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A Systematic Review of Patient- and Family-Level Inhaled Corticosteroid Adherence Interventions in Black/African Americans

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Abstract

BACKGROUND: Inhaled corticosteroid (ICS) adherence rates are suboptimal among adult black/African Americans. Comprehensive studies characterizing the effectiveness and the methodological approaches to the development of interventions to improve ICS adherence in adult black/African Americans have not been performed.

OBJECTIVES: Conduct a systematic review of patient/family-level interventions to improve ICS adherence in adult black/African Americans.

METHODS: We searched MEDLINE, EMBASE, Web of Science, and CINAHL from inception to August 2017 for English-language US studies enrolling at least 30% black/African Americans comparing patient/family-level ICS adherence interventions with any comparator. Two investigators independently selected, extracted data from, and rated risk of bias. We collected information on intervention characteristics and outcomes, and assessed whether studies were informed by behavior theory, stakeholder engagement, or both.

RESULTS: Among 1661 abstracts identified, we reviewed 230 full-text articles and identified 4 randomized controlled trials (RCTs) and 1 quasi-experimental (pre-post design) study meeting criteria. Study participants (N range, 17–333) varied in mean age (22–47 years), proportion black/African Americans studied (71%–93%), and sex (69%–82% females). RCTs evaluated problem-solving classes, self-efficacy training, technology-based motivational interviewing program, and

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the use of patient advocates. The RCT testing self-efficacy training was the only intervention informed by both behavior theory and stakeholder engagement. All 4 RCTs compared interventions with active control and rated as medium risk of bias. No RCTs found a statistically significant improvement in adherence.

CONCLUSIONS: Few studies assessing asthma adherence interventions focused on adult black/African-American populations. No RCTs demonstrated improved ICS adherence in participants. Future studies that are informed by behavior change theory and stakeholder engagement are needed.

Keywords

Asthma; Medication adherence; African Americans; Health status disparities; Implementation science; Behavior theory; Cultural adaptation

INTRODUCTION

Adult black/African Americans are particularly vulnerable to disparities in asthma prevalence and outcomes. Compared with non-Hispanic whites, adult black/African Americans are 20% more likely to have asthma, and they are more than 3 times more likely to have a hospitalization or death due to asthma.¹⁻⁴ Numerous organizations are interested in coordinating interventions to reduce asthma health inequities. The National Heart, Blood, and Lung Institute's Center for Translation Research and Implementation Science is working to identify gaps and research opportunities to address health inequities, including asthma.⁵

One potentially important target for interventions is inhaled corticosteroid (ICS) adherence. ICS adherence rates are 22% to 64% overall, and worse in adult black/African Americans.⁶⁻⁹ Disparities in ICS adherence in adult black/African Americans are thought to be attributable to a unique, and interrelated, mix of barriers at the patient, provider, health system, and societal levels. For example, negative attitudes toward ICS, beliefs about consequences, poor provider-patient communication, low asthma knowledge, depression, and poor access to health care have all been cited in explaining adherence disparities in adult black/African Americans when compared with whites.^{8,10} It is estimated that rectification of ICS nonadherence in adult black/African Americans could prevent 24.4% of all-cause asthma exacerbations (ie, asthma-related hospitalizations, emergency department use, and use of oral steroids).⁶ Thus, to improve asthma outcomes and reduce asthma disparities, there is a need for culturally adapted strategies, targeting the unique barriers to adherence in adult black/African Americans.

There is currently no consensus on the most important components of adult ICS adherence interventions, and few studies have focused on adult black/African Americans. Previous systematic reviews have suggested that education and multicomponent interventions have been efficacious in improving ICS adherence in the general US population.¹¹⁻¹⁸ However, these studies have several gaps. Few have enrolled sufficient numbers of adult black/African Americans; examined the effectiveness of interventions among black/African Americans; sought to address adherence barriers (eg, cultural beliefs, language, and immigration status) in diverse populations; or reported the degree at which traditional interventions are culturally

adapted to the behavioral and contextual barriers faced by adult black/African Americans.^{17,19,20} Furthermore, although behavior change theory and stakeholder engagement are known to yield efficacious behavioral interventions, reviews reporting their use in intervention development are lacking.^{21,22}

A review quantifying the effectiveness of interventions to improve ICS adherence among adult black/African Americans could elucidate mechanisms to directly address disparities in asthma outcomes. We conducted a systematic review to establish the evidence base for patient- and family-level interventions to promote ICS adherence among adult black/African Americans.

METHODS

We conducted a systematic review to identify studies quantifying the effectiveness of interventions to improve ICS adherence among adult black/African Americans.

