Interventions to Improve Outcomes for Minority Adults with Asthma: A Systematic Review

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OBJECTIVES: To systematically review the literature to characterize interventions with potential to improve outcomes for minority patients with asthma.

DATA SOURCES: Medline, PsycINFO, CINAHL, Cochrane Trial Databases, expert review, reference review, meeting abstracts.

STUDY ELIGIBILITY CRITERIA, PARTICIPANTS, AND INTERVENTIONS: Medical Subject Heading (MeSH) terms related to asthma were combined with terms to identify intervention studies focused on minority populations. Inclusion criteria: adult population; intervention studies with majority of non-White participants.

STUDY APPRAISAL AND SYNTHESIS OF METHODS: Study quality was assessed using Downs and Black (DB) checklists. We examined heterogeneity of studies through comparing study population, study design, intervention characteristics, and outcomes.

RESULTS: Twenty-four articles met inclusion criteria. Mean quality score was 21.0. Study populations targeted primarily African American (n=14), followed by Latino/a (n=4), Asian Americans (n=1), or a combination of the above (n=5). The most commonly reported post-intervention outcome was use of health care resources, followed by symptom control and self-management skills. The most common intervention-type studied was patient education. Although less-than half were culturally tailored, language-appropriate education appeared particularly successful. Several system-level interventions focused on specialty clinics with promising findings, although health disparities collaboratives did not have similarly promising results.

LIMITATIONS: Publication bias may limit our findings; we were unable to perform a meta-analysis limiting the review's quantitative evaluation.

CONCLUSIONS AND IMPLICATIONS OF KEY FINDINGS: Overall, education delivered by health care professionals appeared effective in improving outcomes for minority patients with asthma. Few were culturally tailored and one included a comparison group, limiting the conclusions that can be drawn from cultural tailoring. System-redesign showed great promise, particularly the use of team-based specialty clinics and long-term follow-up after acute care visits. Future research should evaluate the role of tailoring educational strategies, focus on

patient-centered education, and incorporate outpatient follow-up and/or a team-based approach.

KEY WORDS: asthma; disparities; interventions; culturally tailored.

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INTRODUCTION

Despite increasing national efforts over several decades, health disparities are widening for numerous illnesses and chronic diseases. The Healthy People initiative began in 1979 with the Surgeon General's Report, followed by Healthy People 2000 and 2010, with Healthy People 2020 currently under development.¹ Although the goal of Healthy People 2010 was to challenge "individuals, communities, and professionals...to take specific steps to ensure that good health, as well as long life, are enjoyed by all,"¹ this need has not been met for minority patients with asthma in the United States (US).

Currently, almost 20 million Americans have asthma, and by the year 2020, asthma is expected to affect 1-in-14 Americans.² Asthma is responsible for a substantial proportion of health care utilization, including outpatient visits (over 10 million),³ emergency department (ED) visits (over 1.5 million)⁴ and hospitalizations (over 400,000 annually) nationally.⁵ This care is costly, with greater than \$30 billion spent annually in the US.⁶ Besides direct costs of treating asthma, missed work days are also non-trivial, with greater than 14 million days missed annually.⁷

Minority patients, however, assume a greater proportion of burden from asthma. African Americans with asthma suffer greater morbidity and mortality, with higher rates compared to whites of ED visits (350 %), hospitalizations (240 %), and mortality (200 %).⁷ Also, within ethnic populations, disparities exist. For instance, the Puerto Rican population has higher prevalence than any other racial or ethnic group, including African Americans.^{7,8} Canino et al. has attributed the root cause of these disparities to a multitude of factors, including individual, environmental,

provider and health system components that may all play an inter-related role.⁹

It has been well documented that a disproportionate number of minority patients have low health literacy, placing them at higher risk for poor health outcomes.¹ Further, environmental factors, such as neighborhood context, pollution and allergens have also been implicated.⁹ At the provider and health care system-levels, access to care, provider beliefs, and cultural sensitivity may all play a role. All of these inter-related components are also affected by the policy context in which they exist. For instance, patient-centered medical homes (PCMH) have been a recent area of interest by both policy makers and medical professionals and may play an increasingly important role in addressing disparities.¹⁰

Because of the multitude of factors that may play a role in perpetuating health disparities for minority patients with asthma, it is important to critically evaluate the scope and target of interventions that aim to improve care for this population. Although hundreds of studies have evaluated individual components of asthma management including educational and system-level approaches to improving health outcomes related to asthma, there is a dearth of studies that are culturally tailored, or that even include a majority of non-White study participants. Through a systematic review of what limited literature exists, clinicians, health care organizations, communities, patients, and policymakers can understand which interventions are likely to be successful in addressing and decreasing health disparities and will identify what gaps remain for future work in this area. Therefore, the aim of this review is to systematically review the literature to answer the following question: what interventions work best to improve outcomes for minority adult Americans with asthma?

