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REVIEW

Patient-centered care and its effect on outcomes in the treatment of asthma

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Abstract: Patient-centered care may be pivotal in improving health outcomes for patients with asthma. In addition to increased attention in both research and clinical forums, recent legislation also highlights the importance of patient-centered outcomes research in the Patient Protection and Affordable Care Act. However, whether patient-centered care has been shown to improve outcomes for this population is unclear. To answer this question, we performed a systematic review of the literature that aimed to define current patient-focused management issues, characterize important patient-defined outcomes in asthma control, and identify current and emerging treatments related to patient outcomes and perspectives. We used a parallel search strategy via Medline®, Cochrane Central Register of Controlled Trials, CINAHL® (Cumulative Index to Nursing and Allied Health Literature), and PsycINFO®, complemented with a reference review of key articles that resulted in a total of 133 articles; 58 were interventions that evaluated the effect on patient-centered outcomes, and 75 were descriptive studies. The majority of intervention studies demonstrated improved patient outcomes (44; "positive" results); none showed true harm (0; "negative"); and the remainder were equivocal (14; "neutral"). Key themes emerged relating to patients' desires for asthma knowledge, preferences for tailored management plans, and simplification of treatment regimens. We also found discordance between physicians and patients regarding patients' needs, beliefs, and expectations about asthma. Although some studies show promise regarding the benefits of patient-focused care, these methods require additional study on feasibility and strategies for implementation in real world settings. Further, it is imperative that future studies must be, themselves, patient-centered (eg, pragmatic comparative effectiveness studies) and applicable to a variety of patient populations and settings. Despite the need for further research, enough evidence exists that supports incorporating a patient-centered approach to asthma management, in order to achieve improved outcomes and patient health.

Keywords: patient-focused, patient outcomes, quality of life

Introduction

Asthma is a complex disease entity. Treatment and research efforts often focus on understanding its immunologic and pathophysiologic processes. However, managing asthma presents clinicians with therapeutic challenges beyond this microbiologic level, and involves collaboration among clinicians and patients. In 2006, Irwin and Richardson, reviewed the benefits and barriers to the implementation of patient-centered care and defined patient-focused care as merging patient education, self-care and evidence-based models of medical practice. They further stated the need to introduce more equality into the physician/patient relationship and to focus as vigorously on patients' knowledge, understanding and participation as we do

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on understanding the disease itself.[1,2] They identified four intervention areas: communication, partnerships, health promotion, and physical care, achieved using the "three Cs: communication, continuity of care, and concordance"[1] all of which incorporate a complex interplay of psychological and behavioral characteristics.[1–9]

Patient-centered care has been demonstrated to improve care for patients with chronic disease such as diabetes and even chronic obstructive pulmonary disease (COPD). Bodenheimer et al discusses the chronic care model's effect on chronic disease management using diabetes as an example in his 2002 meta-analysis of 39 interventional studies. He found that 32 of the 39 studies found at least one outcome or process measure improved and two-thirds of the articles additionally showed a reduction in overall costs.[10] The chronic care model embraces patient-centered care through the use of a comprehensive patient-centered medical home that considers the many barriers to access and successful execution of a care plan. In 2007, the American Academy of Family Physicians (AAFP), American College of Physicians (ACP), American Academy of Pediatrics (AAP), and Alpha Omega Alpha (AOA) all prioritized this concept of a patient-centered medical home.[11] In addition, many studies have reviewed specific approaches for intervention in diabetes self-management via educational programs.[12] For COPD, Adams et al performed a systematic review of the chronic care model and found that utilizing two components of this approach helped reduce hospitalizations and emergency department (ED) visits.[13]

Although asthma was represented to a smaller extent in some of these studies,[10] the question remains whether the patient-centered care concept, which provides a major component of the chronic care model, actually translates to improvement in asthma outcomes. Research to this point does not appear to sufficiently address patient-centered management therapies and techniques, nor are the research designs themselves adequately patient-focused. The increased attention to patient-centered care comes not only from clinicians, but also researchers and even in legislative efforts, as patient-centered outcomes are recognized as a priority in the Patient Protection and Affordable Care Act 2010.[14] To obtain increased resources for clinical, research, and policy efforts to improve patient-centered care for patients with asthma, it is imperative to critically review the existing literature for this patient population to determine what, if any, patient-focused outcomes are improved utilizing this approach. Thus, the objective of our systematic review is to assess the patient-centered approach to the treatment of asthma and to determine whether patient-focused care improves asthma outcomes.

Material and methods

We focused our review using the Medline® search strategy as our primary search engine and then complemented these findings with parallel searches as detailed below. In addition, we limited our review to adults and adolescents, as the care of children largely incorporates the beliefs and actions of the adult caregiver. The Medline search (1950–2010) included MeSH (Medical Subject Headings) terms in conjunction with "asthma": "patient perspectives", "patient satisfaction", "patient perception/patient goals", "patient centered care", "quality of life", "outcomes", "management" and "self-management", limited to "human studies" and "English language", and resulted in 2051 articles. Three independent readers (NQ, AP, VP) performed title and abstract reviews based on exclusion criteria (caregivers, children, asthma camps, asthma action plans, validations of questionnaires, editorials, studies involving small groups lacking easy generalizability, diseases other than asthma) and inclusion criteria (asthma, patient-centered care, adults, adolescents, English language). We also searched CINHAL® (Cumulative Index to Nursing and Allied Health Literature), PsycINFO®, and The Cochrane Central Register of Controlled Trials (2007–2011) databases, utilizing a parallel search strategy and a reference review of key included articles. We first performed a title and abstract review meeting key criteria, resulting in 945 total studies to be retrieved and assessed for final inclusion.

Studies included under these criteria were further subdivided to determine whether the study was primarily descriptive or intervention based. For those that were interventional studies, we extracted them to assess whether patient-focused results improved ("positive"), were equivocal ("neutral"), or did not improve ("negative"). For articles that included a combination of positive, neutral, and negative results, we characterized the article based on their stated primary outcome. If the primary outcome was unclear (as was the case in three articles), we brought them to a committee review and made a group decision on how the article in question should be classified. In the following sections we present the results of this literature review.

Results

Ultimately, 133 studies met all inclusion and no exclusion criteria. Over half were descriptive (75), and the remaining studies were interventional (58:44 positive, 14 neutral, 0 negative) (Table 1). The findings from our review are

described below and are structured around the themes that arose. We provide a summary of these findings in relationship to these themes in Figure 1.

Patient-focused management issues in the treatment of asthma

The first major theme involves issues with implementation of patient-focused care. Most of the studies that focused on this theme were descriptive (6), though the one intervention study favored patient-centered care.

Evidence and outcomes for patient-focused care of asthma

There is some evidence to support that providers employing the patient-centered approach in the management of asthma improve patients' perspectives of asthma control. Patient preferences for clinical encounters in disease states other than asthma were ascertained from patients through a questionnaire distributed in a pre-operative waiting room, which yielded an impressive 95% return rate, in a study designed by Little et al.[15] They discovered key aspects to care, including communication, partnership, and health promotion. Similarly, Flocke[16] identified four approaches to physician consultation interactions in his study in a primary-care practice in Northeastern Ohio: person-focused, bio-psychosocial, biomedical, and high physician control, and compared them with patient-evaluated quality attributes. With respect to patients with asthma, the patient-centered approach has been found to not only be something of interest to patients, but something patients are willing to pay for. Barner et al[8] looked into how much time and money patients are willing to put into an educational program to have their asthma control improved. They found that when patients were presented with a scenario of an 8-week asthma educational program, they were willing to spend a mean of 5.8 hours a week and $29.50 or more if they perceived a self-management program to be beneficial. Further, the patient-centered approach has been found to improve patient satisfaction, symptom burden, and outcomes even for difficult-to-treat patients and adolescents.[1,17] Villanueva et al[17] highlighted an intervention using a comprehensive asthma center and found that although initial costs increased, the long-term health benefits and cost savings made it worth it.

Barriers to patient-centered approaches

When studied, patients can provide insight into barriers interfering with the completion of their treatment plan. These barriers include discordance between patients and physicians on patients' needs versus physicians' underestimation of the patient's desire for disease-specific knowledge.[3,18] For instance, among patients with pulmonary diseases, information needs are not adequately met by physicians in the form of verbal and written information regarding diagnostics, cause of illness, prognosis, and use of long-term medication.[19] White and Sander[20] confirm this concept when looking at asthma severity, treatment, and medication side-effects. The authors found that although a majority (73%) of respondents mentioned side-effects of beta-agonists to their physicians, most were told this was to be expected. Because of this, a third (33%) of adults reduced their bronchodilator dose or frequency to avoid side-effects, and a quarter (24%) skipped doses without physician instruction.

Poor patient–clinician communication is independently associated with poor adherence.[21] Barry et al studied "patient agendas", an approach that allows for patients to express their feelings and opinions[22] and discovered unvoiced concerns regarding psychosocial stressors and omission of key biomedical information that resulted in unwanted prescriptions and nonadherence. Newcomb et al[23] identified patient barriers to successful asthma management, including a lack of communication from physicians in regards to daily asthma management (31%) and home management of asthma (24%). However, one-third of clinicians report they assist patients in decision-making (30%) and tailor medication schedules around patient routines (33%). Physicians do not recognize this breakdown in communication, compounding the problem further.[24] Despite this, patients with asthma seek continuity-of-care and guidance from their physicians, more so than other groups of patients.[25]

Adolescents' views of specific barriers differ compared to adults. Adolescence represents a transition to adulthood,[26] and asthma complicates this transition.[27,28] Psychosocial factors such as anxiety, depression, risk-taking behaviors, and family dysfunction, can complicate asthma control.[29] In a cross-sectional study by Rhee, adolescents with asthma cited barriers such as negativity toward providers and medication regimens, cognitive difficulties, peer/family influences, and denial.[6] Those with increased knowledge and self-efficacy experience less barriers, suggesting that psychosocial factors may be even stronger predictors of self-management obstacles in adolescents versus adults.