Literature search strategy

We designed our search strategy to be as inclusive as possible of published and nonpublished investigations, and to include studies enrolling representative samples of black/African Americans to facilitate generalizable inferences. An experienced librarian conducted searches in MEDLINE, EMBASE, Web of Science, and CINAHL from inception to August 2017. Investigators performed quality checks to ensure that the search identified known (ie, highly publicized or impactful) studies on ICS adherence. Our search strategy used a combination of Medical Subject Headings terms and key words focused on “asthma,” “adherence,” and “African-American” (for our full search strategy, see Tables E1–E5 in this article’s Online Repository at www.jaci-inpractice.org).

We identified unpublished studies and conference abstracts through Web of Science. For conference abstracts, we searched for full-text articles and additional reported outcomes in MEDLINE, Google Scholar, and the clinicaltrials.gov database. We excluded conference abstracts if no associated peer-reviewed publications were identified. We searched the references of studies included in our analysis and the references of previous review articles to identify additional studies that may meet our eligibility criteria. We imported all citations into an EndNote X7 electronic database.

Inclusion and exclusion criteria

We established a priori study eligibility criteria (Table I) with the assistance of an expert panel, consisting of pulmonologists, epidemiologists, and experts in studying health disparities among black/African Americans. We sought to identify interventions targeting patients or family/caregivers to improve adherence. We focused on interventions targeting patient and family/caregivers because we wanted to identify interventions that can empower patients and their family/caregivers. Because we sought to understand the impact among black/African Americans, we arbitrarily selected studies enrolling at least 30% adult (age 18 years or older) black/African Americans with asthma or reporting outcomes for adult black/African Americans separately. We selected a threshold of 30% because it was above the 13% population composition of black/African Americans in the United States but below the 50%

cutoff used in previous systematic reviews of minority-focused interventions, thereby allowing for more broad inclusion of eligible studies that oversampled black/African-American populations compared with previous reviews.²³ Other race/ethnic minorities were not included because studies have demonstrated that barriers to adherence may be different in diverse populations; for example, varied cultural beliefs, language, and immigration status may affect the effectiveness of adherence interventions.^{17,19,20} We limited our review to studies on adults because the barriers to adherence in children are different due to children's rapid developmental transitions, limited input in treatment decisions, and larger dependence on caregivers.^{24–27} Because other types of adherence interventions could provide an insight into effective patient- and family-level ICS adherence interventions and intervention components in adult black/African Americans, we also included a discussion of varied types of adherence interventions (eg, provider, health system) and study populations (eg, predominately noneblack/African-American populations and adult race/ethnic minorities with asthma) in our discussion of previous systematic reviews and common characteristics of effective interventions. In limiting to ICS, we did not exclude ICS/long-acting beta-agonist combination therapies. We did not include studies focusing on adherence to oral asthma therapies (eg, leukotriene receptor antagonists) or injections (eg, omalizumab and mepolizumab) because adherence is known to be affected by the medication administration route; for example, attitudes toward oral medications may be different from attitudes toward injections, which may be different from those toward inhalers.²⁸ Because ICS takes at least 4 weeks to reach maximal efficacy,^{29–32} we further limited studies to those measuring ICS adherence for at least 1 month. Interventions had to be conducted among US populations. In multinational studies, we only included data obtained among US study participants. We sought to include trials, cohort studies, and single-group pre/post studies published in English.

We assessed information on study population demographic characteristics, including age and race/ethnicity. We also assessed the type of interventions conducted and whether it focused on ICS adherence and targeted patients or family/caregivers. Our primary outcome of interest was adherence, a behavioral outcome that has been measured in numerous ways.³³ We included studies recording any measure of adherence—objective (eg, monitor, pharmacy refills, or other objective measures) or subjective (eg, via participants' self-reports).

Study selection

Two members of the team independently reviewed each title and abstract for eligibility (I.L.R./Z.R., I.L.R./B.M.). Reviewers resolved conflicts by discussion, and the third reviewer (Z.R. or B.M.) adjudicated disagreements, if needed, during all stages of the review. Two team members (I.L.R./Z.R., I.L.R./B.M.) independently reviewed the full text of articles, and discrepancies in inclusion/exclusion were resolved by discussion. We recorded the main reason for exclusion at each stage of study selection.

Data extraction

Reviewers extracted data from each study meeting our inclusion criteria with a standardized and structured form. One reviewer extracted relevant data, and a second reviewer reviewed the primary reviewers' abstraction. Reviewers extracted information on studies' participants,

design (eg, trial, cohort studies with concurrent control, or quasi-experimental), setting (eg, health system, community), intervention type, comparators, adherence measures, assessment period, and results. We recorded the location of intervention delivery and the personnel delivering intervention. We also determined whether interventions reported using behavior theory, stakeholder engagement, or cultural adaptation to inform the development of the intervention because they are common characteristics of effective adherence interventions (eg, behavior theory) and interventions in adult race/ethnic minorities (eg, stakeholder engagement and cultural adaptation). We defined stakeholder engagement as the incorporation of the views of stakeholders in intervention development through mechanisms such as, but not limited to, qualitative methods, advisory boards, and pilot testing with feedback. We considered studies to have used cultural adaptation if they referenced conducting qualitative research to inform intervention development and tailored interventions to behavioral and contextual factors associated with ICS adherence in adult black/African Americans with asthma. We extracted information on several medical and patient-centered outcomes for which disparities in asthma outcomes have been previously implicated among black/African Americans, including adherence, asthma outcomes (eg, asthma exacerbation, asthma control, asthma quality of life, and asthma-related mortality), health care utilization, asthma knowledge, and asthma self-management.

