1: Response Prior to Instruction (n = 32)** Mean ± S.D.	**Video #2: Response Post-Instruction (n = 32)** Mean ± S.D.	**Significance**
The pharmacist uses a conversational style and engages the learner.	4.2 ± 0.84	4.1 ± 0.91	p = 0.474
The pharmacist assesses the learner's baseline knowledge about their inhaler technique.	2.7 ± 1.18	2.6 ± 1.39	p = 0.823
The pharmacist chooses appropriate content and words throughout the consult.	4.0 ± 0.93	4.2 ± 0.81	p = 0.263
The pharmacist adapts the counseling information to account for the patient's lifestyle and daily routines.	2.4 ± 1.04	2.4 ± 1.08	p = 0.757
The pharmacist summarizes the key counseling points.	3.0 ± 1.26	3.1 ± 1.22	p = 0.910
The pharmacist addresses the learner's misunderstandings in a respectful way.	3.2 ± 1.22	3.4 ± 1.13	p = 0.365
How would you rate the pharmacist's overall counseling performance?	3.4 ± 0.84	3.5 ± 0.85	p = 0.378
[a]Based on a 5-point Likert Scale (1 = Poor and 5 = Excellent)			

With each video critique, participants were also asked to indicate their comfort level with four selected challenging aspects of patient counseling. As summarized in Table 3, there were significant positive differences in their responses to all questions.

Table 3 Comparison of pharmacists' counseling comfort level before and after instruction

How comfortable are you that you:

Questions[a]	**Response Prior to Instruction (n = 32)** Mean ± S.D.	**Response Post-Instruction (n = 32)** Mean ± S.D.	**Significance**
Are able to provide adequate counseling when time is limited?	5.0 ± 2.35	6.8 ± 1.95	$p < 0.0001$[b]
Can help learners who require additional teaching strategies to overcome learning barriers?	5.2 ± 2.40	6.6 ± 1.93	$p < 0.0001$[b]
Can engage learners who seem uninterested in receiving a medication consult?	5.3 ± 2.29	6.4 ± 2.09	$p < 0.0006$[b]
Can provide motivation to learners who are struggling with changes (such as medicines, conditions, lifestyle)?	5.9 ± 2.14	6.8 ± 1.73	$p < 0.005$[b]

[a]Based on an 11-point Likert Scale (0 = Not at All Comfortable, 5 = Neutral, and 10 = Extremely Comfortable)
[b] Significant, $p < 0.05$

Following instruction, the participants felt more able to provide counseling when time is limited (5.0 before instruction vs. 6.8 following instruction, $p < 0.00001$), more capable of helping learners who require additional teaching strategies to overcome learning barriers (5.2 vs. 6.6, respectively; $p<0.0001$), more able to engage learners who seem uninterested in receiving a medication consult (5.3 vs. 6.4, respectively; $p < 0.0006$), and better able to provide motivation to learners who are struggling with life changes (5.9 vs. 6.8, respectively; $p < 0.005$).

As shown in Table 4, participants were asked if the information presented (1) reinforced their current counseling practice/habits, (2) provided new ideas or information they expected to use, (3) improved their counseling skills, and (4) enhanced their current knowledge base.

Table 4 Responses to the post-instruction question: "The information presented (check all that apply)"

Response	**Number of times response was selected**
Reinforced my current counseling practice/habits	14
Will improve my counseling skills	24
Provided new ideas or information I expect to use	25
Enhances my current knowledge base	26

They could select any or all of the provided responses that applied to their learning situation. The responses were very positive with most participants indicating that the exercises improved their knowledge base, improved their counseling skills, and provided them with information that they expected to use. When asked if the information presented would cause them to make changes in their counseling, twenty-four of twenty-five participants (96%) responding to the question indicated yes. Two pharmacists indicated not applicable as they were retired from practice. When asked to rate their commitment to making changes in their practices using a 5-point Likert scale (5 = Very Committed and 1 = Not at All Committed), the average score was 4.2 ± 0.78, with a median score of 4.