Characterizing specific and important outcomes in patients' perspectives of asthma control

As seen previously, patients seek an active role and identify barriers to their care. The second theme that

Table 1 Interventional studies

Study	Design	Intervention	Results: positive	Results: neutral	Results: negative
Positive					
Clark et al[7]	RCT	An intervention addressing gender roles was conducted 2 years prior, and they wanted to follow up to assess whether or not there were long-term effects on participants (originally assigned to control versus female-oriented intervention group).	Women in the intervention group saw a decrease in asthma symptoms: sexual activity ($P = 0.01$), less days off in winter ($P = 0.03$), improved self-regulation ($P = 0.02$), improved confidence ($P = 0.01$), and QOL ($P = 0.02$). Intervention group used less SABAs ($P < 0.05$).	Only significant difference in health care use was associated with scheduled office visits, no other significant health care use differences found.	
Villanueva, et al[17]	Cohort	Lahey Clinic Asthma Center (AC) was started in Burlington, MA in 1996 to improve management of patients with difficult to control asthma expanded treatment to mild-to-moderate asthmatics.	Use of >2 canisters of SABA in 3 months dropped after AC ($P < 0.001$). 32% reported good asthma control before AC versus 89% afterwards. Improvements in 6/7 QOL measures found, all significant.		
Van der Palen et al[49]	RCT	Self-management program where control group received equal education as intervention, except for the intervention group received self-treatment of exacerbations education.	Intervention group improved self-efficacy ($P = 0.036$). Self-treatment behavior in intervention group appeared to be sufficient $P < 0.001$.	Proper inhalation technique improved in both groups ($P = 0.041$). No change in self-reported compliance ($P = 0.08$). No change in self-reported compliance ($P = 0.37$). Both groups improved asthma-specific knowledge (95% CI 17.2–23.1).	
Onyirimba et al[68]	RCT	A study of patients with a lower SES, examining standard of asthma care versus the intervention group with direct feedback from a clinician.	Adherence increased to 81% in the intervention group and decreased to 47% in control group ($P = 0.0003$).		
De Vries et al[69]	Control trial	Three different asthma education programs conducted to identify if there were differences in patient satisfaction.	Satisfaction increased with length and intensity of training ($P < 0.001$) (for inpatient training).	Patient satisfaction different between outpatient and inpatient, with outpatient showing the least satisfaction.	
Pinnock et al[79]	RCT	One of three asthma review services (telephone versus face-to-face versus usual care).	Increased proportion of completed reviews (telephone > face-to-face, $P < 0.001$), with increased enablement ($P = 0.03$) and confidence ($P = 0.007$), and cost-per-review was lower ($P < 0.001$).	Morbidity was equivalent.	

Curtin et al[80]	RCT	An asthma game plan provided an automated system to both providers and patients regarding specific asthma-related items.	More patients reported having peak-flow meters and an asthma game plan ($P < 0.01$) in the intervention group. Asthma-related hospitalizations decreased to 60% in the intervention group. Total costs of admissions in intervention group decreased by more than 70%. Decrease of control group was only 3%.	
Van der Meer et al[81]	RCT	Using the nurse-controlled internet-based program to evaluate self-management versus usual care.	The Internet group improved adherence and ACQ score after a year in all three subgroups of asthma control ($P < 0.001$). The Internet group did better with adherence to ICSs in first 3 months ($P = 0.001$).	At 12 months, no differences in daily ICS use or LABAs.
Smith et al[84]	RCT	Inner-city ED acute asthma patients enrolled in either SPE or PCE.	A decrease in returns to the ED was seen in the PCE group and remained unchanged in the SPE group (OR 0.4 95% CI 0.2–1.1) at 4 months and 12 months (0.3 (0.1–0.9) and 0.3 (0.1–0.8) respectively).	Trend of better asthma control that was not significant.
Huang et al[85]	RCT	Evaluated individualized education versus usual care, with and without peak flow monitoring.	Individualized education groups showed higher asthma self-care competence scores ($P < 0.001$) and asthma self care and self-efficacy scores ($P < 0.001$). Using individualized education plus peak flow monitoring showed higher asthma self-care behavior and self-efficacy scores ($P < 0.001$).	No difference between the three groups in unscheduled health service usage.
Tousman et al[86]	Cohort	Adult asthma self-management program, evaluated with the introduction of an individualized portion.	Asthma knowledge increased. They evaluated this in two ways: quiz ($P < 0.01$) and schemas ($P = 0.002$). QOL improvement (total QOL $P = 0.001$) and also significantly in 4 specific QOL measures. Education also induced positive behavioral changes such as an increase in use of peak flow monitors ($P < 0.001$) and decrease in SABA use ($P = 0.002$) along with other improvements.	No significant differences in vital signs, PEF rate or daytime and nighttime symptoms.

(*Continued*)

Table 1 (*Continued*)

Study	Design	Intervention	Results: positive	Results: neutral	Results: negative
Shelledy et al[88]	RCT	Asthma management program evaluated by the provider giving the information: RT versus RN versus usual care.	RT- and RN-provided education led to fewer hospitalizations, decreased length of stay, lower costs, greater HRQOL scores versus usual care ($P < 0.05$).	Outcomes did not differ whether education was given from RT versus RN ($P > 0.05$). No differences in pulmonary function.	
Bruzzese et al[89]	RCT	Middle-school aged children and their caregivers were given individual and group education versus no intervention.	For those in the intervention group: Families were more able to solve problems together ($P < 0.05$). Children became more responsible for remembering medications ($P < 0.05$) and also took more steps to prevent worsening of their asthma, while controls declined in this ability ($P < 0.05$). Children experienced 67% reduction in night symptoms in past 2 weeks versus 19% increase in controls ($P < 0.01$).	No improvements in warmth/ hostility for family outcomes. Daytime symptoms did not improve.	
Martin et al[91]	RCT	Asthma education intervention involving home visits versus mailed education in African-American communities in Chicago.	Intervention group had: Higher asthma self-efficacy at 3 months ($P < 0.001$). Improved asthma QOL at 6 months ($P = 0.002$). Improved coping ($P = 0.01$) All compared with controls	The intervention group had nonsignificant improvements in behavioral and clinical outcomes.	
Cruz-Correia et al[94]	RCT	Comparison of the use of P'ASMA a Web-based asthma self-management versus standard written material.	More patients preferred to continue using the Internet program versus much fewer in the paper-based intervention ($P = 0.002$).		19 problems reported with P'ASMA.
Van der Meer et al[96]	RCT	Internet-based self-management program versus usual care.	Asthma control improved in the Internet group (adjusted difference –0.47 CI –0.64 to –0.30). At 12 months, although both groups improved in quantity of symptom-free days, there was more improvement seen in the Internet group (adjusted absolute difference of 10.9%, CI 0.05%–21.3%). Pre-bronchodilator FEV_1 improved in the Internet group and actually decreased in the usual care patients (adjusted difference, 0.25 L CI 0.03–0.46 L).	ARQOL improved in both (adjusted between-group difference, 0.38 with 95% CI, 0.20–0.56). No reduction in exacerbations.	

Sobel, et al[97]	Pre/post	Efficacy of the program Asthma 1-2-3 (low-literacy multimedia educational tool) looked at improving asthma knowledge in African-Americans.	Knowledge scores improved pretest to posttest for everyone ($P < 0.001$).	Low literacy improved scores the least ($P = 0.002$).
Joseph et al[98]	RCT	Internet asthma management program versus basic asthma website was evaluated in urban African-American teenagers.	At 12 months, treatment students reported: Fewer days with symptoms ($P = 0.003$). Fewer nights with symptoms ($P = 0.009$). Less missed school ($P = 0.006$). Improved activity ($P = 0.02$). Fewer hospitalizations ($P = 0.01$). All compared to control.	
Keith et al[102]	Cohort	Cohort of patients who were already on one controller was given montelukast to see if it made a difference in their allergic rhinitis and asthma.	Majority of patients received asthma control (76.1%). Asthma control improved via ACQ score ($P < 0.001$). Mini Rhinitis QOL questionnaire improved also ($P < 0.001$). Satisfaction of both patients and physicians also improved.	
Voltolini et al[104]	RCT	Evaluated efficacy of SLIT with birch pollen extract	Rhinorrhea and nasal obstruction improved in SLIT group ($P < 0.05$). Asthma symptoms also improved with SLIT ($P < 0.05$).	
Van Rensen et al[105]	RCT	Evaluated use of anti-IgE versus placebo after allergen challenge.	Anti-IgE group decreased inflammatory responses versus placebo ($P < 0.002$). Eosinophil sputum counts were less in the IgE group versus placebo ($P < 0.03$).	No significant differences for PC (20) methacholine test results found in either group.
Miller et al[106]	Cohort	Use of omalizumab in patients with "allergic asthma" to see if it improved asthma control and symptoms.	Omalizumab group had more controlled asthma ($P = 0.005$) and slept better ($P = 0.004$). The treatment group also was able to increase their activity level ($P < 0.001$).	
Basheti et al[109]	Cohort	Inhaler technique labels used by pharmacists in attempts to improve inhaler technique.	At 6 months, inhaler technique was better in intervention I ($P < 0.001$), and asthma was better controlled ($P = 0.0015$).	
Bender et al[110]	RCT	Evaluation of the use of an automated interactive voice response intervention telephone calls versus usual care.	Adherence improved using the telephone intervention ($P = 0.003$). Telephone intervention led to improvements in negative attitudes toward ICSs ($P = 0.003$).	No difference in QOL.