Risk-of-bias assessment of individual studies

Two independent reviewers assessed the risk of bias for each study, using the Agency for Healthcare Research and Quality Methods Guide to assess the risk of bias (internal validity).³⁴ Criteria included an assessment of selection bias, confounding, performance bias, detection bias, and attrition bias (see Table E6 in this article's Online Repository at www.jaci-inpractice.org). In this risk-assessment method, studies with "low risk of bias" are considered to have valid results and receive favorable scores on most questions with relatively minor unfavorable responses (eg, lack of masking in behavioral interventions). Studies with "moderate risk of bias" are considered to not have major risk of bias but may have some risk of bias that would not invalidate their results. Studies evaluated as "high risk of bias" are considered to have errors in design, conduct, or analysis that may invalidate their results (eg, high rates of attritions, no intention-to-treat analysis, and use of invalid measures of outcomes).

Data analysis and synthesis

To determine whether a meta-analysis was appropriate, we assessed the clinical and methodological heterogeneity. We assessed clinical heterogeneity by assessing the variability of the population, intervention, comparator, outcome, time, setting. We assessed methodological heterogeneity by assessing variability of study design and risk of bias.³⁵

RESULTS

We identified 1661 unique titles and abstracts and assessed 230 full-text articles for eligibility (Figure 1). Using our inclusion/exclusion criteria, we excluded 225 articles. Of articles not meeting the population criteria (N = 58), 20 had exclusive pediatric populations or mixed pediatric and adult populations without subgroup analysis of adults; 18 had less

than 30% adult black/African Americans; and 20 had patients without asthma or included heterogeneous medical conditions without subgroup analysis by condition. Eighty-eight articles did not meet the intervention criteria by not reporting results of an intervention (eg, discussed barriers to adherence) or the intervention did not have a patient or family/caregiver component (Figure 1).

For our final analysis, we included 4 randomized controlled trials (RCTs)^{36–39} and 1 single-arm quasi-experimental study with pre-post design.⁴⁰

Characteristics of included studies

Total sample sizes ranged from 17 to 333 participants who were predominately middle-aged black/African-American women. The percentage of black/African Americans in the eligible studies ranged from 71% to 93%, and women made up 69% to 82% of participants. The mean age of black/African-American adults ranged from 22 to 47 years across the studies. Study analyses presented no subgroup analyses by race (Table II).^{36–40}

Intervention characteristics

Interventions were heterogeneous and focused on the use of patient advocates,³⁶ problem solving,³⁷ technology-based motivational interviewing,³⁸ self-efficacy skills development,³⁹ and a pharmacist-led education intervention⁴⁰ (Table III). The patient advocate intervention was conducted among 71 adult black/African Americans (total study participants N = 100). In this intervention, a patient advocate prepared patients for provider visits, attended 1 clinic visit, confirmed patients' understanding of issues discussed during the visit, facilitated patients' return appointments, and followed up with patients between visits. The control group received asthma education delivered via audio CD.³⁶

The problem-solving intervention was conducted among 226 adult black/African Americans (total study participants N = 333) and incorporated a motivational technique to train patients to view problems as "inevitable, normal, and solvable."³⁷ It consisted of four, 30-minute individual sessions tailored to the specific adherence barriers of each patient. College-educated lay staff members taught problem-solving skills as a way to overcome the barriers to medication nonadherence and had subjects apply problem-solving skills to other areas in their lives to help solidify real-world application of skills. The control group received four, 30-minute in-person asthma education sessions not related to adherence, self-management, or ICS therapy.³⁷

The technology-based motivational interviewing intervention was conducted among 48 adult black/African Americans (total study participants N = 49) and consisted of 2 computer-delivered motivational interviewing sessions a month apart. Each session was customized for participants on the basis of ecological momentary assessment information (ie, medication adherence and asthma control) collected 7 days before the session. Sessions included feedback on medication use and symptoms, feedback on readiness to improve adherence, the pros and cons of medication adherence, and an optional goal setting. Personalized text messages were delivered daily between sessions. The control group received 2 interactive computer-delivered asthma education sessions focused on asthma facts and myths,

environmental factors, and medications. Between sessions, the control group received daily text messages containing general asthma facts.³⁸