4. Discussion

Patient counseling is an important component of a pharmacist's responsibility, especially for patients who use inhalers to manage a respiratory disease. More than 80% of pharmacists participating in this continuing professional development activity indicated that the information presented would prompt them to make changes to their current counseling techniques and made them feel significantly more confident in their counseling ability. Participants also indicated that they will be (1) more confident in providing counseling when time is limited, (2) of greater help to patients who require additional teaching strategies, (3) better at engaging patients who seem uninterested in receiving counseling, and (4) better able to provide motivation to patients who are struggling with life changes. Multiple studies have demonstrated that patient adherence with inhalers is improved by repeated training and education from healthcare providers (Fink, 2005; Lavorini, 2014; National Heart, Lung, and Blood Institute, 2016; Global Initiative for Asthma, 2016). Adherence has been defined as the extent to which a patient's behavior matches agreed recommendations from the prescriber (Horne, 2006). The World Health Organization recommends that healthcare providers have a good understanding of the complexity of patient adherence in the management of asthma (World Health Organization, 2003). Three types of non-adherence have been defined by WHO: erratic non-adherence, intelligent non-adherence, and unwitting non-adherence (World Health Organization, 2003; van Boven, 2015). Erratic non-adherence is the most common form of non-adherence and is often referred to as forgetfulness. In the case of pulmonary disease, the patient intends to be adherent to therapy but may not be successful with combining the medication regimen with his or her daily routine. A patient who deliberately alters, discontinues, or fails to start therapy is demonstrating intelligent non-adherence. Reasons for this type of non-adherence in patients with asthma or COPD may be fear of medication side effects, poor taste of an inhaler, cost of the device, or disagreement with the prescriber on the need for therapy. Unwitting non-adherence is described as the failure of a patient with pulmonary disease to understand the therapy regimen or forgetting all the steps to using a pulmonary delivery device.

All three types of non-adherence benefit from individualized interventions by pharmacists (van Boven, 2015). Not every type of non-adherence can be addressed by simply retraining a patient to use an inhaler correctly. Patients who exhibit erratic or intelligent non-adherence benefit from pharmacists taking time to assess their understanding about their medication regimen and providing advice on how to incorporate sometimes complex medication regimens into their daily routine. While no statistical difference was noted for counseling points between the two video critiques completed by participants, this activity demonstrates that pharmacists recognize important counseling techniques to address non-adherence. Studies have documented the benefits

of a single training session on pharmacists' skill with using inhalers (Cain, 2001; Basheti, 2009). What has been missing from previously published training sessions is an assessment of pharmacist self-efficacy in providing patient counseling beyond teaching inhaler technique. Our program utilized multiple training approaches to improve self-efficacy: review of current asthma guidelines, identification of important medication counseling points using a video, refresher on inhaler technique using placebo devices, and application of this information to a simulated patient case.

A key positive outcome of this training session was an increase in self-confidence in patient counseling. As reflected in Table 3, attendees reported a significant increase in their comfort level in all queried areas moving from the neutral ranking of 5.0 pre-instruction, toward the less neutral ranking of 6.0 in the direction of greater comfort, an increase of at least one point. This increase in comfort level should help the attendees incorporate patient screening on inhaler technique and patient education into their future consultations.

In summary, participants indicated that this program reinforced current counseling practices and habits while providing them with new skills, strategies and enhanced self-confidence to enable them to improve their counseling skills. The group as a whole demonstrated an overall increase in self-efficacy and desire to improve their practice skills. Our findings align with those of Basheti et al. (2009) and Cain et al. (2001), showing that a single instructional session can improve a pharmacist's ability to demonstrate correct inhaler technique. However, neither of the aforementioned studies examined or addressed pharmacists' self-efficacy in patient counseling. The results of this study add to the current body of knowledge regarding pharmacists' self-efficacy and inhaler technique training.