METHODS

Initial Search

In consultation with a biomedical librarian, we conducted an electronic search of the English literature in Medline from 1950 to Fall 2010 by exploding Medical Subject Heading (MeSH) terms related to asthma (e.g., respiratory inhalers, anti-asthmatic agents) combined with terms to identify studies focused on minority populations (e.g. MeSH “Minority Groups” and keyword “dispari*mp”) and with terms to identify intervention studies. [Text Box 1] Please refer to the technical web appendix in the introductory paper by Chin et al. for recommended search strategies for interventions to reduce racial and ethnic disparities in health care.¹¹ We conducted parallel searches in PsycINFO and CINAHL. To identify additional studies that may not have been included in these search results, we reviewed the Cochrane database of interventions and all references from included studies. Finally, an expert reviewer evaluated the included references to ensure key articles were not inadvertently missed. To explore publication bias, we reviewed meeting abstracts from 2009

and 2010: American Thoracic Society, American Academy of Allergy, Asthma and Immunology, and the Society of General Internal Medicine, for studies that may not have yet been published or were not published due to negative findings.

Text Box 1: Medline search strategy

Medline search strategy:

[(Asthma or Pulmonary Disease, Chronic Obstructive) or (Nebulizers and Vaporizers or Bronchodilator Agents or Anti-Asthmatic Agents or inhaler)] AND [(Minority Groups or Ethnic Groups or Hispanic Americans or minority or African American or dispari or Asian Americans or Indians, North American or Continental Population Groups or African continental ancestry group or American native continental ancestry group or Asian continental ancestry group or oceanic ancestry group or brazil [United States] or Portugal [United States] or Arabs [United States, or Inuits or United States or Healthcare Disparities or Health Status Disparities or Minority Health or health*adj3 disparit* or underserved)] AND [(intervention or Intervention Studies or evaluation studies or Evaluation Studies or evaluat* or Disease Management or Case Management or health interventions or Health Knowledge, Attitudes, Practice, or Health Education, or health program or Health Promotion)] limited to the English language, humans and adults.*

Inclusion criteria were: 1) adult population (age 18 or older); 2) intervention studies with greater than 50 % minority participants or with a subset analysis of minority patients by race/ethnicity were included; and 3) intervention studies affiliated with a health care delivery setting (i.e., outpatient clinic, ED, hospital). We limited our search to adult populations because the Finding Answers program has previously published on interventions to address disparities for care of minority children with asthma.¹² While community interventions are an important part of an overall disparities reduction strategy, the current paper focuses on interventions that occur in or have a sustained linkage to a health care delivery setting. Only studies that took place in the United States and published in English language were included. All study designs were included.

Article Selection

Following the initial searches, duplicates were eliminated and a title and abstract review was performed whereby each

article was independently reviewed for exclusion by two co-authors (authors VGP, VMA, AAP, WDC, AAP). Articles were excluded based on title and abstract review if the article focused on a topic other than asthma, did not include adult patients, was not an intervention-based study, did not have a focus on, or inclusion of, minority patients, or did not have an affiliation with a health care delivery setting. For any titles or abstracts that were unclear, the authors erred on the side of including for full article review. This title/abstract review was followed by an article extraction review. To ensure reviewers were consistent across article extraction, all reviewers participated in a training process. Two articles were then selected at random and were reviewed by all reviewers to ensure the training was successful and definitions were being applied appropriately. All discrepancies were resolved by consensus. Following this training, all articles were extracted onto a uniform extraction form first by one author (AAP, WDC, ATP, or VGP), with all articles then undergoing a second independent extraction by a different author for verification (VMA, VGP, or MHP); a weighted k was calculated to determine inter-rater agreement. The standardized extraction form focused on identifying the following elements for each study: intervention type (education-based or system-level), study design (RCT, Pre/Post, Cohort, Case control), study population (White, African American, Latino/a, Asian, American Indian, other), setting (community [if linked to a health care delivery setting], outpatient, inpatient), the studies' outcome measures, the assigned study quality score (DB score).

Data Analysis and Synthesis. Authors examined heterogeneity of studies qualitatively through comparing study population, study design, intervention characteristics (setting, target), and outcomes.¹³ Then the studies were broken down into education-based or systems-level interventions. The education-based studies were identified as culturally tailored education (CTE) if either the authors of the study being reviewed self-defined their intervention as culturally tailored, or our review of the intervention indicated that it had at least one foci of cultural tailoring (language appropriate education or use of focus groups for the target population in the development of the intervention). A structured data abstraction form in Microsoft Access facilitated collection of these data elements. Any articles not meeting inclusion criteria were excluded. Added to the final included studies were those meeting inclusion criteria found from reference mining, meeting review and expert opinion.

Quality and Bias Assessment

This review conforms to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) standards.

However, because the interventions and outcomes evaluated by, and reported on, in the included studies in this review varied and did not have a unified methodology or health outcome, our systematic review did not meet current guidelines for submission to a systematic review protocol registry.¹⁴