The self-efficacy intervention was conducted among 39 adult black/African Americans (total study participants N = 42), and coupled clinic-based group sessions with home visits to teach asthma self-efficacy skills.³⁹ The intervention included 4 group sessions on asthma management, stress, physical activity, and social support and 4 to 6 community health worker home visits focusing on the patient's asthma status, asthma facts, medications, communication with providers, asthma triggers, and cigarette smoke avoidance. The group sessions were implemented by social workers and the home visits by community health workers. The control group received 2 asthma education mailings consisting of the same content presented at the group sessions for the intervention group.³⁹

The pharmacist intervention was conducted among 14 adult black/African Americans (total study participants N = 17) and consisted of a 30-minute in-hospital counseling session covering asthma basics, signs and symptoms of exacerbations, disease triggers, peak flow monitoring, role of medications and spacers, and adverse effects of therapy. Pharmacists reinforced counseling, by phone, at 1 and 5 weeks after discharge.⁴⁰

Use of behavior change theory, cultural adaptation, or stakeholder engagement in intervention development

Only 1 study (the self-efficacy intervention) reported that it was informed by stakeholder engagement, cultural adaptation, and behavior change theory. The investigators used self-efficacy and social learning theory and focus groups, of predominately adult black/African Americans with asthma, to inform intervention development.³⁹ Two studies (the patient advocate³⁶ and technology-based motivational interviewing³⁸ interventions) were informed by both qualitative analysis (eg, focus groups and semistructured interviews) and cultural adaptation. Two studies (the pre/post pharmacist intervention and problem-solving interventions) did not report any use of behavior theory, qualitative analysis, or cultural adaptation to inform intervention development.^{37,40}

Study outcomes

Studies measured several outcomes, including ICS adherence, asthma control, health care utilization outcomes (eg, any emergency department visit, asthma-related emergency department visit), quality of life, as well as asthma knowledge and self-efficacy (Table IV).

Adherence.—Three studies reported objective measures of adherence, defined as 30-day adherence^{36,37} or percent refills achieved within 10% of targeted refill dates.⁴⁰ The pre/post pharmacist intervention reported the percent of refills achieved within 10% of targeted refill dates to measure monthly and 6-month adherence.⁴⁰ They reported a statistically significant increased mean adherence rate of 22% ± 6% to 63% ± 24% over 6 months ($P = .02$)⁴⁰ (Table IV).

Two RCTs reported both subjective and objective measures of adherence.^{36,37} Both measured baseline adherence with validated adherence questionnaires specifically designed for ICS and measured adherence with an electronic actuation monitor monthly for 4 months.

^{36,37} In both RCTs, ^{36,37} 2 electronic ICS monitors were used because of the range in ICS devices (eg, dry powder inhalers and hydrofluoroalkanel [HFA]) used by patients. Both devices could identify dumping of medication by measuring the frequency and time of day of actuations. None of the 4 RCTs reported a statistically significant difference between the intervention and comparator groups in measures of adherence.^{36,37,39} However, 3 studies^{36,38,39} reported an overall increase in ICS adherence in both study arms, whereas a third study³⁷ reported an overall decrease in adherence in both arms.

Two RCTs used only subjective questionnaires to measure adherence.^{38,39} The study implementing a self-efficacy intervention used a nonvalidated questionnaire to assess 14-day ICS adherence and adherence was measured at baseline and at 3 and 6 months.³⁹ The study implementing a technology-based motivational interviewing intervention used multiple subjective measures of adherence including a validated assessment of 1-month adherence, text prompts 3 times a day assessing adherence over a 7-day period, and 1 text prompt asking total doses missed over 7 days. Adherence was measured at baseline and at 1 and 3 months.³⁸

Other outcomes.—Studies had variable assessment of asthma control,^{36–39} health care utilization,^{36,37,40} asthma-related quality of life,^{36,37,39} asthma knowledge, and asthma self-efficacy, with results reported in Table IV.

Study quality

Studies were rated as having medium^{36–39} to high risk of bias (Table V).⁴⁰ The most common sources of bias were attrition, measurement, selection, and detection. Two RCTs had attrition and measurement bias (eg, failure to download adherence data) but adequately adjusted for missing data using linear mixed effects modeling.^{36,37} One RCT had attrition and detection bias (eg, use of a subjective adherence measure).³⁹ Another RCT had selection (eg, no details on randomization, no concealment, and no adjustment for confounders) and detection bias (eg, use of subjective adherence measures).³⁸ The pre/post study received high risk of bias as a result of its susceptibility to selection bias (see Table E7 in this article's Online Repository at www.jaci-inpractice.org).⁴⁰

Study heterogeneity

We were not able to perform a meta-analysis due to both clinical and methodological heterogeneity. The included studies were clinically heterogeneous because each used different intervention types—problem solving, self-efficacy, technology-based motivational interviewing, patient advocate, and pharmacist-led education.

