

Review Article

Technology-Based Interventions for Asthma—Can They Help Decrease Health Disparities?

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Asthma is a condition that has consistently demonstrated significant health outcome inequalities for minority populations. One approach used for care of patients with asthma is the incorporation of technology for behavioral modification, symptom monitoring, education, and/or treatment decision making. Whether such technological interventions can improve the care of black and inner-city patients is unknown. We reviewed all randomized controlled trial technological interventions from 2000 to 2015 performed in minority populations. A total of 16 articles met inclusion and exclusion criteria; all but 1 was performed in a childhood or adolescent age group. The interventions used MPEG audio layer-3 players, text messaging, computer/Web-based systems, video games, and interactive voice response. Many used tailored content and/or a specific behavior theory. Although the interventions were based on technology, most required additional special staffing. Subject user satisfaction was positive, and improvements were noted in asthma knowledge, medication adherence, asthma symptoms, and quality of life. Unfortunately, health care utilization (emergency department visits and/or hospitalizations) was typically not improved by the interventions. Although no single intervention modality was vastly superior, the computer-based interventions appeared to have the most positive results. In summary, technology-based interventions have a high level of user satisfaction among minority and urban/low-income individuals with asthma, and can improve asthma outcomes. Further large-scale studies are needed to assess whether such interventions can decrease health disparities in asthma. © 2016 American Academy of Allergy, Asthma & Immunology (J Allergy Clin Immunol Pract 2016;■:■-■)

Key words: Asthma; Health disparities; Technology; Computers; Inner-city; Text messages; Cellular phones

Asthma is a chronic inflammatory disease of the lungs, and also a health condition with significant income and racial inequalities in outcomes. Although the overall prevalence of asthma

in the United States is 8.0%, this rate is significantly higher (10.3%) among non-Hispanic blacks.¹ Furthermore, the black-white asthma disease severity and control disparity is even wider. For example, the hospital discharge rate for asthma was 8.7 per 10,000 for whites, whereas it was 29.9 for blacks; mortality rates were 8.4 per million for whites and 25.9 per million for blacks.² Many factors may explain such disparities including both environmental and underlying genetic influences. Urban areas, which often have a predominance of black patients, are heavily concentrated with risk factors associated with asthma such as air pollution,³ cockroaches,⁴ dust mites,⁵ poor diet,⁶ poverty,⁷ stress,⁸ and violence.⁹ Compared with whites, blacks visit an asthma specialist less often, and use an inhaled corticosteroid for persistent asthma less frequently.^{7,10-12}

Although no single intervention may be able to address all factors associated with asthma health disparities, a novel approach is the use of technology. Technological interventions have the ability to assist in the delivery of behavioral, monitoring, educational, and shared decision-making activities. Examples include the use of computer programs, short message service text messaging, Internet Web sites, social media groups, and MPEG audio layer-3 (MP3) players. Although technology-based interventions are innovative, the medical community has questioned whether these could be effective in reducing asthma morbidity in communities of color with high need, but low access. In this article, we summarize published reports on technology-based interventions that have been evaluated in black and urban/low-income individuals with asthma.

METHODS

To complete this narrative review, PubMed, OVID, PsychInfo, and CINAHL searches were conducted for abstracts published between January 2000 and October 2015. The databases were searched using a combination of the text word “asthma” and one of the following text words: “technology base,” “computers,” “cellular phones,” “outcomes,” “texting,” “urban populations,” and “inner city.” Other combination words such as “social media” and “apps” did not yield successful searches. Abstracts that were not written in English and did not pertain to human subjects were excluded. The resulting abstracts went through a tiered elimination system and were excluded if they fell in any of the following categories: not related to asthma outcomes, not technology-based, not a randomized controlled trial (RCT), not a minority population, or not conducted in the United States. Also excluded were systematic reviews. The remaining abstracts were considered as candidate articles, and their full texts were examined by 2 investigators (C.L.M.J. and A.B.). The inclusion criteria were focused on minority and inner-city populations containing patients of all ages. Sixteen articles met inclusion and exclusion criteria for this review, and described 13 unique interventions (Figure 1).

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Abbreviations used

IVR- interactive voice response
MP3- MPEG audio layer-3
RCT- randomized controlled trial

Each article was assessed for the demographic characteristics of the study population (total subjects, age, and ethnicity) and percent retention. We also identified the specific type of electronic format used, number of sessions, and whether each intervention was a pilot study, theory-based, had tailored content, or required special staffing. To assess intervention efficacy, we focused on the following outcomes: health care utilization (emergency department visits, hospitalizations, urgent care visits), medication adherence, quality of life, asthma knowledge, *functional status* (defined as factors related to asthma control, including symptom-days/nights, days of restricted activity, school days missed, and days of changed plans), and positive participant feedback. The following categories of interventions were identified and are described below: MP3, short message service text messaging, computer/Web-based, and other (video games, interactive voice response [IVR], and Health Buddy).