To assess study quality, the previously validated Downs and Black (DB) checklist was used.¹⁵ The original DB score is calculated by rating each study across a variety of domains including external validity (3 items), bias (7 items), confounding (6 items), and power (1 item). Instead of using a five-point range for scoring the power item,¹⁵ we simplified the scoring to a binary system of granting a point (1) for adequate power calculations, or no points (0) if power was not adequately addressed. Additionally, we have added one item from the Cochrane tool for bias¹⁶ that was not captured with the DB tool, for a total maximum modified DB score of 29.¹⁵ The average DB quality score (out of a maximum of 27 points; they did not include the power item or additional bias item) from a prior set of systematic reviews performed by the Finding Answers team is 17.65 (213 studies total).¹⁷ The inter-rater agreement for data abstraction using the modified DB tool was adequate ($k=0.67$).¹⁸ To describe the risk of methodological bias for each study, the Cochrane Collaboration tool was used, and was captured in the overall modified DB quality score as above.¹⁶ We used the DB score, rather than other methods for assessing quality, for the following reasons. First, this tool was used in the prior systematic reviews of health disparities interventions by the Finding Answers team.¹⁷ Therefore, the benefit of using it for our review is to have a benchmark by which to compare the DB quality scores for studies in our review across other reviews in this supplement and to prior large systematic reviews of health disparities interventions. Second, the DB checklist is particularly useful for intervention studies as it assesses the quality of the study method for both RCTs and non-randomized designs. Finally, it also provides an overview of the paper, highlighting the strengths and weakness of each study.¹⁵

RESULTS

From 1637 studies, 24 were eligible for review (Figure 1). Excluded studies did not study asthma ($n=821$), were not intervention-based ($n=526$), not an adult population ($n=119$), not US-based ($n=83$), did not have sufficient minority population ($n=22$), were pharmacologic-based ($n=16$), duplicates ($n=14$) or were not affiliated with a health care setting ($n=12$). Meeting abstracts were reviewed ($n=1219$); three met inclusion criteria, none resulted in manuscripts.^{19–21} Ultimately, 15 educational^{22–36} and 9 system-level studies were included.^{37–45} (Table 1) The education-based interventions primarily targeted patients while the system-level interventions targeted providers and/or health systems.

Figure 1. Flow diagram.

Study Quality

Study quality ranged from 12 to 26, with a mean of 21.0. Using a previously published categorization of DB scores,⁴⁶ 16 (67 %) were in the *very good* range (≥ 20), 6 (25 %) in

the *good* range (15–19), 2 (8 %) in the *fair* range (10–14), and none (0 %) were rated as *poor* (< 10). The ten randomized clinical trials were the most highly rated (range 16–26, mean 22.1), following by the six pre/post design studies (range 17–24, mean 21.7), the two case-control

Table 1. Asthma Interventions and Outcomes

Reference	Design	Setting	N, Population %	Intervention	Type	Length of Followup	Outcomes	Results	Quality score
Martin 2009 ²⁴	RCT ^a	C ^b	42; AA ^c 100 %	African American adults recruited from primary care clinics received 4 group educational sessions led by a community social worker along with 6 home visits by community health workers; education included general asthma information, medication information including controller medication, inhaler technique, and spacer use, and symptom monitoring and avoidance [triggers]. Those in the control group were mailed asthma education materials.	CTE ^d	6 months	SF ^e SM ^f A-QOL ^g K ^h	NS ⁱ : daytime symptoms; nocturnal symptoms NS: Receipt of action plans from doctor; trend toward sig at 3 months; NS at 6 months NS: inhaled corticosteroid use; use of a spacer 12 % absolute improvement (4.2 vs. 3.7, p=0.002) in intervention group at 6 month follow-up NS: Asthma knowledge	24
Sobel 2009 ²³	Pre/Post	C	130; AA 100 %	A health literacy focused educational program that recruited participants from an internal medicine clinic, church or adult education center, who were provided an educational video to promote self-care concepts including basic asthma information, avoiding triggers, medication education and self-monitoring of control, via laptop. Pharmacists or pharmacy students provided oral and written education in the participants' primary language, using in-person, group sessions that included videotapes and written information on pathophysiology, triggers, therapies, inhaler technique, and use of PFM's.	CTE	Immediately post intervention	K	>60 % absolute increase in mean posttest knowledge score (4.2 to 6.8, p<0.001)	17
Odegard 2004 ²⁶	Pre/Post	C, O ^j	32; SA ^k 100 %		CTE	6 months	U ^m SF SM	78 % absolute decrease in mean clinic visits decreased (1.8 to 0.4, p<0.001) from 6 months prior to 6 months post intervention 73 % absolute decrease in Mean # asthma attacks (3.7 to 1.0, p<0.001) and 79 % decrease in nocturnal symptoms (1.4 to 0.3, p<0.001) 44 % absolute increase in use of chambers (22 to 56 %, p<0.001) and 41 % PFM use (3 to 44 %, p<0.002) 28 % absolute reduction in ED ^p visits (from 3.9 to 2.8, p=0.0005); 41 % reduction in hospital admission (from 1.65 to 0.97, p<0.001) in intervention group (intervention group had higher starting ED visits than matched controls by gender and age within 10 years who declined the intervention) 20 % absolute improvement (for those who completed four questionnaires)	22
Tatis 2005 ²⁵	Cohort	O	198; L ⁿ 91 %	Patients were seen by a specialist (pulmonologist or allergist) and were provided care and education first by the physician followed by a review with a trained asthma educator using lung models to teach about airway inflammation, controller therapy, inhaler technique and trigger control; booklets at the 3 rd grade reading level were provided in English or Spanish; intervention group compared to matched controls.	CTE	6 months	U		18
Galbreath 2008 ²⁹	RCT	C, O	429; L 51 %, W ^r 31 %, AA/other, 18 %	Telephone disease management (6-7 calls) [DM] that provided individualized education and an action plan by trained respiratory nurses; and [ADM] -that also included telephone plus 4 home visits from respiratory therapists who provided hands-on equipment instruction and a home-environment evaluation; compared to traditional care.	E ^s	1 year	K U SF A-QOL	NS: Asthma knowledge NS: urgent office visits; ED visits; Inpatient admissions NS: time to first event 14 % absolute improvement in ADM ^t (4.2 to 4.9, p=0.04)	24