DISCUSSION

To our knowledge, this is the first systematic review of interventions to improve ICS adherence in adult black/African Americans—a population disproportionately affected by adverse asthma outcomes. We found few studies assessing ICS adherence focused on adult black/African-American populations. Furthermore, we found no RCTs that reported improved ICS adherence in adult black/African Americans. The low number of articles

identified is an important finding and reflects the need for studies of interventions designed specifically to address ICS adherence among black/African-American adults. Our findings are even more impactful when one realizes that disparities in asthma health outcomes and adherence have been characterized extensively in adult black/African Americans for decades. One of the important first steps in facilitating the transition from defining the problem to implementing effective solutions is identifying and characterizing effective ICS adherence interventions already evaluated in adult black/African Americans. Our finding serves to highlight the need to develop additional, rigorously evaluated, interventions.

Although we focused on the effectiveness of patient- and family-level ICS adherence interventions specifically in adult black/African Americans, our findings are consistent with those of other systematic reviews on minority-focused asthma interventions and reviews of asthma adherence interventions among the general population with varied targets (eg, provider, health system). In general, the strength of evidence for adherence interventions is not strong and though we make conclusions about common characteristics of effective interventions, the quality and strength of evidence are low to moderate in all previous reviews. Press et al²³ found a paucity of asthma intervention studies that included predominately adult minorities (eg, black/African American, Hispanic/Latino, and Native American) with rigorous study designs (eg, RCT). An Agency for Healthcare Research and Quality systematic review, not limited to black/African Americans, of adherence interventions in patients with chronic diseases concluded that self-management and shared decision-making interventions were the most efficacious at improving asthma medication adherence. However, asthma self-management interventions that included an intense education component were rated as “moderate strength of evidence of benefit,” whereas the shared decision-making interventions received a “low strength of evidence of benefit.”¹⁵ Our review serves as an update to Press et al, which was conducted on studies before 2010 among populations not limited to black/African Americans. Only 2 of our 5 studies were included in the Press et al review, and none of our included studies was evaluated in the Agency for Healthcare Research and Quality review.^{15,23} In addition, our review explores mechanisms (ie, cultural adaptation, qualitative analysis, and behavior theory) that informed intervention development.

Several reasons could account for the lack of efficacy of interventions studied in our review. First, the interventions were variably tailored to the needs of the black/African-American study participants, and may not have directly targeted barriers relevant to black/African-American participants.⁴¹ Also, none of the studies reported the prevalence or degree of impairment of the targeted barrier to ICS adherence (eg, low self-efficacy, low asthma knowledge, and poor problem solving) in their respective sample populations; consequently, a study could have targeted poor problem solving when financial barriers or poor social support were more prevalent barriers. Second, only 1 study was powered to evaluate change in their primary outcome³⁷; most of the included studies were feasibility studies.^{36,38–40} Third, the active controls could have mitigated the effect size. For instance, the problem-solving study noted an overall improvement in asthma control, asthma quality of life questionnaire, and FEV₁ in both study arms. The authors ascribed the improvement in clinical outcomes to 66% of the control group, thinking that their objective was to improve medication adherence.³⁷ Finally, the low number of studies identified in this review could be

due to the perceived difficulty in recruiting adult black/African Americans to clinical trials and/or the lack of focus on adherence promotion in this population.^{42,43}

To rigorously ascertain the effectiveness of ICS adherence interventions among black/African Americans, studies should attend to numerous gaps in the literature we uncovered in our review. First, only 1 study exclusively used objective measures of asthma adherence. Objective measures of asthma adherence are readily available, and their more routine use in clinical trials could help studies better quantify the effectiveness of interventions targeted toward black/African Americans.^{44,45} Second, only 1 study reported that it used behavioral change theory to inform the development of the interventions. There is increasing evidence that theory-informed, multicomponent approaches are critical for successful behavior change across race/ethnicity and disease condition.^{21,22} A meta-analysis of 147 medication adherence studies, which used behavior theory to inform intervention development, reported a statistically significant improvement in medication adherence outcomes.⁴⁶ Therefore, multicomponent interventions, targeting more than 1 barrier to ICS adherence, could be helpful. Designing interventions on the basis of theory (eg, health beliefs model and theoretical domains framework) enables the possibility of understanding the behavior change processes that underlie the interventions and the ability to apply this knowledge to inform the design of future interventions. Third, only 3 studies reported that they engaged stakeholders (including patients or their families) in the development of interventions. The use of focus groups and interviews of stakeholders can help ensure that interventions are relevant to target populations, are culturally acceptable, and can be easily translated into the real world.^{22,23} Consequently, the use of a behavior change theory and qualitative methods (eg, focus groups and semistructured interviews) to inform intervention development could potentially improve the extent to which interventions target barriers to adherence faced by black/African Americans. Finally, there needs to be an exploration of the unique barriers and facilitators to high-risk populations' (eg, black/African Americans) response to standard adherence interventions.