(*Continued*)

Table 1 (*Continued*)

Study	Design	Intervention	Results: positive	Results: neutral	Results: negative
Press et al[111]	Pre/post	Can patients with asthma and COPD learn how to use their inhalers properly, and does their technique and ability to learn differ between the two disease states?	Everyone regardless of disease could learn exactly how to use their device.		
Thomas et al[119]	RCT	Comparison between breathing training versus asthma education given by RNs.	At 6 months, breathing training seemed to improve QOL over asthma education given by RNs 0.38 units, 95% CI 0.08–0.68. Also, breathing training offered less anxiety and depression than asthma education by RNs (1.1, 95% CI 0.2–1.9, 0.8, 95% CI 0.1–1.4).	Breathing training had a trend to improve asthma control. No significant differences were seen at 1 month. No physiological changes were noted in breathing training.	
Janson et al[129]	RCT	Urban community randomized patients to either individualized self-management education or usual care.	Improved ICS adherence in the individualized education group ($P = 0.02$) that continued to the end of the study ($P = 0.03$). SABA use decreased more in the individualized self-management group as well ($P = 0.01$).		
Thoonen et al[130]	RCT	Self-management versus usual care groups were followed for 2 years.	The usual care group limited their activity more than the intervention group: 3.9 days (95% CI 0.5–1.9) versus 1.2 days (95% CI 2.5–5.4). Self-management group needed less inhaled ICSs ($P < 0.05$). QOL improved in the self-management group ($P = 0.055$).	FEV_1, FEV_1 reversibility and PC20 histamine did not change.	
Urek et al[131]	RCT	Evaluated different educational interventions utilizing: individual verbal instructions (IVI), written information (B), and asthma school (AS).	QOL improved in AS and IVI groups ($P < 0.001$) versus B group. PEF rate in IVI group improved in morning and the evening ($P < 0.05$ and $P < 0.001$) and PEF rate in AS group improved in the morning only ($P < 0.05$). Significant improvement in symptoms for all groups ($P < 0.001$).	All groups decreased use of SABA.	

Wilson et al[132]	RCT	Evaluated the use of a shared decision making (SDM) versus usual care model as an approach to asthma management.	Year 1: SDM group improved adherence ($P < 0.0001$) and ARQOL, health care use, medication use, asthma control, and lung function. Year 2: SDM had lower medication need and better adherence versus usual care ($P = 0.03$) for controller adherence, LABA ($P = 0.0143$), and higher cumulative dose ($P = 0.005$).		
Schaffer and Tian[135]	RCT	Evaluation of an experimental audiotape using the protection motivation theory approach to asthma self-management versus, standard asthma management booklet, using both or none.	Intervention groups improved adherence and declined in control groups at 6 months ($P = 0.02$).		
Ponieman et al[136]	Cohort	Impact of medication beliefs on adherence with ICS therapy in a cohort of inner-city asthmatics.	Belief that ICS use is important regardless of symptoms was the strongest predictor of using medications regularly (OR 4.5; $P < 0.001$). If one was confident in using the medications as they are supposed to, adherence improved (OR 2.4–3.5; $P < 0.001$).	Adherence steady across time. Majority of patients felt that use of ICSs was most important when symptomatic ($P = 0.06$), but this was not found to be associated with adherence ($P = 0.05$).	Many people were worried about using ICSs. In this study, most were concerned about side effects (49%), and 37% were concerned about addiction to ICSs. These two items were associated with low adherence ($P < 0.001$). If a regimen was found to be difficult to follow, less adherence was noted ($P = 0.04$).
Janson et al[148]	RCT	Evaluated an educational self-management intervention versus control care.	Intervention group improved adherence to ICSs ($P = 0.01$) and improved self-reported control of asthma ($P = 0.04$). Sputum eosinophils decreased in intervention group versus control ($P = 0.02$).	Trends to improvement in QOL for those in the intervention group ($P = 0.06$).	
Saini et al[149]	RCT	Evaluated the use of specialized asthma service in community pharmacies versus usual care.	In intervention group compared to control: Reduction in asthma severity ($P < 0.001$). Peak flow improved ($P < 0.001$). Decrease of SABA use ($P < 0.015$). Perceived control of asthma and asthma knowledge scores also improved.		

(*Continued*)

Table 1 (*Continued*)

Study	Design	Intervention	Results: positive	Results: neutral	Results: negative
Chervinsky et al[152]	RCT	Evaluation of the use of budenoside/formoterol 160/4.5 × 2 inhalations versus budesonide 160 × 2 inhalations + formeterol dry powder × 2 inhalations versus budesonide × 2, formoterol, or placebo, each twice daily.	Budesonide/formoterol improved AQLQ and asthma control variables ($P < 0.001$). Improvements were greatest in the budesonide/formoterol group versus placebo ($P = 0.001$). Budesonide/formoterol greater PSAM scores ($P < 0.001$).		
Hodder et al[154]	RCT	Efficacy trial of budesonide delivered via Respimat soft Mist inhaler versus turbuhaler dry powder inhaler.	Patients preferred Respimat versus Turbuhaler ($P < 0.0001$) and were more willing to use Respimat ($P < 0.0001$).		
Murphy et al[155]	RCT	Efficacy trial of budesonide/formoterol pMDI 80/4.5 microgram, budesonide pMDI 80 microgram, formeterol via dry powder inhaler 4.5 microgram, versus placebo.	Budesonide/formoterol pMDI improved AQLQ, and asthma control versus placebo ($P < 0.033$). Greater PSAM scores than any other treatment arm ($P < 0.004$).		
Price et al[157]	RCT	Evaluated the efficacy and QOL of salmeterol/fluticasone propionate versus an adjustable maintenance dosing of formoterol/budesonide.	Symptoms improved ($P = 0.034$), and there were less exacerbations ($P = 0.008$) when using the stable versus the changing dose.	AQLQ scores were no different at week 52 ($P = 0.121$).	
Knoell et al[160]	RCT	To compare a pharmacist-provided comprehensive education program along with care from a pulmonologist versus pulmonologist care alone.	Increased amount of patients in the pharmacist + pulmonologist group stated that they received information on asthma self-management ($P = 0.001$), and checked peak flows ($P = 0.004$). They also were more satisfied.	Both groups decreased their health care usage.	
D'Souza et al[161]	Cohort	Evaluated the adult "credit card" asthma self-management plan and whether it retains improvements originally seen at 6 months post-intervention at 2 years.	Significant improvement in all but one of the asthma morbidity measures.		
Buchner et al[163]	Cohort	Evaluation of an asthma educational intervention when compared with 12-month baseline of the same patients.	Less inpatient ($P < 0.01$) and less use of oral corticosteroids seen in the intervention group. Also, improvements were seen in the intervention group in: HRQOL ($P < 0.05$), satisfaction ($P < 0.05$), exposure to education, asthma knowledge, and confidence.		

Thoonen et al[172]	RCT	A tailored education program using a feedback instrument versus usual care.	Tailored education group showed a significant reduction in information need ($P = 0.005$) and improved patient versus the usual care group ($P = 0.000$).	
Sheth et al[173]	Cohort	Evaluation of the use of a dose counter with an Advair HFA via an MDI without a dose counter.	Patients were satisfied with the dose counter and found it helpful.	
Paasche-Orlow et al[93]	Cohort	Evaluated the efficacy of written and oral instruction at hospital discharge to see whether health literacy mattered.	Learning difficulty was not related to health literacy ($P = 0.33$) nor retention of instructions ($P = 0.35$). The intervention was successful regardless of level of health literacy.	
Equivocal/neutral				
Nokela et al[87]	RCT	Evaluated a usual care group versus an educational (written and oral) intervention group.	QOL improved in both groups but more so in the intervention group ($P < 0.05$).	Asthma Control Questionnaires (ACQs) improved ($P < 0.05$) in both, with more trends toward improvement in educational group versus usual control, but this was not significant, and since this was their primary outcome, they were grouped as equivocal.
Mehuys et al[90]	RCT	Evaluation of usual pharmacist care or a pharmacist intervention on inhalation technique and adherence.	Subgroup analysis showed improvement of asthma control for severe asthmatics versus usual care ($P = 0.038$). Those in the intervention group refilled their medications more often ($P = 0.016$). Inhalation technique improved in intervention group ($P = 0.004$).	Asthma control did not change in both study groups. No differences between the groups in severe exacerbations. No change in self-reported adherence. No change in ARQOL.
Mosnaim et al[99]	RCT	Use of MP3 health messages in inner-city asthma patients using celebrity asthma messages versus general health information between tracks.		Asthma knowledge scores were higher in the celebrity asthma message group versus general health information group. ($P = 0.05$).
Van den Bemt et al[100]	RCT	Assessing the effect of house dust mite impermeable covers.		House dust mite impermeable covers for pillows, duvets, and mattresses did not result in improved HRQOL.
Barnes et al[103]	RCT	Uncontrolled asthmatics either doubled their inhaled corticosteroid versus were given 10 mg of montelukast × 12 weeks.		PEF and QOL improved in both, and there was no change in inflammation in sputum.