Table 1. (continued)

Reference	Design	Setting	N, Population %	Intervention	Type	Length of Followup	Outcomes	Results	Quality score
Stiegler 2003 ³¹	Pre/Post	O, I	17; AA 100 %	Pharmacist provided 30 minute intensive counseling on asthma information, triggers, PFM, medications, inhaler and spacer use and side effects of therapy, for patients hospitalized with acute exacerbations of asthma, followed by outpatient telephone follow-up at 1 week post discharge to reinforce education and answer questions and 5 weeks post discharge to reinforce education and assess adherence	E	6 months	U	78 % absolute decrease in hospital admissions and ED visits (from 1.58 to 0.35, p=0.0016) 41 % absolute improvement in medication refill (from 22 % to 63 %, p=0.0175)	24
George 1999 ³⁰	RCT	O, I	77; AA Majority	Inpatient education by an asthma nurse educator on disease information, medication information, inhaler technique, symptom monitoring and an action plan, bedside spirometry; a phone call 24 hours after discharge to answer questions on discharge instructions, medication and asthma symptoms; follow-up in an asthma program in 1 week post discharge for spirometry, physician visit and asthma nurse education to reinforce the hospital-based education; controls were given usual care.	E	1 week	U	89 % relative decrease in ED visits and 88 % relative decrease in hospital admissions in intervention (27 to 3, p=0.04; 26 to 3, p=0.04) vs. control (17 to 15; NS; 14 to 12, NS) LOS ^a : NS	22
Castro 2003 ³²	RCT	O, I	96; AA 78–86 %	Multi-faceted educational program including review of regimen, a daily 'asthma care' flow sheet, education tailored to patient provided by asthma nurse specialist, psychosocial support, individualized self-management plan, discharge planning and outpatient follow-up with phone contact, home visits and physician follow-up appointments as needed.	E	6 months	U	50 % fewer hospital re-admissions (21 intervention; 42 control, p=0.04) and 61 % relative decrease in LOS (53 total, 1.1 per patient intervention; 129 total, 2.8 per patient control; p=0.04) NS: health care provider visits 33 % relative increase in intervention group (2.7 to 4.02; p<0.001) and 30 % relative increase in control group (2.74 to 3.9; p<0.001) NS: difference in asthma QOL between intervention and control at 3 or 6 months	24
Blixen ²²	RCT	I ^d	28; AA 100 %	A nurse-run asthma education program that provided 3 1-hour individual educational sessions on asthma self-management utilizing a previously validated workbook and a video on MDI technique and PFM; control group received usual care.	CTE	6 months	A-QOL	A-QOL	25
Press VG 2011 ³³	Pre/Post	I	100; Nonwhite (AA, AI ^e , AN ^w , PI ^x) 89 %	Teach-to-Goal strategy provided by research staff using cycles of assessment and demonstration to instruct hospitalized patients on use of MDI ^s and Diskus [®] devices.	E	Immediate post education	SM	100 % mastery of MDI and Diskus [®] technique with at most 2 rounds	21
Paasche-Orlow 2005 ²⁷	Cohort	I	73; AA 84 %	One-on-one, 30 minute, guideline-based, written and oral instructions about asthma discharge regimen and MDI technique provided by research assistants.	E	2 weeks	SM	100 % mastery of MDI technique with at most 3 rounds in the hospital 21 % absolute improvement in mean MDI technique score at follow-up visit compared to discharge visit (3.8 to 4.8, p<0.001)	18

Table 1. (continued)