Future asthma medication adherence interventions in adult black/African Americans can also be informed by effective adherence interventions in predominately noneblack/African-American populations and studies conducted in adult race/ethnic minorities with various medical conditions. Previous systematic reviews of general medication adherence interventions, evaluated in predominately non—black/African-American populations, report that behavior change theory, multiple intervention components, or interventions with education, self-management, or shared decision-making components are most often found in effective general medication adherence interventions.^{14,15,17,18,47} To our knowledge, there are no reviews on adherence interventions with a stratified analysis by race/ethnicity or reviews that have explored intervention components associated with differential adherence outcomes by race/ethnicity. The Robert Wood Johnson Foundation: Finding Answers Initiative found that multifaceted programs, those focusing on cultural relevancy, nurse-led programs, interactive education, and family and community programs, were most often part of successful interventions in adult race/ethnic minorities across multiple chronic diseases.⁴⁸ Taken together, these common characteristics may lead to improved development of asthma medication adherence interventions and reduced asthma disparities.⁴⁸

There are a few limitations of our review. First, our search was limited to the United States, which could have limited our discovery of studies that could also inform interventions among black/African Americans. However, black/African Americans may experience unique barriers to ICS adherence not faced by other first world countries with universal health insurance. Furthermore, in an effort to study the effect of interventions primarily among black/African-American adults, we limited included studies to those enrolling at least 30% black/African Americans. This may have limited our capacity to detect effects among black/African Americans enrolled into smaller studies. Third, studies were heterogeneous in their intervention, design, and risk of bias, which limited our capacity to conduct a quantitative meta-analysis. Finally, it is possible that studies may have used behavioral change theory or stakeholder engagement in their designs but did not include this information in their manuscripts. Future efforts to report the process by which interventions target behavior change could help better clarify whether interventions tailored specifically to adult black/African Americans are more effective than those designed for the general public.

In conclusion, few studies assessing ICS adherence interventions focused on black/African-American adults, and rigorously studied interventions were not efficacious. Future rigorous RCTs of interventions informed by behavioral theory and cultural tailoring to improve ICS adherence and clinical outcomes among adult black/African Americans are needed.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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Abbreviations used

ICS	inhaled corticosteroid
RCT	randomized controlled trial

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What is already known about this topic?

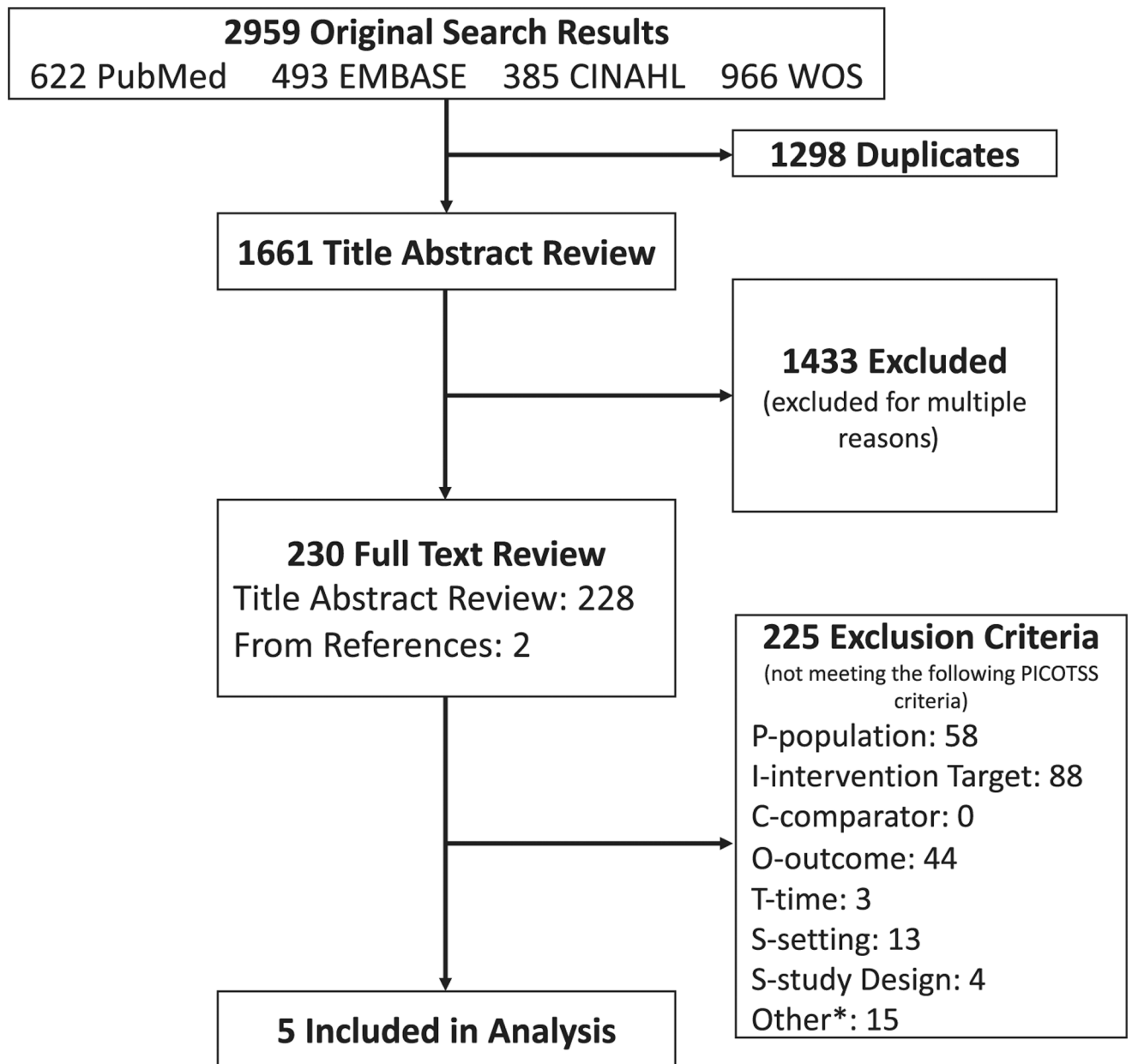
Inhaled corticosteroid adherence is suboptimal in adult black/African Americans and is a potential target to reduce asthma disparities. Little is known about the effectiveness of adherence interventions targeting adult black/African Americans or how they were developed.