There are several limitations to our study. The first limitation was a small sample size that was not randomized. Some pharmacists who attended our program were retired from active pharmacy practice; due to their retired status, they may not have felt as confident in their counseling abilities as when they were practicing. Also, the participants were not asked how much of a role patient counseling played in their current position. Lastly, our study was intended to measure the immediate impact a single training session had on pharmacists' inhaler technique and self-efficacy with patient counseling; it was not intended to evaluate pharmacists' maintaining their competence in inhaler technique long term.

5. Conclusions

This continuing professional development activity demonstrated that focused instruction can improve the baseline knowledge, counseling skills and the self-efficacy of pharmacists such that they will be better prepared to counsel patients with asthma and COPD. The majority of attendees are committed to making changes that will improve their counseling techniques. It is hoped that greater self-efficacy in pharmacists will result in better adherence rates with inhaler use, thus leading to improved health care outcomes in patients with respiratory disease.

A combination of teaching strategies for continuing professional development can lead to improved pharmacist knowledge, skills and self-efficacy, with pharmacists committed to improving their patient counseling techniques. Improvements in patient counseling will result in better adherence rates in their patients, thus leading to improved health care outcomes.

Funding Source

None

Conflict of Interest

The authors report no conflicts of interest.

References

Akinbami LJ, Moorman JE, Bailey C, et al. (2012). Trends in asthma prevalence, health care use, and mortality in the United States, 2001-2010. Centers for Disease Control and Prevention NCHS Data Brief. No. 94, May 2012. Available at: http://www.cdc.gov/nchs/data/databriefs/db94.pdf

Axelsson M, Lötvall J. (2012). Recent educational interventions for improvement of asthma medication adherence. Asia Pac Allergy. 2:67-75. http://dx.doi.org/10.5415/apallergy.2012.2.1.67

Barnes CB, Ulrik CS. (2015). Asthma and adherence to inhaled corticosteroids: current status and future perspectives. Respir Care. 60:455-68. http://dx.doi.org/10.4187/respcare.03200

Basheti IA, Reddel HK, Armour CL, Bosnic-Anticevich SZ. (2007). Improved asthma outcomes with a simple inhaler technique intervention by community pharmacists. J Allergy Clin Immunol. 119:1537-8. http://dx.doi.org/10.1016/j.jaci.2007.02.037

Basheti IA, Reddel HK, Armour CL, Bosnic-Anticevich SZ. (2009). Long-term maintenance of pharmacists' inhaler technique demonstration skills. Am J Pharm Educ. 73: article 32. http://dx.doi.org/10.5688/aj730232

Cain WT, Cable G, Oppenheimer JJ. (2001). The ability of the community pharmacist to learn the proper actuation techniques of inhaler devices. J Allergy Clin Immunol. 108:918-20. http://dx.doi.org/10.1067/mai.2001.119153

Calis KA, Hutchison LC, Elliott ME, et al. (2004). Healthy people 2010: challenges, opportunities, and a call to action for America's pharmacists. Pharmacotherapy. 24:1241-94. http://dx.doi.org/10.1592/phco.24.13.1241.38082

Chronic obstructive pulmonary disease among adults – United States, 2011. CDC MMWR Weekly. November 23, 2012 61:938-43.

Dalcin PT, Grutcki DM, Laporte PP, et al. (2011). Impact of a short-term educational intervention on adherence to asthma treatment and asthma control. J Bras Pneumol. 37:19-27. http://dx.doi.org/10.1590/S1806-37132011000100005

De Muth JE. (2006). Basic Statistics and Pharmaceutical Statistical Applications. 2nd ed. Boca Raton, FL: Chapman & Hall/CRC:558.