(*Continued*)

Table 1 (*Continued*)

Study	Design	Intervention	Results: positive	Results: neutral	Results: negative
Riscili et al[107]	RCT	Evaluation of the affect of silent reflux on asthma control by giving emeprazole 40 mg twice daily versus placebo.		No improvement in asthma with GERD treatment.	
Lemaigre et al[162]	Cohort	To evaluate the effect of a shortened asthma self-management program versus control.	Asthma-related knowledge and hyperventilation symptoms improved initially, but this did not continue throughout the study.	Improvements in asthma symptoms were found in both groups.	
Ulrik et al[108]	Cohort	Those who received combined ICS/LABA therapy and failed to improve were randomized to either continue therapy as it was versus continuing therapy with the addition of compliance enhancement training.		Both control and intervention improved asthma control. Compliance enhancement training did improve achieving total control.	
Cowie et al[120]	RCT	Evaluation of an asthma program using Buteyko breathing technique versus control group.	Buteyko group reduced daily dose of ICSs ($P = 0.0002$) versus control ($P = 0.4$), but only for those participants who remained in the assessment, therefore bias may be present. Further, the sample size was small.	At 6 months, both groups improved asthma status. Both groups showed QOL improvement. $P < 0.0001$.	
Choi et al[121]	RCT	Assess the use of active acupuncture versus sham acupuncture versus waiting list.	QOL improved in the active acupuncture group.	No significant differences in PEF and FEV_1 were found.	
O'Connor et al[153]	RCT	Evaluation of fixed-dose budesonide/formoterol 160/2.5 × 2 inhalations twice daily versus fixed-dose fluticasone propionate/salmeterol twice daily followed by adjustable budesonide/formoterol versus remaining on fixed-dose fluticasone propionate/salmeterol.	Budesonide/formoterol group had higher satisfiaction versus fluticasone in two satisfaction parameters: symptom improvement ($P < 0.037$) and direct effects of medications ($P \leq$ to 0.02). Onset of effect improved with budesonide/formoterol regimen versus fixed dose fluticasone ($P < 0.002$).	No significant difference between the groups in AQLQ.	
Leidy et al[158]	RCT	Assessment of whether a patient can feel a medication working right away and their satisfaction with this perception utilizing budesonide/formoterol via MDI versus budesonide MDI.	Of those who did feel that their inhaler worked quickly, they also felt "positive airway sensations".	No significant differences in patient perception. No difference in satisfaction when sensitivity analyses were employed ($P = 0.162$).	
Cain and Oppenheimer[177]	RCT	Evaluated floating properties of three MDIs and how they compared.		All three MDIs had different floating properties that varied throughout the study.	

Van Schayck et al[156]	Cohort	Compliance and patients subjective opinion was measured in patients using autohaler versus MDI.	Nonsignificant trend of percentage of patients with a negative opinion toward MDI 38% versus 12% with autohaler; patient opinion about device type did not influence rates of compliance.	Adherence decreased when required to take the inhaler more times a day with the autohaler 90.8% and 78.5% ($P < 0.001$). Those who were on the medication longer and were supposed to take the medication more often had a negative influence on adherence ($P = 0.05$).

Abbreviations: ACQ, asthma control questionnaire; ACT, asthma control test; AQLQ, asthma quality of life questionnaire; ARQOL, asthma-related quality of life; CI, confidence interval; COPD, chronic obstructive pulmonary disease; ED, emergency department; FEV_1, forced expiratory volume in 1 second; GERD, gastroesophageal reflux disease; HFA, hydrofluoroalkane; HRQOL, health-related quality of life; ICS, inhaled corticosteroid; LABA, long-acting beta-agonist; MDI, metered dose inhaler; OR, odds ratio; P'ASMA, Portal for Asthma Self-management and Medical Assessment; PCE, patient-centered education; PEF, peak expiratory flow; PFT, pulmonary function test; PSAM, Patient Satisfaction with Asthma Medication questionnaire; QOL, quality of life; RCT, randomized control trial; RN, registered nurse; RT, respiratory therapist; SABA, short acting beta-agonist; SES, socioeconomic status; SLIT, sublingual immunotherapy; SPE, standard patient education.

arose was quantifying how patients' perceptions impact asthma control, by looking at patterns of adherence and belief systems. Again, this theme was mostly addressed by descriptive studies (28); though intervention studies found important outcomes with the use of tailored self-management educational programs in patients' perspectives of asthma control, adherence, and beliefs (5:3 positive, 0 neutral, 2 negative).

Adherence and age, personality, and socioeconomic status

Investigating adherence patterns offers insight into patients' perspectives.[30] Beginning with adolescence, decisions influencing adherence[31,32] are often directly related to perceived vulnerability.[33–36] Slack and Brooks,[37] found that despite positive attitudes toward taking medication for asthma ($P < 0.01$) and considering themselves compliant ($P < 0.05$), adolescents rarely discuss medications with pharmacists, and many wanted more control and additional information.[38] Similarly, Buston and Wood[39] showed only 8% of the adolescents interviewed reported compliance, with the remaining stating that at least one aspect of their treatment plan was forgotten or ignored most of the time.[39]

Adherence to asthma management plans for older adults adds complexity.[40] Studies have largely excluded this population; additionally Goeman et al acknowledged diagnosing asthma in older adults poses a problem when symptoms are attributed to comorbidities.[41] Unclear side-effect profiles (eg, long-acting beta2-agonists), psychosocial factors, costs of medication, and physical limitations all contribute to nonadherence in older adults. Simplification of medication regimens, clearly communicated instructions, with motivational incentives and actively involving patients, may improve adherence to asthma management plans. However, more studies are needed to see whether these interventions would affect adherence and health outcomes.

Additionally, personality traits may relate to adherence. Axelsson et al described the unintentional aspects of personality on adherence and found a significant relationship with negative affectivity and impulsivity on personality test[42] and poor asthma control in both men and women.[7] While the day-to-day applicability of this is unclear, personality traits further influence the need for individually tailored therapy plans.[43] Furthermore, several studies have shown patients who are anxious and depressed have worse asthma control[5] and quality of life,[9] in addition to the psychological stressors that impact patients with asthma.[4]

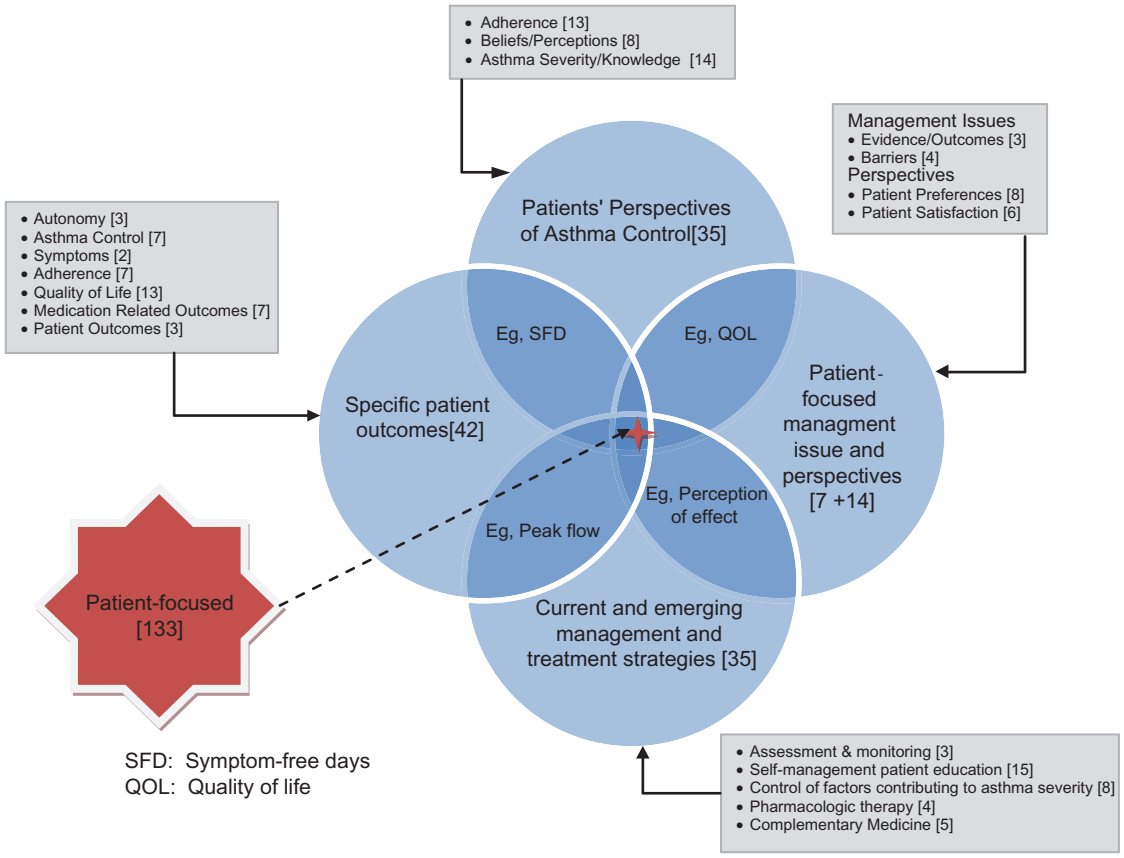

Figure 1 Themes of results regarding efforts to improve outcomes through patient-focused care in the management of asthma.

Beyond factors such as age and personality, Apter et al[21] aimed to identify specific factors that influence asthma severity by studying adherence to twice-daily inhaled corticosteroids (ICSs) and administered surveys to assess patients' understanding and monitoring of their disease. Their study, in fact, demonstrated harm to the patient as adherence to ICSs decreased. Certain factors were associated with decreased adherence such as: less than 12 years of formal education ($P < 0.001$), poor patient–clinician communication ($P < 0.001$), household income less than $20,000 ($P = 0.002$), Spanish as primary language ($P = 0.005$), and minority status ($P = 0.007$).