Reference	Design	Setting	N, Population %	Intervention	Type	Length of Followup	Outcomes	Results	Quality score
Ford 1997 ²⁸	RCT	I (ED)	537; AA 72 %, W 27 %, Other 1 %	The intervention group attended 3 small group education sessions in ED by health care professional, on disease, compliance and self-care; those who did not attend received the materials in the mail. Those in the control group did not receive education.	E	12 months	U SF	NS: ED visits/year by race NS: differential effect of intervention by race on change in limited activity days due to asthma	26
Kelso, 1995 ³⁶	Case Contol	I (ED)	52, AA 100 %	1-hour education session in ED by unspecified educators (presumably research staff) on disease, triggers and self-management with inhaler technique instruction (with spacer); PFM's were provided with demonstration; 1 wk f/u appt at free clinic.	E	1 year	U	NS: differential effect on knowledge of intervention by race 41 % absolute reduction in ED visits (4.4 to 2.6, $p<0.01$) and 62 % in hospital admissions (1.3 to 0.5 [62 %] $p<0.01$), for intervention group, NS control group	19
Bolton 1991 ³⁵	Cohort	I (ED)	241; NW 69 %, W 31 %	The intervention group received usual care plus three in-person educational group sessions over an unspecified time-period, provided by an asthma nurse educator on basic asthma pathophysiology and self-management information (1 st session); pharmacology and inheir technique (2 nd session); avoidance of triggers (3 rd session).	E	12 months	U	59 % absolute decreased ED visits for intervention group (16 per 100 persons) compared to control group (39 per 100 persons) in 12 months of follow up ($p=0.0005$); strongest during first 4 months (68 vs. 220 per 100 persons; $p=0.003$), but not as strong during last 4 months (69 vs. 98 per 100 persons; NS) NS: Hospital admissions; consultations with health professionals: no dif 30 % fewer days of limited activity due to asthma in intervention vs. control (622 vs. 888, $p=0.03$) in first 4 and averaged over all 12 months (161 vs. 246, $p=0.04$), not in the last 4 months (939 vs. 633, NS)	23
Maiman 1979 ³⁴	RCT	I (ED)	245; AA 92 %, Non-AA 8 %	Asthma nurse provided education on prevention and control of exacerbations, medication compliance and self-efficacy followed by a 6 weeks post-ED discharge phone call to reinforce ED-based education	E	6 months	U	20 % relative difference in percentage of patients with no further ED visits in the intervention group (asthmatic nurse education with booklet) compared to those in the control group (ED nurse) (82 vs. 66 %, $p<0.05$)	16
Hicks 2010 ⁴⁰	Pre/Post	O	3887; W 38.4 %, AA 22.4 %, L 25.8 %, Other 13.4 %	Health Disparities Collaborative developed to improve the care of patients with chronic diseases including asthma by disseminating quality improvement techniques developed by the Institute for Healthcare Improvement.	S ^z	1 year	QOL M	NS: quality improvement score 13 % absolute improvement in disparity score (39.3 to 45.4, $p<0.05$)	22
Landon 2007 ⁴¹	Pre/Post	O	3392; W 41.4 %, AA 21.3 %, L 23.7 %, Other 13.7 %	Health Disparities Collaborative developed to improve the care of patients with chronic diseases including asthma by disseminating quality improvement techniques developed by the Institute for Healthcare Improvement.	S	1 year	SM QOL	70 % absolute increase in use of asthma management plan (from 8 to 27 %, $p<0.001$) 25 % absolute increase in score (from 38.7 to 51.7, $p<0.001$)	24

Table 1. (continued)

Reference	Design	Setting	N, Population %	Intervention	Type	Length of Followup	Outcomes	Results	Quality score
Pauley 1995 ⁴⁵	Case Control	O	25; AA 76 %	Participants attended a special asthma clinic that provided group-based education about asthma triggers and proper use of asthma medications, telephone contact with pharmacist and an open-door clinic policy.	S	6 months	U	87 % relative decrease in mean per patient ED visit (1.88 to 0.24, $p=0.006$) when comparing control period to the study period (1 year interval between the two)	21
Sperber 1995 ⁴²	Cohort	O	84; PR ^{aa} 48 %, M/C ^{bb} 27 %, AA 24 %	All patients in one clinic referred to asthma specialist (allergist/immunologist); those who went were “intervention group” and received education on use of inhalers, triggers, PFM use; control group was seen by general practitioner.	S	2 years	U	63 % relative decrease in clinic walk-in visits (73 vs. 27, $p<0.001$), 83 % fewer ED visits (30 vs. 5, $p<0.001$) and 88 % fewer hospital admissions (16 vs. 2, $p<0.001$) in the intervention group compared to the non-intervention group; NS changes except for 68 % increased ED visits (7 vs. 22, $p<0.05$)	12
Mayo 1990 ⁴³	RCT	O	104; L 80 %, AA 15 %, W 4 %	An intensive treatment program consisting of two 1-hour clinic visits on pathophysiology and self-management strategies, followed by as needed ½ hour follow-up visits provided by physician or nurse practitioner compared to routine clinic, for patients with multiple prior hospitalizations for asthma exacerbations.	S	32 months	U	67 % absolute decrease in hospital readmissions (0.4 vs. 1.2 per patient, $p<0.004$) and 54 % shorter LOS (3.1 per patient days vs 6.7; $p<0.02$)	22
Mayo 1996 ³⁹	Cohort	O, I	126; L 79 %, W 10 % AA 9 %	A team intervention whereby hospitalized patients who did not have a private physician were evaluated and taught pathophysiology, MDI technique, and spacer and PFM use, by a nurse; housestaff and attending were also taught. The nurse provided one-on-one education and left a detailed note for housestaff team. At discharge, patient was provided a one-week follow-up appointment.	S	Hospital Discharge	U	17 % absolute decrease in LOS (4.8 to 4, $p<0.001$) NS: Hospital readmission 36 % increased PFM by residents (42 to 77 %, $p<0.001$) and 55 % increased use of spacers by patients (38 to 85 %, $p<0.001$)	23
Akerman 1999 ³⁸	Cohort	I (ED)	200; AA 88 %, L 8 %, W 0.7 %, Other 3.3 %	A continuous quality improvement project to improve asthma care and outcomes in an inner-city ED implementing asthma treatment guidelines.	S	2 years	U	20 % absolute decrease of admissions (4.85 to 3.90 per 100 ED visits, $p<0.05$) 36 % decrease in relapse (from 12.18 to 7.83, $p<0.001$)	14

Table 1. (continued)