What does this article add to our knowledge?

Few studies assessing asthma adherence interventions focus on adult black/African Americans, no randomized-controlled trials improved adherence, and only 1 study was developed using processes previously shown to increase the effectiveness of behavior interventions in minority populations.

How does this study impact current management guidelines?

It highlights the need to refocus efforts on critical and long-standing gaps in evidence linked to asthma disparities.

**FIGURE 1.**

Article review flow diagram. *WOS*, Web of Science. The 1433 citations excluded for multiple reasons included citations without an intervention and studies exclusively in children, nonasthma conditions, or conducted outside the United States. Studies often met multiple exclusion criteria. *Other: 1 full-text unavailable, 6 duplicates, 8 conference abstracts with insufficient information.

TABLE I.

Inclusion and exclusion criteria

PICOTSS Criteria		Inclusion	Exclusion
P- population	<ol style="list-style-type: none"> 1 At least 80% of study population has asthma 2 Age 18 y or older or adult data reported separately 3 At least 30% African-American or African-American data reported separately 	All other populations	
I- intervention	<ol style="list-style-type: none"> 1 Asthma ICS adherence promotion intervention - Example: medication reminder system, multicomponent intervention that measures ICS adherence 2 Interventions targeting patients, family/caregivers, or both 	<ol style="list-style-type: none"> 1 Interventions solely targeting providers, health systems, or any nonpatient/family entity - Example: EHR reminders for providers 2 Interventions not ICS adherence 	
C- comparator	<ol style="list-style-type: none"> 1 Any (active or usual care) comparator 	None	
O- outcomes	<p><i>Primary Outcomes:</i> Any measure of adherence including objective or self-reported</p> <p><i>Secondary Outcomes:</i></p> <ol style="list-style-type: none"> 1 Health outcomes—any measures of asthma morbidity and mortality - Not limited to asthma exacerbation, asthma control, asthma quality of life, mortality 2 Health utilization outcomes—any use of health care services including emergency department, outpatient, and hospitalization visits 3 Intermediate outcomes—asthma knowledge and self-management 	None	
T- previous time over which to review literature	<p>Databases (from inception):</p> <ol style="list-style-type: none"> 1 MEDLINE (1966 to present) 2 CINAHL (1946 to present) 3 EMBASE (1966 to present) 4 Web of Science (1900 to present) 		
T- time allotted for outcomes to appear	At least 1 mo		None
S- study designs allowed	<ol style="list-style-type: none"> 1 Trials (randomized and nonrandomized) 2 Cohort studies with a concurrent control 3 Single-group pre/post 		<ol style="list-style-type: none"> 1 Case series 2 Case control 3 Systematic reviews 4 Conference abstracts

PICOTTSS Criteria		Inclusion	Exclusion
S- setting allowed	1	Conducted in the United States	None
Publication language	2	Multicountry study if data reported by country and United States was included	All other languages

All other languages

Conducted in the United States

Multicountry study if data reported by country and United States was included

1

2

English

EHR, electronic health record.