Beliefs and perceptions

Patients' attitudes toward their disease may influence when and where they seek care. There is ample evidence that many individuals solely seek acute care rather than primary care.[44,45] Haire-Joshu et al investigated attitudes and knowledge of low-income, African-American adults in an acute-care setting versus an outpatient private specialty clinic. They found the low-income group encountered daily stressors (such as transportation, finances, crime, and occupation) more frequently, and acute-care patients disagreed with the need for routine physician care (21 versus 2% of private-care patients, $P = 0.001$). They tended to try to "fight asthma attacks" themselves "rather than getting medical help", (75% versus 49%, $P = 0.01$) and subsequently delayed seeking care (58% versus 43%).[46] Haire-Joshu et al states that "patient perceptions are important barometers of likely patient action". Likewise, Sibbald[47] found that asthmatics with greatest morbidity delayed appropriate response to symptoms and that 25% expressed strong feelings of stigma and pessimism.

Loignon et al[48] recognized that patients adapted three different self-care strategies (controlling symptoms, preventing symptoms, or tolerating symptoms), and social factors contribute to which strategy is employed. Putting this idea into action, van der Palen et al[49] found that self-management programs influence positive behavioral changes in patients with asthma by randomizing them to an active control group versus a self-treatment group. All patients received self-management training, but the intervention group learned techniques for self-treatment. They found that only the self-treatment group showed improvements in self-efficacy,

social support, self-treatment and self-management behavior. Identifying how patients' cope with asthma may help clinicians understand how to focus visits.

Adolescent attitudes also lend insight into medication usage patterns. A survey of inner-city high school students evaluated the influence of psychosocial factors on management capabilities: 70% felt in control of their asthma symptoms, and 63% had feelings of anxiety.[50] Those who felt in control of their asthma were more likely to carry their asthma inhaler with them (r = 72, $P = 0.004$). Conversely, those who were embarrassed about their asthma were significantly less likely to do this (r = 0.98, $P < 0.001$), and only 39% admitted having asthma to friends. Psychosocial factors can either promote or limit self-management strategies, as adolescents that reported feelings of control over asthma symptoms had more positive attitudes toward self-treatment.[50] A video intervention assessment (VIA) used in adolescents can reveal physical and psychosocial environments and educate clinicians about day-to-day realities of patients.[51,52]

Asthma severity and knowledge

Patients differ in expectations of asthma management and views of asthma severity when compared with clinicians.[27,53,54] In a survey of adults with persistent asthma, perceptions of asthma severity and its impact on daily activities found suboptimal control in two-thirds (67%) and daily symptoms in a quarter (25%) of patients. However, daily symptoms did not correlate with reported asthma severity; 37% of patients with daily symptoms reported their severity as "mild". This disparity was also seen in descriptions of asthma exacerbations; physicians described exacerbations in terms of signs and symptoms, while patients focus on inability to perform activities. Finally, almost half (45%) of patients did not agree with their doctors' instructions to start controller treatment, indicating that patients' minimize their disease severity.[55] In another study, patients' perceptions of their ability to influence their asthma symptoms (eg, internal locus of control) related to their level of asthma control.[56] Choi et al showed that beliefs about disease severity influence asthma medication adherence[57] and found that beliefs did not differ based on asthma severity or current therapy. Recognizing what patients dislike about their medications gives the physician the opportunity for education as well as intervention to adopt a more inclusive approach when discussing asthma treatment plans. By addressing goals and expectations of asthma management, doctors and patients are more likely to accomplish improved control of asthma.

Further, descriptive studies find the belief that asthma is a periodic instead of a chronic disease infiltrates asthma self-care, but specific interventions focusing on reversing this myth are lacking. One simple question asked by Halm et al[58] "Do you think you have asthma all of the time, or only when you are having symptoms?", discovered that half (53%) believed they only had asthma when they were having symptoms. This belief was associated with a one-third decrease in adherence to ICSs when asymptomatic ($P < 0.02$). This dilemma was echoed by Jones et al study in correlating this belief with poor access to primary care services.[59] The psychological burden of near-fatal asthma,[60] along with this dichotomy between symptomatic and preventative treatment of asthma,[61,62] leads to poor understanding of disease and lack of ability to perceive severity.[63] Kendrick et al[63] investigated 255 patients with asthma from a general practice disease registry in Bristol to see if their perceived view of asthma severity matched peak expiratory flow measurements. Sixty percent of patients were unable to assess their level of asthma control accurately ($P > 0.05$), but the authors also state that although similar findings were previously noted, most were in controlled environments which likely differ from real-life situations. Adherence, whether the provider realizes this or not, is often negatively affected by the patients' perceptions of their symptoms and disease severity.[64,65] Whether concentrating educational efforts combating this view specifically affect patient outcomes needs to be further investigated.

While most patients value their health care providers' role in decision-making about asthma treatment plans, including patients in treatment decisions is crucial.[66] Patients desire a larger role, especially when respondents had better insight than clinicians into their own cost barriers and psychosocial factors. Ratcliffe's descriptive study found that all patients wanted their opinions regarding costs related to the visit and how they perceived their symptoms to be heard by their clinicians.[67] Also, direct patient feedback on corticosteroid use with a physician helps adherence and improves understanding of reasoning why patients stop medications,[68] providing a framework to tailor specific asthma educational interventions and action plans.[58] De Vries et al[69] used a multicenter study to investigate the different variants of an asthma educational program in adults with asthma to see whether patient satisfaction differed with various approaches. They discovered that as the intensity of the educational intervention increased, so did the satisfaction. It becomes clear that patient satisfaction and perspective should be addressed when formulating an asthma treatment plan, and that this needs to occur in conjunction with, instead of "for" the patient. More

studies will be needed in order to see whether this approach translates into improved patient health outcomes, more than just satisfaction, but collaboration appears to be key in creating coordinated, reliable, and feasible self-management strategies that not only coincide with asthma guidelines but function in the context of patients' lives.

Overview on the current and emerging treatment options for management of asthma

In this section, we highlight the third theme and provide an overview of current asthma treatment options as described in national and international clinical guidelines and systematic reviews. We also present emerging treatment options with an emphasis on patient-centered care. Of the 35 studies, most were intervention studies (31), of which most had favorable findings (21 positive and 10 equivocal). Studies ranged from 2007–2011 (since guidelines are current through March 2006).

Expert guidelines

The National Asthma Education and Prevention Program (NAEPP) of the National Heart Lung Blood Institute (NHLBI) aims to "help health care professionals bridge the gap between current knowledge and practice" by convening expert panels to prepare national guidelines (expert panel report, [EPR]) for the diagnosis and management of asthma.[70] They published three reports, the first in 1991 (EPR 1991)[71] and most recently in 2007 (EPR-3).[72] This report identified four components of asthma management: assessment and monitoring; patient education; control of factors that may contribute to asthma; and pharmacologic therapy.[72] Similarly, the Global Initiative for Asthma (GINA) formed in 1993 to disseminate up-to-date information about asthma care, published their first report in 1995.[73] The most recent 2006 guidelines emphasize the importance of a partnership between patient and caregiver in self-management.[74]

Reviews of asthma management

Several systematic reviews have evaluated asthma self-management. In our search, we found four reviews in the last decade. Two reviewed management strategies,[75,76] one evaluated patient-centered approaches,[77] and the fourth summarized pharmacological strategies for self-management of asthma exacerbations.[78] When searching for evidence of the four components of asthma management (EPR-3), all four addressed pharmacologic therapies, all but one addressed patient education, but none presented data on assessment and monitoring. Current and emerging therapies highlighted in these reviews are summarized in Table 2.

Current and emerging patient-focused treatment options for asthma

In this section, we review clinical guidelines and more recent studies updated since their publication, that address patient-focused management of asthma.

Assessment and monitoring

Guidelines recommend regular (≥twice yearly) review of asthma management. The EPR-3 guidelines emphasize elements of assessment and monitoring such as "severity, control and responsiveness to treatment". Standard assessment tools include focused histories and measurements of lung function, such as the examples provided here (Text Box 1).

Because there are multiple barriers to patients receiving regular review of their asthma, patient-centered approaches that decrease these barriers are needed. One novel approach looked at the effectiveness of routine asthma telephone check-ins and showed 26% more asthma patients' care was reviewed in a practical and cost-effective manner.[79] Another implemented a computer-generated reminder system to convey education that would encourage self-care.[80] An additional example used an internet program for weekly input by patients, with monitoring and treatment-adjustments by an asthma nurse-specialist. This tailored approach improved asthma control and adherence for the intervention group ($P < 0.001$ and $P = 0.001$ respectively).[81]

Self-management patient education

High-level evidence exists to support the need to provide asthma self-management education to ensure patients have skills necessary to control their asthma.[72] This education requires repetition and reinforcement, and the most recent

Text Box 1 Assessment and monitoring

- Focused history
  - Symptoms
  - Quality of life
- Medication review
  - Adherence
  - Side effects
  - Inhaler technique
- Lung function (spirometry)
  - Peak flow
  - FEV1
  - Airway responsiveness
  - FeNO

Table 2 Summary of current and emerging treatments by systematic reviews (2001–2006)