Reference	Design	Setting	N, Population %	Intervention	Type	Length of Followup	Outcomes	Results	Quality score
Rydman 1998 ³⁷	RCT	I (ED)	113; AA 74 %, Other 74 %	Patients recruited from ED after 3 hours of therapy then randomized to ED observation unit or control group which received inpatient admission.	S	8 weeks	SF QOL	NS; PEFR ^{cc} ; Relapse significant improvement for 5 of 8 domains (intervention vs. control): 19 % physical function (72 vs. 58, p=0.01); 42 % emotional function role (78 vs. 45, p=0.001); 15 % social function (80 vs. 68, p=0.021); 14 % mental health (78 vs. 67, p=0.008); 20 % vitality (59 vs. 47, p=0.016); NS: physical functioning role, bodily pain, general health perceptions	22

^aRCT: Randomized Controlled Trial^bC: Community^cAA: African American^dCTE: Culturally Tailored Education^eSF: Symptom frequency^fSM: Self-management behaviors^gAQOL: Asthma-related QOL^hK: KnowledgeⁱNS: Not significant^jO: Outpatient^kSA: South Asian^lPFM: Peak Flow Meter^mU: Health care utilizationⁿL: Latino^oQOL: Quality of Life^pED: Emergency Department^qI: Inpatient^rW: White^sE: Education^tADM: Augment Disease Management^uLOS: Length of Stay^vAI: American Indian^wAN: Alaskan Native^xPI: Pacific Islander^yMDI: Metered-Dose Inhaler^zS: System Level Intervention^{aa}PR: Puerto Rican^{bb}M/C: Mexican/Columbian^{cc}PEFR: Peak Expiratory Flow Rate

studies (range 19–21, mean 20), and the six cohort studies (range 12–23, mean 18).

Race/Ethnicity

The majority of studies included participants from several race/ethnicity populations; studies focusing on African Americans predominated. Five studies focused entirely on one race/ethnicity; four on African Americans; one on Asian Americans. There were an additional ten studies where the majority of participants were African American, and four where the majority were Latinos.

Intervention Sub-Types

Education-Based Interventions (N=15; Mean Study Quality Score (DB) 21.5). The majority of the interventions were education-based (n=15); five were culturally tailored; three defined by the studies' authors^{22,23,25} and two by our review.^{24,26} None of the CTE studies included a comparison group. Three focused on the African American population,^{22–24} one on the Latino community,²⁵ and one used language-appropriate education for different Asian populations.²⁶ Four CTE interventions demonstrated improved outcomes.^{23–26} The remaining ten educational interventions were not specifically culturally tailored, but did include a majority of non-white participants; most included a majority of African American participants, though one included a majority of Latino/a participants. Of these ten interventions, all but one took place at least partially in the hospital setting,²⁹ in contrast to the CTE interventions that were primarily outpatient-based.

System-Level Interventions (N=9, Mean Study Quality Score (DB)=19.6). Nine system-level studies met criteria for this review. The setting was primarily outpatient;^{40–45} three were inpatient-based.^{37–39} Two utilized health disparities collaboratives to introduce quality improvement interventions.^{40,41}

Intervention Outcomes

Almost all of the interventions had at least one successful component; several studies reported on similar outcomes (e.g., ED visits, hospitalizations). However, a meta-analysis was not performed as the interventions themselves were too heterogeneous to provide a valid conclusion. The interventions varied in their setting, design, and follow-up. For example, some studies utilized pharmacists while others utilized nurses or asthma educators, and some utilized multiple education sessions, sometimes in different settings. Several lessons can still be learned by comparing, when

possible, across the studies' measured elements. A summary by the most commonly reported outcome measures follows. (Table 1)

Health Care Utilization. The most common outcome measured among the 24 studies was health care utilization (16/24, 67 %). There was not, however, a unifying item that could be compared across studies, as the specific utilization component(s) differed among the studies.

Among the education-based interventions two-thirds (10/15) followed utilization; eight evaluated ED visits,^{25,28–31,34–36} 7 followed hospital admissions,^{25,29–32,35,36} 3 followed outpatient visits,^{26,29,32} and 2 followed length of stay (LOS).^{30,32} The education provided by these interventions was multifaceted and included in varying degrees: basic disease information, self-management skills, medication information and trigger control. The education was provided in the outpatient,^{25,26} inpatient,^{30–32} ED^{28,29,34–36} or community setting.²⁹ Of note, all three inpatient studies^{30–32} and 2/4 ED based interventions^{34,36} included an outpatient follow-up component (phone call or visit). The education was provided by a range of trained clinical or research staff, including health care professionals,²⁸ pharmacists,^{26,31} asthma educators,²⁵ asthma nurse educators,^{29,30,32,34,35} respiratory therapists (RT)²⁹ or research staff.³⁶ All of the education was provided to the individual participant except for two of the ED-based interventions^{28,35} and an outpatient pharmacist based intervention that utilized group sessions.²⁶ Several provided more than one session, including Galbreath's telephone plus home visit intervention,²⁹ all three inpatient interventions,^{30–32} and all but one of the ED studies.³⁶

Of the 8 studies that followed ED visits, all but two^{28,29} demonstrated absolute reductions post-education (22–89 %)^{25,31,36} or relative reductions compared to control (16–59 %).^{30,34,35} The most successful interventions (≥50 % reduction) included two inpatient-based studies provided by a pharmacist³¹ or asthma nurse³⁰ and Bolton's ED multiple-group session intervention.³⁵ Tatis' specialty clinic with asthma educator intervention²⁵ and three of four ED-based interventions showed slightly less-impressive reductions.^{28,34,36} The two interventions with non-significant findings, included Galbreath's respiratory nurse telephone education +/- home visits by RTs²⁹ and Ford's ED, multiple-session, group-based education.²⁸