TABLE II.

Characteristics of included studies (N = 5)

Study, year	Intervention type	Study design	Setting	Asthma criteria	No. of participants	Mean age (y)	% Women	Race/ethnicity composition	Assessment period (mo)
Apter et al., ³⁶ 2013	Patient advocate	RCT	Health system	Moderate or severe asthma on ICS	100	47	75	AA 71% W 16% H 2% Other 13%	4
Apter et al., ³⁷ 2011	Problem solving	RCT	Health system	Moderate or severe asthma on ICS	333	49	72	AA 68% W 20% H 7% Other 12%	4
Kolmodin MacDonnell et al., ³⁸ 2016	Computer-based motivational interviewing	RCT	Community	Persistent asthma, <80% adherence and <19 on ACT	49	22.4	73	90% AA 10% AA/mixed race or NR	3
Martin et al., ³⁹ 2009	Self-efficacy	RCT	Health system and community	Persistent asthma with 1. At least 1 acute care visit OR 2. Steroid use in past year	42	Control : 37 Intervention : 33	69	AA 93% Other 7%	6
Stiegler et al., ⁴⁰ 2003	Education	Pre/Post	Health system	Hospitalized for asthma using 1 pharmacy for all prescriptions	17	38.3	82	AA 82% W 12% H 6%	6

AA, African American; ACT, Asthma Control Test; H, Hispanic/Latino; NR, 1 subject did not report race/ethnicity; Other, Native American, Alaskan Native, Pacific Islander, Asian, Hawaiian Islander, Not reported; W, white.

* Mean age not reported for the total population.

TABLE III.

Intervention characteristics

Study, year	Intervention type	Comparator	Personnel implementing intervention	Used to inform intervention development		
				Behavior change theory	Qualitative analysis	Culturally adapted
Apter et al, ³⁶ 2013	Patient advocate	CD of asthma education	Lay staff with college degree	No	Yes	Yes
Apter et al, ³⁷ 2011	Problem solving	In-person asthma education	Lay staff with college degree	No	No	No
Kolmodin MacDonell et al, ³⁸ 2016	Computer-based motivational interviewing	Computer-based asthma education	Electronic	No	Yes	Yes
Martin et al, ³⁹ 2009	Self-efficacy	Asthma education mailings	Community health worker and social worker	Yes	Yes	Yes
Stiegler et al, ⁴⁰ 2003	Education	NA	Pharmacist	No	No	No

NA, Not applicable.

TABLE IV.

Outcomes of included studies

Study, year	Intervention type	Assessment period (mo)	Adherence measure	Adherence outcome	Self-management outcomes	Asthma health outcomes	Health care utilization outcomes
Apter et al., ³⁶ 2013	Patient advocate	4	Self-report (baseline rate) Electronic monitor with date and time (outcome measure)	NS	NR	FEV ₁ (NS) ACQ (NS) AQLQ (NS)	Asthma ED visits (NS) Asthma hospitalization (NS) Any ED visit (NS) Any hospitalization (NS)
Apter et al., ³⁷ 2011	Problem solving	4	Self-report (baseline rate) Electronic monitor with date and time (outcome measure)	NS	NR	FEV ₁ (NS) ACQ (NS) AQLQ (NS)	Asthma ED visits (NS) Asthma hospitalization (NS) Any ED visit (NS) Any hospitalization (NS)
Kolmodin MacDonell et al., ³⁸ 2016	Computer-based motivational interviewing	3	Self-report	NS	NR	FEV ₁ (NS) ACT (NS)	NR
Martin et al., ³⁹ 2009	Self-efficacy	6	Self-report	NS	Asthma self-efficacy (NS) Asthma knowledge (NS)	AQLQ-adjusted difference 1.8 (<i>P</i> = .002)* Symptomatic days/nights (NS)	NR
Stiegler et al., ⁴⁰ 2003	Education	6	Pharmacy refill	Mean ± SD 22% ± 6% vs 63% ± 24% <i>P</i> = .0175*	NR	NR	Combined asthma ED and hospitalizations Mean ± SD 1.58 ± 1.13 vs 0.35 ± 0.62, <i>P</i> = .0016*

ACQ, Asthma Control Questionnaire; AQLQ, asthma quality of life questionnaire; ED, emergency department visit; NR, not reported; NS, not statistically significant.

* Statistically significant.

TABLE V.

Overall risk of bias of included studies

Study, year	Intervention type	Overall risk of bias
Apter et al., ³⁶ 2013	Patient advocate	Medium
Apter et al., ³⁷ 2011	Problem solving	Medium
Kolmodin MacDonell et al., ³⁸ 2016	Computer-based motivational interviewing	Medium
Martin et al., ³⁹ 2009	Self-efficacy	Medium
Stiegler et al., ⁴⁰ 2003	Education	High