	Study			
	Green et al[75]	**Currie et al[76]**	**Peeble and Hartert[77]**	**Reddel and Barnes[78]**
Assessment and monitoring	N/A	N/A	N/A	N/A
Patient education	• Self-management plans/action plans	• Asthma action plans	N/A	Self-management action plans – tailored
Control of factors contributing to asthma severity	• Smoking cessation – Studies needed, but still recommended • Allergen avoidance – Improve asthma outcomes: studies inconclusive, larger studies needed – Prevent atopy/asthma (allergen control in infants reduces respiratory symptoms, but prevention not known) • Immunotherapy modest benefits, with ongoing concerns about safety; not recommended in UK – Breathing retraining (Buteyko) techniques rigorous trials not published, more work needed	• Allergen avoidance • Dietary manipulation • Buteyko	• Environmental control – Allergen skin testing (patients who are unaware of triggers or experience perennial symptoms) – Allergen avoidance (effective for allergic rhinitis and asthma) • Allergen immunotherapy • Vaccination	N/A
Pharmacologic therapy	• Mild intermittent – As needed short acting B2– agonists (SABA) • Mild Persistent – add low dose inhaled corticosteroids • Moderate persistent – Add long acting β-agonists (LABAs) – Increase dose of inhaled corticosteroids – Leukotriene antagonists – Theophylline (usually used only for patients with more severe asthma) • Severe persistent – Confirm diagnosis – Ensure persistent symptoms due to asthma (not other factors eg, rhinitis, reflux) – Assess compliance with existing therapy – "Step-up" pharmacologic therapy with high-dose corticosteroids along with long-acting agents (above) – Oral corticosteroids (OCS; use only if control not attained with prior efforts) – Corticosteroid sparing agents: methotrexate, gold, cyclosporine (each has some limited evidence of steroid-sparing effects; they all have concerns related to safety, should only be prescribed by specialists).	• Combined inhaled corticosteroids and long acting B2 agonist inhalers • Leukotriene receptor antagonists • Anti-immunoglobulin E • Anti-interleukin 5 and interleukin 12 Acute exacerbation • Magnesium • Leukotriene receptor antagonists • Non-invasive ventilation	• Treatment by severity → NAEPP	Exacerbations • OCS • ICS • Combination ICS/LABA • β-agonists • Anticholinergics • Antibiotics

(*Continued*)

Table 2 (*Continued*)

	Study			
	Green et al[75]	**Currie et al[76]**	**Peeble and Hartert[77]**	**Reddel and Barnes[78]**
Emerging/further study	• Novel pharmacological therapies – Anti-IgE monoclonal antibody (omalizumab; developed/ studied in moderate and severe allergic asthma also treated with inhaled corticosteroids) – Monoclonal antibody to interleukin-5 (early study no effect on FEV_1/airway responsiveness; further work needed) – Humanized recombinant interleukin-12 (in mild disease, no improvements in airway hyperresponsiveness; significant side effects for some subjects) – Interleukin-4 receptor antagonists (early studies demonstrate well tolerated, some benefit with respect to reversing deterioration in symptoms after withdrawal of inhaled corticosteroids, but not after asthma exacerbation; larger studies needed) • Targeted individualized therapy – Eosinophilic airway inflammation and hyper-responsiveness • Pharmacogenetics – B2-Agonist – Leukotriene	• Titrating treatment according to inflammatory biomarkers or airway hyper-responsiveness • Monitoring sputum eosinophils • Tailoring based on patients' genotype eg, polymorphisms (B2 adrenoreceptor or leukotriene C4 synthase)	N/A	• Community-based studies to clarify issues about therapeutic interventions for self-management of asthma exacerbations – Cost-effectiveness – Side-effects – Patient acceptability

Abbreviations: FEV_1, forced expiratory volume in 1 second; ICS, inhaled corticosteroids; LABA, long-acting beta-agonist; OCS, oral corticosteroids; SABA, short-acting beta-agonist; N/A, not addressed; UK, United Kingdom.

guidelines increased emphasis on written asthma action plans and awareness of cultural and health literacy factors in the delivery of asthma self-management education,[72,73] such as the items listed here (Text Box 2). Smith et al[82] noted that until recently, research on asthma education primarily focused on behavior change. They emphasize individual-centered rather than educator-centered education and suggest first identifying and acknowledging patients' individual concerns.[71]

Management programs for asthma may improve patient outcomes while reducing care costs; however, not all are equally effective. Reviews found that the highest level of evidence for success were found with self-monitoring tools (eg, symptom or peak-flow based) coupled with written action plans.[72,73,83] Newer studies continue to evaluate novel features of various self-management programs. For instance, patient-centered care is now recognized as important in providing high-quality care. Smith et al[84] performed a randomized trial evaluating a patient-centered versus standard patient education (SPE) and found subgroups in the intervention group benefited significantly more than the control group. Although this requires further study, patient-centered education may help subpopulations with asthma. Huang et al[85] evaluated an individualized program for older adults with asthma, and found that indicators of asthma control improved. Tousman et al[86] developed a "learner-centered" program that utilized homework assignments with "individual status reports" in weekly small group meetings; participants improved in knowledge, quality of life (QOL), and behavior change. Finally, Nokela et al[87] investigated the use of structured information along with monitoring (asthma diary). Asthma control improved significantly in the intervention group, indicating that a simple patient-driven tool may improve patient outcomes.

Text Box 2 Patient education

- Regular review of knowledge and control (see text box 1)
- Teach at all points of care about*:
  - Asthma disease information
  - Control
  - Symptoms/Triggers
  - Roles of medication
  - Skill-based self-management
- Encourage partnerships between patients, family and providers
  - Address concerns/barriers
  - Identify preferences
  - Develop treatment goals together
  - Encourage self-efficacy

*Tailor self-management education on needs and preferences of patient

Patient education can also occur outside the physician's office. Community settings, including home-based education as studied by Peeble and Hartert et al[77] who evaluated the use of respiratory therapists in a home management program, is one example. Also, school-based education programs are frequently used for children; however, Bruzzese et al[89] noted a paucity of interventions for adolescents with asthma, especially those aged 11–14. They found in their randomized school-based trial that the intervention group had decreased night-time symptoms and improved self-care behaviors. Pharmacists are another way to reach patients outside health care encounters. Mehuys et al[90] evaluated community pharmacist-led educational interventions and found that they improved adherence and technique with controller medications. One study[91] strove to improve self-efficacy for African-American adults with asthma through a community-based intervention with social workers, involving home visits (versus receiving education via mail), and found the intervention group improved self-efficacy, QOL, and coping.

Another important patient-centered issue related to patient education is the concept of health literacy (ability to understand and participate in one's health management). Patients with poor health literacy are at greater risk of worse health outcomes and increased hospitalizations,[92] and for patients with asthma, this can lead to lack of medication knowledge and inhaler technique.[93] Written educational materials and self-management tools may themselves be barriers; therefore, use of communication technology, such as web-based technology[94–96] and multimedia tools[93] may be useful in improving knowledge and self-management skills. Cruz-Correia et al[94] found that web-based intervention was feasible, safe, and preferred over paper-based formats. Van der Meer et al[95,96] found patients randomized to an internet-based self-management plus educational intervention versus usual care improved lung function and asthma control, even though exacerbations were unchanged. In African-American patients with low literacy, Sobel et al[97] found that a multimedia tool significantly improved participants' understanding of asthma, although at higher rates for patients with marginal and adequate literacy versus those with low literacy.

When tailoring self-management education, adolescents may be particularly amenable to technology. One study employed a web-based program targeting urban African-American high-school students and found that their tailored approach was not only economical and feasible, but also improved asthma outcomes.[98] Another used MP3 players to increase knowledge for inner-city African-American adolescents, and found that asthma knowledge improved in those randomized to the intervention group versus control.[99] Finally, van der Meer et al's internet-based self-management strategy found that adolescents with poor asthma control were more able to incorporate asthma self-management through an internet-based program for a long period of time, while those with good control were not.[95] This strategy may be particularly useful for this high-risk group of adolescents.

Control of factors contributing to asthma severity

Despite insufficient evidence that environmental strategies prevent the development of asthma, the guidelines recommend testing for exposure and sensitivity to allergens as well as reduction of allergen and respiratory irritant exposure for management of existing asthma, a brief summary is provided (Text Box 3). Studies continue to evaluate ways to minimize environmental and other triggers. Van den Bemt et al[100] evaluated the use of dust mite impermeable covers, but did not find improved health-related quality of life (HRQOL) for adults with asthma. In another study, Brodtkorb et al[101] evaluated the use of laminar airflow during sleep in adolescents with allergic asthma and found that it may add quality-adjusted life-years at a reasonable cost, but further work needs to be done to understand the full potential of this therapy.

Although asthma treatment is the subject of the next section, it is important to highlight that there are some pharmacologic therapies that are being studied to aid in decreasing effect of factors affecting severity of asthma, therefore they will be included here. In one study by Keith et al[102] montelukast was found to be effective as an add-on therapy for patients with dual diagnoses of asthma and allergic rhinitis, uncontrolled on ICSs or ICSs + long-acting beta-agonist (LABA) regimen(s), while another study found improvements in lung function and QOL without modification of effects by decreasing airway inflammation.[103] Voltolini et al[104] studied sublingual immunotherapy

Text Box 3 Control of factors contributing to asthma

- Evaluate for allergen exposures
- Test for sensitivity to allergens
- Reduce exposure to allergens
- Avoid exposure to respiratory irritants (eg tobacco smoke)
- Consider allergen immunotherapy for certain individuals
- Evaluate for co-morbid conditions that may interfere with asthma control
  - Gastroesophageal reflux disease (GERD)
  - Obesity
  - Rhinitis

for dual-diagnosed patients, and found promising results in the ability to step down asthma therapy (77% versus 0%, $P = 0.05$). Van Rensen et al[105] found the benefits of omalizumab (anti-IgE) in asthma may be due to a decrease in eosinophilic inflammation. Miller et al[106] then compared the ability to sleep, work, and participate in activities among patients with IgE-mediated (allergic) asthma. They received salmeterol/fluticasone combination with or without omalizumab, and found the omalizumab group was more than twice as likely to have controlled asthma (odds ratio 2.62; $P = 0.005$). These findings support the use of omalizumab as adjunctive therapy for patients with IgE-mediated (allergic) asthma and who have severe persistent asthma. Riscili et al,[107] however, did not find empiric treatment of "silent" reflux helpful.