Of the seven studies that followed hospital admissions, all but two^{29,35} demonstrated absolute^{25,31,36} or relative^{30,32} reductions (41–88 %). All but Tatis' asthma educator strategy²⁵ showed reductions of ≥50 %, including the three inpatient interventions,^{30–32} and Kelso's one-hour ED-based intervention.³⁶ The three studies that followed outpatient visits included Odegard's language-appropriate pharmacist-based, Galbreath's telephone, and Castro's nurse-specialist inpatient, education.^{26,29,32} However, only Odegard's

showed a significant absolute decrease (78 %) in visits.²⁶ Finally, only two inpatient-based education interventions, both provided by asthma nurses, followed LOS.^{30,32} The results were split: Castro found 59 % relative fewer days for the intervention group compared to the control group,³² while George did not find a relative decrease in LOS.³⁰ Because only one CTE study evaluated ED visits,²⁵ hospital admissions,²⁵ and outpatient visits,²⁶ and none evaluated LOS, conclusions based on the effectiveness of CTE on reducing utilization cannot be made from this data.

Two-thirds (6/9) of system-based studies evaluated utilization post-intervention. Half followed ED visits.^{42,44,45} These interventions were similar in that they were clinic-based and utilized experts, including pharmacists^{44,45} and specialty-based clinics (e.g., allergists).^{42,45} All three found a relative^{42,45} or absolute⁴⁴ decrease between 63–87 %; the control group in one study actually had increased ED visits by 71 %.⁴² These three studies, along with another clinic-based intervention that used multiple sessions and a hospital-based nurse-led intervention, both by Mayo, followed hospital admissions.^{39,43} All but Mayo's hospital-based study³⁹ found an absolute decrease by 20–88 % in post-intervention admissions. LOS decreased in both of Mayo's studies (17 %, inpatient; 54 %, outpatient).^{39,43} Sperber found a relative decrease in urgent outpatient clinic visits of 63 %.⁴²

Symptom Control and Self-Management. The next most commonly measured items fell under the topics of symptom control/asthma severity (8/24; 33 %) and self-management tools (6/24; 24 %). However, as with the general topic of 'health care utilization,' these topic areas were also diverse and varied. For instance, with respect to asthma control, some studies specifically measured the frequency of day/night symptoms, while others used symptom scales, limited activity days, etc. Similarly, with respect to measuring self-management, these ranged from the use of spacers or peak-flow meters [PFM], to action plans, to respiratory inhaler technique.

Of the five education-based studies that followed symptoms,^{24,26,28,29,35} only two found improvements.^{26,35} Odegard's language-appropriate pharmacist-based education demonstrated a 73 % absolute reduction in asthma attacks and a 79 % absolute reduction in nocturnal symptoms.²⁶ Bolton's asthma nurse inpatient education demonstrated a 30 % relative decrease in number of days of limited activity (intervention group vs. control group).³⁵ The three studies that did not find a reduction in symptoms included Martin's social-work led group educational sessions with community health workers home visits,²⁴ Galbreath's telephone +/- RT home visits,²⁹ and Ford's multi-session ED-based intervention.²⁸ The results for self-management (5/15) were more favorable,^{24,26,27,31,33} all but one²⁴ found improvements in participants' self-management

skills. Two pharmacist-based education interventions^{26,31} showed absolute improvement of chambers (34 %),²⁶ PFMs (41 %),²⁶ and/or medication refills (41 %).³¹ Similarly, two inpatient interventions that used repeated rounds of inhaler technique instruction demonstrated 100 % mastery after two or three rounds.^{27,33} The only study that did not demonstrate improvements in self-management was Martin's community-based intervention.²⁴ Again, few CTE studies evaluated symptoms and self-management;^{24,26} therefore conclusions based on the effectiveness of cultural tailoring on improving patient self-care or symptoms cannot be made.

One-third (3/9) of system-based interventions evaluated symptoms.^{37,38,44} Kelso's comprehensive long-term management program decreased sleep loss by 63 % and night awakenings by 43 %.⁴⁴ Akerman's continuous quality improvement program at an inner-city ED³⁶ decreased absolute relapse rates by 83 %. However, Rydman's ED observation unit³⁷ did not show a relative decrease in relapse rates. Of the three studies that followed self-management, Landon's use of quality improvement collaborative at community health centers⁴¹ demonstrated a 19 % absolute increase in use of self-management plans. Both Pauley and Mayo found a relative increase in spacers use (47–86 %) and PFMs (35–100 %).^{39,45} Pauley also demonstrated relative improved inhaler technique (48 %) and use of inhaled corticosteroids (52 %).⁴⁵

Overall Health Status and Asthma Quality of Life. About one-third (8/24) of the studies evaluated some aspect of quality of life (QOL). Some measured overall QOL (n = 4),^{25,40,41,44} while others used asthma-related QOL instruments (A-QOL, n = 5).^{22,24,29,32,44}

Of the five education-based studies that measured QOL, all but one²⁵ looked at A-QOL.^{22,24,25,29,32} All but one demonstrated a relative³² or absolute^{24,29} improvement in QOL of 12–33 % (scores of 0.5 to 1.32) post-intervention. Blixen's inpatient asthma-nurse education did not find a relative improvement in A-QOL.²² Tatis' was the only study²⁵ to evaluate improvement in overall QOL scores and found a 20 % absolute improvement for those completing the four rounds of questionnaires. Three CTE studies evaluated QOL (2 A-QOL, 1 QOL);^{22,24,25} there is not enough data to make any conclusive role on cultural tailoring and improvements in QOL.