RESULTS**MP3**

Young adults and adolescents frequently listen to music through audio portable media players, frequently referred to as MP3 players. A national survey performed by the Kaiser Family Foundation found that 76% of teenagers used an iPod or MP3 player.¹³ MP3 players may also play a role in improving health and health-related behaviors. For example, studies have been performed using MP3 players to screen for sleep apnea,¹⁴ to deliver positive messages to ventilated patients in the intensive care unit,⁹ and to improve adherence with human immunodeficiency virus medications.¹⁵ In asthma care, 2 randomized controlled pilot studies have been performed among black/Hispanic populations. Both were performed in teenage populations, and both by the same author using 2 interventions, and conducted among 2 cohorts of patients.

In the first pilot, Mosnaim et al¹⁶ randomized 28 inner-city black adolescents with asthma to receive (1) celebrity asthma messages or (2) general health messages (control group) between music tracks on an MP3 player. The celebrity asthma messages were delivered by black athletes and musicians in an attempt to reduce the stigma associated with having this chronic disease. At 12 weeks, there was a statistically significant increase in asthma knowledge (assessed by the ZAP Asthma knowledge test) among the celebrity asthma message group than among the control group. No other outcomes were evaluated.

More recently, Mosniam et al¹⁷ randomized 68 inner-city black and/or Hispanic adolescents with asthma to an intervention that consisted of weekly peer support groups augmented by MP3 messages that promoted medication adherence, or a control group.¹⁷ The messages were developed and recorded by the adolescents themselves, and each participant recorded 2 to 4 messages gleaned from discussions at the weekly peer support meetings. These messages were set to music, and randomly played between favorite music tracks on an MP3 device provided to participants. At 10 weeks, there was no difference in adherence or asthma knowledge between the intervention and control groups. No further outcomes were measured.

Text messaging

According to the Pew Research Center, as of October 2014, 90% of American adults own a cellular phone and 81% of these adults use the phone for text messaging.¹⁸ Blacks are as likely or more likely to have a cell phone compared with those of other races.¹⁸ There is also data that patients with asthma are interested in using text messaging as a platform to improve asthma care. A study from 2011 by Baptist et al¹⁹ assessed the electronic preferences (email, text messaging, and social media) of patients with asthma between the ages of 12 and 40 years. Specific items investigated included overall use, interest in receiving asthma information, and interest in communicating with a health care provider about asthma through each of the electronic media modalities. Of the 145 participants included in the study, 20.1% were black and 60% were female. Among all participants, text messaging was the most commonly used electronic media, with 82.5% of the respondents stating they text at least once a week. There was also significant enthusiasm for the use of text messaging to receive asthma information; among those aged 18 to 29 years, 50% stated they would be interested in doing so. Text messaging has been used successfully for blacks as an adjunct treatment for obesity²⁰ and to increase physical activity²¹; however, this method was unsuccessful in improving outcomes of glaucoma treatment,²² nor was it able to increase vaccination rates.²³

Two pilot RCTs were identified that examined the use of text messaging among racially/ethnically diverse populations with asthma. In 2012, Seid et al²⁴ performed an RCT of 26

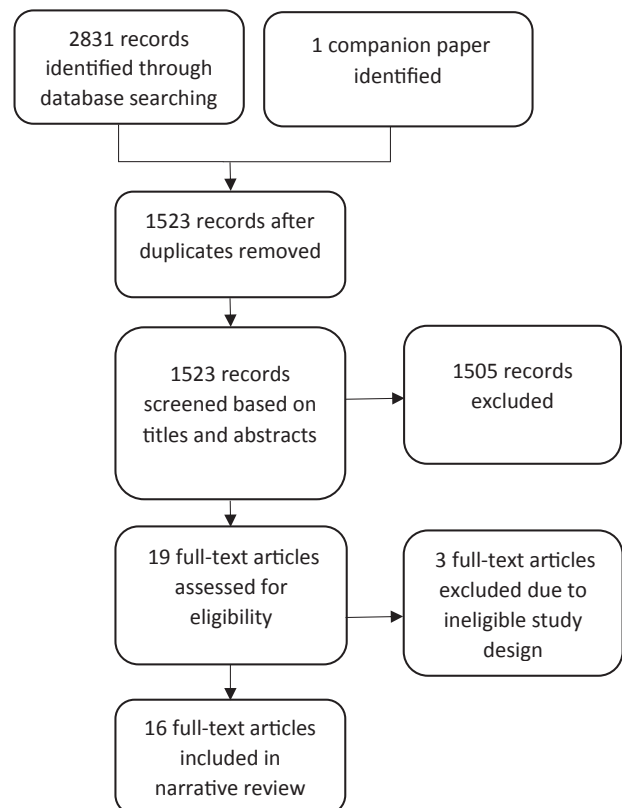


FIGURE 1. Selection of studies for narrative review.

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