Pharmacologic therapy

The guidelines provide up-to-date pharmacologic therapy recommendations, such as those listed here (Text Box 4). This section, therefore, will focus on patient-centered approaches to therapeutic advances, including use of respiratory inhalers and complementary and alternative medicine (CAM).

Respiratory inhalers

Because most asthma medications are delivered by respiratory inhaler devices, adherence to therapeutic regimens is complex, beyond the usual adherence challenges of motivation. Even with good intentions, if patients misuse inhalers, they may not receive an adequate dose, unknowingly decreasing adherence.

Text Box 4 Pharmacotherapy

- Long-term control medications
  - Inhaled corticosteroids (i)
  - Systemic corticosteroids
  - Cromolyn Sodium/Nedocromil (ii)
  - Imunomodulators
  - Leukotriene Receptor Antagonists
  - 5-Lipoxygenase Inhibitor
  - Long-Acting Beta2-Agonists (LABA)
  - Methylxanthines
- Quick-relief medications
  - Short Acting Beta-Agonists (SABA) (iii)
  - Ipratropium (iv)
  - Systemic Corticosteroids
- Devices
  - Inhalers
    - (A) Metered dose inhaler (i-iv)
    - (B) Breathe actuated MDI (iii)
    - (C) Dry powder inhaler (i, iii, iv)
  - Spacer/holding chamber (A)
  - Nebulizer(i-iv)

Numerous studies evaluate ability of patients to use inhalers and their preferences and several novel educational strategies aimed to improve skills related to use of medications. Ulrik et al[108] evaluated the use of asthma compliance enhancement training with the use of combination salmeterol/fluticasone propionate. This technique did not increase the likelihood of "total control". Another study utilized reminder labels applied directly to inhaler devices to remind patients of inhaler technique after education by pharmacists; this improved technique and asthma outcomes.[109] One study evaluated an interactive voice response intervention to improve adherence, and found the intervention group adhered 32% more frequently ($P = 0.003$).[110] Paasche-Orlow et al[93] looked at whether health literacy affected patients' abilities to learn and retain discharge instructions. Although baseline medication knowledge and metered-dose inhaler (MDI) technique were worse for patients with inadequate health literacy, patients were able to learn and retain tailored hospital-based education. Building on this work, Press et al[111] specifically evaluated a "teach-to-goal" strategy that utilized cycles of assessment and education of patients until they mastered the inhaler technique. By using these cycles of "teach-back" and education, 100% of patients, regardless of their level of health literacy, mastered the inhaler technique for both MDIs and Diskus devices, after at most two rounds of teaching.

Complementary and alternative health

CAM is defined as "a group of diverse medical and health-care systems, practices, and products that are not generally considered to be part of conventional medicine" by the National Center for CAM.[112] A prior review by Slader et al[113] found a wide range of prevalence estimates (4%–79%) for CAM use among asthmatics; the most common use being breathing techniques, herbal products, homeopathy, and acupuncture. Use does not differ by race or ethnicity.[114] Slader's review found that few studies have shown efficacy in asthma, and therefore conclusions are of limited use due to inadequate quality and small sample sizes.[113,115–121] At least one study reported adverse effects of use of herbal products for asthma management.[122] Thomas et al evaluated breathing exercises for asthma. While there was some signal that patient-centered outcomes such as QOL, nonpathophysiologic measures were improved, this technique is unlikely to reduce the need for pharmacologic therapies,[119] though one study found promising results.[120] The guidelines state that there is insufficient evidence to recommend/not recommend CAM, with two exceptions: acupuncture is contraindicated in the treatment of asthma (a recent study in 2010

also found no improvement in pulmonary function, though there was a "favorable effect" on QOL),[121] and certain herbal preparations are cautioned against for risk of potential harm secondary to either interactions with recommended asthma medications and/or they may be irritants. Most importantly, since up to half of patients do not report CAM use to their clinicians,[122] the guidelines recommend that clinicians specifically inquire about their patients' use of CAM and advise against substituting CAM for their clinicians' recommended treatment plan.

Identification and impact on specific patient outcomes

The following section expounds on studies specifying patient priorities in asthma care including autonomy, and how they affect asthma control, QOL, and patient outcomes. The fourth theme focused on patient-centered features of asthma management and resulted in 42 studies, half were descriptive (22), and half were interventions (20), with largely favorable results (16 positive, 3 equivocal, 1 negative).

Autonomy

Autonomy preferences vary among patients with asthma. Gibson et al examined decision-making and information seeking in relation to QOL.[123] Subjects recruited from pharmacies were compared with patients who were recently hospitalized for acute severe asthma. Both groups had QOL impairment, but this was greatest in the post-hospitalization group ($P < 0.05$), and as severity of the asthma exacerbation increased, the desire to make decisions decreased ($P < 0.05$). Although patients with asthma have strong preferences for joint decision-making, they do not want to be the sole decision-makers during an exacerbation. These findings are similar to those found in developing countries.[124] Further, Adams et al[125] also found that physicians' participatory style relates to patients' use of acute health visits and HRQL. Therefore, while autonomy is important when aiming for high self-efficacy, a balance between autonomy and the ability to use joint decision-making needs to be further explored.

Asthma control outcomes

Asthma control is considered the ultimate outcome for patients with asthma; patients' perspectives and adherence are directly related to this outcome. Holt et al[126] describes that although the majority (93%) of patients studied had suboptimally controlled asthma, most (76%) felt their asthma was well controlled and were satisfied (80%) with their control.

It has already been established by previous studies that educational programs for asthma patients result in improved control of asthma.[127,128] To study whether individualized asthma self-management improved markers of asthma control, Janson et al[129] performed a randomized control trial of individualized education with self-monitoring of symptoms and peak flow versus usual care. Patients in the self-management group maintained consistently higher ICS adherence levels, and had threefold greater odds of higher than 60% adherence. Thoonen et al[130] investigated whether self-management can provide a safe treatment strategy in general practice by randomizing patients to usual care (UC) or self-management (SM), and the SM group showed a mean of 78% successfully treated weeks per patient compared with 72% in the UC group ($P = 0.003$). Urek et al[131] studied the effect of different educational modalities in asthma control, QOL, and knowledge. Adults with moderate persistent asthma on ICSs received either individual verbal instructions (IVI), written information as an "asthma booklet" (B) or integrated asthma classes "asthma school" (AS). AS and IVI groups showed significantly greater improvement in QOL ($P < 0.001$) and asthma-related knowledge ($P < 0.001$) than the B group. The IVI, the most interactive group, produced the best response overall in both parameters of asthma control and QOL.[131] Similarly, Wilson et al[132] examined a shared decision-making model (SDM) and showed that mutual information sharing improved such factors as QOL.

Symptoms

One important measure of control is symptom burden. Clinical measures of outcome such as FEV_1 (forced expiratory volume in 1 second) and peak flow rates tend to be associated with acute episodes of asthma. This concept led to the development of the "symptom free day" (SFD).[133] However, since SFD assigns equal weights to symptoms which may not be accurate, McKenzie et al used discrete choice methods to study symptom-based outcome measures by assessing preferences of those with moderate to severe asthma. They showed that patients weigh daytime cough and breathlessness higher than other symptoms. Future studies need to explore preference-based weights for asthma symptoms for improved accuracy of the SFD.[133] Perceptual accuracy and its relation to treatment adherence has not shown a positive correlation thus far, but respiratory function variability (peak flow variability) within individuals has been correlated with increased symptom perception accuracy.[134] A specific tool, like peak flow, that provides a consistent framework for both patients and physicians to measure symptom severity is necessary.

Adherence

Patient characteristics that influence adherence were addressed above. However, adherence is an important measure of asthma control and therefore this element will be addressed in this section. The effects of asthma education on promoting medication adherence were examined by Schaffer and Tian[135] by randomly assigning patients to receive an experimental audiotape, a standard asthma-management booklet, both, or no intervention. Mean treatment adherence improved from 15% to 19% in the intervention groups and declined 22% in the control group over the course of 6 months, showing that education is a factor in adherence.

Many factors such as beliefs, attitudes, and experiences of patients influence adherence. Self-management necessitates some degree of active participation and motivation on behalf of the patient.[123] Ponieman et al[136] evaluated inner-city asthma patients' beliefs about their ICSs and showed these beliefs influenced adherence, further postulating that addressing modifiable beliefs improves adherence. Asthma patients with a high preference for involvement and information had nonadherence to medication and had a higher interest in self-management.[137] A follow-up study found that the patients' perceived burden of illness plays a more important role for education, self-management, and guideline adherence than the actual severity of the disease.[138]

Other factors that affect adherence outcomes with medical regimens include knowledge, attitudes, and self-efficacy.[139] Menckeberg et al's study[140] reiterated what was discussed in the adherence section but are more specific to the medication-related outcomes. Patients' perception of necessity and concerns about side-effects along with environmental factors further influence their attitudes and adherence. Osman[141] discusses how attitudes are affected by friends, family, and media as well as patients' personal experiences with medication characteristics. He proposes that "for most patients attitudes to medication will follow control of symptoms". By focusing on improving patients' control of symptoms and QOL, we will improve their attitude towards using medication.

Quality of life related outcomes

Psychosocial factors can also influence patient outcomes. Depressive symptoms and lower degrees of self-efficacy have been correlated with lower asthma-related QOL scores.[142–146] Calfee et al[147] found that greater perceived control was associated with improved physical health status, better asthma-related QOL, fewer days of restricted activity, and lower asthma severity scores. And although these differences were not mediated by changes in asthma practices, there was a significantly decreased prospective risk of ED visits and hospitalizations for asthma which is in contrast to previous studies[148,149] showing changes as a result of self-management programs. This discrepancy could be linked to inaccurate perceptions of asthma control. Clark et al[7] also found that QOL improves in women with asthma when a tailored educational intervention for women was employed. Also, Lloyd et al[150] found that people with the worst HRQL were willing to pay the least to avoid symptoms and asthma attacks. Clearly, there is significant influence of psychosocial factors on patient outcomes.