Four system-based studies evaluated QOL,^{37,40,41,44} one of which also studied A-QOL.⁴⁴ Hicks and Landon both studied health disparities collaborative.^{40,41} While Landon demonstrated a 25 % absolute improvement in his overall quality improvement score,⁴¹ Hicks did not find significant absolute improvement in QOL.⁴⁰ Kelso's comprehensive community clinic and Rydman's ED-based observation unit showed absolute and relative improve-

ments, respectively, of 14–98 % in the majority of SF-36 domains they studied (6/8 and 5/8, respectively).^{37,44} Neither study found significant results for the bodily pain domain. Kelso also evaluated A-QOL using the asthma bother profile and found that 12/15 domains decreased significantly by 23 to 42 %.

Asthma-Related Knowledge. Only six of the studies measured knowledge related to asthma such as disease-related information, triggers, and medication post-intervention.^{23–25,28,39,44} Four education-based studies evaluated asthma-knowledge;^{23–25,28} of these, only Sobel's educational video promoting self-care concepts increased knowledge (>60 %).²³ The others included Martin's multi-session social-work intervention, Tatis' outpatient specialty-clinic, and Ford's multi-session ED-based study.^{24,25,28} Only two system-based studies evaluated knowledge.^{39,44} Kelso's comprehensive clinic improved participants' understanding of medications and self-management knowledge from 0–100 %.⁴⁴ Mayo's hospital-based education increased patient and resident education (41 %, 34 %).³⁹

DISCUSSION

This review demonstrates that, first and foremost, a surprising dearth of intervention studies exist that address the health disparities of racial and/or ethnic minority adults with asthma in the US. Since these disparities overwhelmingly affect African Americans and Puerto Ricans, it is not surprising that the majority of studies focused on these two populations. Unfortunately, few studies utilized adequate control groups, limiting our ability to endorse interventions that would specifically address racial disparities for patients with asthma.

However, our review still provides guidance for clinicians and health care systems about what modalities have been tried and successfully implemented. For instance, we are unable to determine which educational intervention is most likely to reduce disparities for minority patients with asthma, but we can report that a variety of educational modalities appeared effective at improving outcomes for minority patients with asthma, including point-of-care education by health-care professionals (e.g., pharmacists, asthma nurses) or technological approaches (e.g., videos). Further, although our review is unable to definitively conclude CTE interventions are superior due to limitations in study design, despite prior documented success with CTE interventions,⁴⁷ it is still noteworthy that education that included language-appropriate materials (e.g., Spanish, Chinese, health literacy focus) for the patient seemed to play an important role in the majority of the CTE interventions.

When looking at specific outcomes, group-based education appeared less-successful in reducing health care utilization, as 1/3 found non-significant reductions in ED visits and 2/3 in admissions. Neither symptoms nor knowledge improved across most of the education-based studies; there was no unifying theme that directs the success or lack thereof. Self-management was often improved when education was provided by pharmacists (~40 %) and/or was inpatient skill-based education (100 % mastery). Studies that measured Asthma-related QOL found improvements of up to 33 %. Finally, educational strategies that began in the hospital but continued with outpatient follow-up demonstrated some of the more promising findings with greater than 50 % reductions in health care utilization.²² Clinicians should recognize that reproducible educational programs that target health-disparities for sub-populations of the US need to be further developed and implemented and the role of cultural tailoring should be further explored.

We found that specialty clinics, especially for “high risk” patients, consistently demonstrated decreased utilization and improved symptoms, self-management, knowledge and QOL. Similarly, inpatient-based interventions were nearly uniformly successful across the various outcomes studied. However, despite the promising nature of health disparities collaboratives, results to date have not shown expected improved outcomes. Therefore, efforts to further evaluate and possibly combine the most successful strategies should be explored.

There are several limitations of this review. Although we reviewed recent abstracts from key scientific meetings in the field of asthma and allergy, publication bias may limit our findings. Also, the interpretation of results may be affected due to the high proportion of data from the studies being at high risk of bias.¹⁶ Further, community-based studies without a health center affiliation were excluded. Future reviews may seek to understand how they may improve outcomes for patients with asthma. Finally, we were unable to perform a meta-analysis limiting the quantitative evaluation of this review.

CONCLUSION

Overall, education delivered by healthcare professionals (nurses, pharmacists, community health workers or even technology) appeared effective in improving processes and outcomes for minority patients with asthma. Because few studies were culturally tailored and lacked adequate control groups, it is currently unclear whether this is a superior approach for reducing health disparities. System redesign showed great promise, particularly the use of team-based specialty clinics and long-term follow up after acute care visits. High-priority future areas of research

should evaluate the role of tailoring educational strategies, focus on patient-centered education, and incorporate outpatient follow-up and/or a team-based approach.

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