Engelkes M, Janssens HM, de Jongst JC, Sturkenboom MC, Verhamme KM. (2015). Medication adherence and the risk of severe asthma exacerbations: a systematic review. Eur Respir J. 45:396-407. http://dx.doi.org/10.1183/09031936.00075614

Farris KB, Schopflocher DP. (1999). Between intention and behavior: an application of community pharmacist's assessment of pharmaceutical care. Soc Sci Med. 49:55-66. http://dx.doi.org/10.1016/S0277-9536(99)00078-7

Fink JB, Rubin BK. (2005). Problems with inhaler use: a call for improved clinician and patient education. Respir Care. 50:1360-74.

Gillissen A. (2007). Patients' adherence in asthma. J Physiol Pharmacol. 58 (suppl 5):205-22.

Global Initiative for Asthma (GINA). Pocket Guide for Asthma Management and Prevention 2015. Available at: http://ginasthma.org/wp-content/uploads/2016/01/GINA_Pocket_2015.pdf.

Global strategy for the diagnosis, management and prevention of COPD. Global Initiative for Chronic Obstructive Lung Disease (GOLD). (2016). Available at: http://www.goldcopd.org/.

Horne R. (2006). Compliance, adherence, and concordance: implications for asthma treatment. Chest 130:65S-72S. http://dx.doi.org/10.1378/chest.130.1_suppl.65S

Lavorini F. (2014) Inhaled drug delivery in the hands of the patient. J Aerosol Med Pulm Drug Deliv. 27:414-8. http://dx.doi.org/10.1089/jamp.2014.1132

National Heart, Lung, and Blood Institute, National Institutes of Health. National Asthma Education and Prevention Program. Expert Panel Report 3: guidelines for the diagnosis and management of asthma. NIH Publication No. 07-4051. (2007). Available at: http://www.nhlbi.nih.gov/health-pro/guidelines/current/asthma-guidelines/full-report.

Odedina FT, Hepler CD, Segal R, Miller D. (1997).The pharmacists' implementation of pharmaceutical care (PiPC) model. Pharm Res. 14:135-44. http://dx.doi.org/10.1023/A:1012032223328

Pradel FG, Obeidat NA, Tsoukleris MG. (2007). Factors affecting pharmacists' pediatric asthma counseling. J Am Pharm Assoc. 47:737-46. http://dx.doi.org/10.1331/JAPhA.2007.06138

Rifaat N, Abdel-Hady E, Hasan AA. (2013). The golden factor in adherence to inhaled corticosteroid in asthma patients. Egyptian Journal of Chest Diseases and Tuberculosis. 62:371–6. http://dx.doi.org/10.1016/j.ejcdt.2013.07.010

Schlender A, Alperin PE, Grossman HL, Sutherland ER. (2012). Modeling the impact of increased adherence to asthma therapy, PLOS ONE. 7:1-6. http://dx.doi.org/10.1371/journal.pone.0051139

Sumino K, Cabana MD. (2013). Medication adherence in asthma patients. Curr Opin Pulm Med. 19:49-53. http://dx.doi.org/10.1097/MCP.0b013e32835b117a

van Boven J, Trappenburg J, van der Molen T, and Chavannes N. (2015). Towards tailored and targeted adherence assessment to optimize asthma management. NPJ Prim Care Med. 25:15046. doi:10.1038/npjpcrm.2015.46. http://dx.doi.org/10.1038/npjpcrm.2015.46

Williams LK, Peterson EL, Wells K, et al. (2011). Quantifying the proportion of severe asthma exacerbations attributable to inhaled corticosteroid nonadherence. J Allergy Clin Immunol. 128:1185-91. http://dx.doi.org/10.1016/j.jaci.2011.09.011

Williams LK, Pladevall M, Xi H, et al. (2004). Relationship between adherence to inhaled corticosteroids and poor outcomes among adults with asthma. J Allergy Clin Immunol. 114:1288-93. http://dx.doi.org/10.1016/j.jaci.2004.09.028

World Health Organization (2003). Adherence to long-term therapies: evidence for action. http://www.who.int/chp/knowledge/publications/adherence_report/en/.