The Asthma Quality of Life Questionnaire (AQLQ) is one method to identify the causes of distress when patients present with acute severe asthma. Adults presenting to the ED with acute severe bronchoconstriction had severe impairment in asthma-specific QOL at baseline, but improved after treatment ($P < 0.00001$). By utilizing tools such as AQLQ, physicians can gain insight into how distressing the experience is for patients, both from a symptomatic and emotional perspective, while identifying the degree and cause of the distress.[151]

Medication-related outcomes

Current and emerging treatments were discussed above; however, patient outcomes related to use of these therapies will be summarized in this section. Objective measures of improved outcomes such as lung function are commonly used to assess the efficacy of medications. However, these changes may not reflect what patients value, therefore making patient-reported outcomes (PROs) vital to evaluating asthma therapies. Four articles compared PROs between dry powder and pressurized MDIs,[153–157] and one discussed features of inhaler devices that patients prefer.[157] Positive correlation to compliance has also been shown with low daily frequency of medication administration.[154] Patient-reported outcomes addressed were: HRQL[155] or QOL,[139,156] ability to sleep, work, and participate in leisurely activities,[117,139] asthma control,[117,139,155,156] patient satisfaction,[153–157] patient preferences,[156] and onset of effect.[156] Chervinsky et al,[152] in a double-blind controlled study of adults with moderate-to-severe asthma, studied PROs on differing doses/combinations of budesonide and/or formoterol pMDI. They found that the group receiving combined budesonide/formoterol reported significantly greater improvements on the AQLQ(S) and asthma control variables ($P < 0.001$), improved Patient Satisfaction with Asthma Medication Questionnaire scores, and Physician-Patient Global Assessment. O'Connor et al[153] looked at the outcome of onset of effect in adjustable versus fixed

doses of budesonide/formoterol compared with fluticasone/propionate/salmeterol and found a higher reported onset of effect in the budesonide/formoterol group. Finally, Price et al[157] evaluated salmeterol/fluticasone (stable-dose) versus formoterol/budesonide (adjustable maintenance dosing) and found that the former resulted in significant improvements, including increased symptom-free days, decreased rates of exacerbation, and better HRQL.

The question of quick onset of effect of maintenance therapy was addressed by Leidy et al.[158] They found 87% who perceived their inhaler working right away identified sensations of easier breathing, and propose if patients feel maintenance therapy works right away, this may provide positive reinforcement and improve adherence. Further studies on this topic are necessary, as perception may be one key to improving adherence. Tying all this together, a study by Schatz et al[159] looked at the ratio of controller medication to total asthma medication use and its relation to patient-centered outcomes in adult HMO members with persistent asthma. Patients with a ratio of ≥0.05 had mean asthma QOL, asthma control, and symptom severity scale scores that were significantly more favorable ($P < 0.0001$). The authors concluded that the study provided support for the use of the medication ratio as an asthma quality of care measure.[160]

Patient outcomes

D'Souza et al[161] evaluated the long-term effectiveness of self-management plans with the adult "credit card". There was a significant improvement in all but one asthma morbidity measure (>7 days out of action). The proportion of "waking most nights" in the previous 12 months decreased from 29% to 9% ($P = 0.02$), emergency visits to GPs decreased from 43% to16% ($P = 0.001$), ED visits decreased from 19% to 5% ($P = 0.02$), and hospital admissions decreased from 17% to 5% ($P = 0.04$). Similarly, Lemaigre et al[162] showed that even a shortened asthma self-management group program could produce effects on knowledge and asthma symptoms; however, these effects did not persist significantly after 3 months. Lastly, a guideline-based asthma management program within a managed care organization showed statistically significant improvements in patients' HRQL, satisfaction, education, disease knowledge, and confidence in ability to manage their disease.[163]

Patient-focused perspectives

In this section we review the final theme highlighting patient perspectives on asthma management plans and resulting patient satisfaction. Fourteen studies explored this theme, most (11) were descriptive; of the 3 intervention studies, the findings were mostly in favor of patient-centered care (2 positive, 1 equivocal, 0 negative).

Patient preferences

Ultimately, patient preferences are an important aspect of asthma management. Ulrik et al[164] asked patients to rank three treatment models according to preferences: 1) fixed daily-dosing of controller therapy; 2) fixed dosing of controller medication, with written plan outlining adjustment during worsening; 3) or daily-dosing of low-dose combination reliever/controller medication with this inhaler used as needed until control of symptoms occurred. The first model was preferred, and the distribution of preferences mirrored how patients already reported taking their medication. More than half of patients took less medication than prescribed when having fewer symptoms. There was no significant association between self-perceived severity of asthma and the response to therapy in case of exacerbation. These findings illustrate that patients' strategies of management when encountering disease variability are not necessarily driven by their knowledge of disease but more by preferences towards specific strategies.[164]

Another aspect of self-management involves increasing awareness of worsening of disease. Tools to identify patient responses to worsening of their asthma and the reasons for their particular responses need to be improved. While patients prefer monitoring symptoms to peak flow measurements (PFM), likely because of ease[161] (only 10%–16% of patients report use),[63,165] neither method is perfect. Symptom monitoring lacks objectivity, while peak flow monitoring can be impractical at times. However, preferences for symptom monitoring, despite increased objectivity with PFM[166] demonstrates that ease of self-management and simplification of care regimens are patient preferences[167] of which clinicians need to be aware. Preferences for both education content and modality have also been studied and reveal the Internet and telephone as a preferred means for communication with an information provider.[168]

Incorporating patients' preferences when it comes to treatment decisions has been shown to improve disease management.[169] McTaggart-Cowan et al[170] evaluated treatment preferences in terms of risk/benefit tradeoffs using discrete choice experiments and found the relative importance of six attributes of asthma therapy. Patients preferred a treatment regimen that resulted in more SFDs but were willing to forgo some of this benefit in exchange for a more convenient regimen. Furthermore, gender, age, asthma control, and high socioeconomic status were statistically significant predic-

tors of maintaining current asthma therapy.[170] This provides useful information for physicians when designing management plans, as every patient has a unique risk–benefit ratio secondary to these factors.

Patient satisfaction

A tailored approach to management appears to be a key element to patient satisfaction. Studies have examined patient satisfaction from education provided in different settings.[67,171] In another study performed by Thoonen et al,[172] patients in a tailored education group had patient satisfaction increase, whereas there was no change in usual care group. Providing patients with tools to evaluate and highlight their own needs and demands was associated with an increase in patient satisfaction. Little et al[169] found communication aimed at understanding the patients' needs and fears is crucial to patient centeredness. To provide patients with asthma education that they perceive as being relevant to themselves, we have to make our educational interventions both accessible and in accordance to their needs. Preferences for different styles to asthma education according to extent of teaching and intensity showed a significant positive linear association between intensity of the education program and effect on asthma knowledge and HRQL.[69]

This same idea can be applied to specific medication devices; this resulted in one study that examined patient preference for a dose-counter.[173] Although patients must keep track of doses to determine when to replace their MDIs,[173] 63% do not realize that they are supposed to keep track of the number of actuations,[174] and 54% of patients do not know the number of actuations for their inhalers.[175] Patients use various inaccurate methods to determine MDI depletion,[176,177] and may then provide "doses" that contain less therapeutic medication.[178] Patients using their MDIs past the recommended number of actuations compromise their disease control.[179] Sheth et al[173] found that 95% of patients were satisfied with the counter, 92% agreed that it would prevent them from running out of medication, 73% felt the MDI dose-counter would help improve control of their disease, and 92% felt added reassurance about medication supply. By focusing efforts on innovations that make the use of medications easier, the authors propose we can potentially improve efficacy of and adherence to those treatments and consequently asthma control.

Conclusion

Our review aimed to answer whether patient-centered care improves patient-focused outcomes for patients with asthma. We hypothesized that in order to achieve improved patient outcomes, it is vital to incorporate a patient-centered approach to asthma management, and that clinicians' should expand from managing the disease according to guidelines, to collaborating with patients to self-manage their disease. Our review cited 133 total articles addressing this issue with the majority (43/60) of the intervention studies favoring a patient-centered approach. Many of these studies were in specific patient populations, making these data difficult to generalize, and the interventions themselves may be difficult to implement globally. Therefore, to better answer this question, improved research strategies that incorporate patient-centered techniques will need to be conducted, along with increasing clinician awareness and policy changes.

Current barriers to self-management of asthma can be addressed by patient-centered care, and through novel approaches, we can provide education and expand multimedia tools that better tailor treatment to include psychosocial factors. In addition to patient education, approaches to monitoring, such as checking in via telephone, help to provide patient-focused care in a practical and cost-effective manner.

Providers may perceive their own barriers clashing with the ideals of patient-focused care, such as time limitations and adaptations; however, Clark et al[180] proved that patient-centered care is a learned skill and can be provided without requiring greater time spent with the patient. While these studies are promising, they alone will not change the type of care patients receive without greater efforts to implement those changes. Further, benefit to the provider as far as improved satisfaction and decreased malpractice has been found.[1,2]

Future patient-centered research studies should investigate feasibility and strategies to implement patient-centered care for a host of patient needs, and should themselves be patient-focused. Without incorporating our patients' viewpoints and insight into treatment plans, suboptimal adherence and patient outcomes are likely.

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