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The Detroit Young Adult Asthma Project: Pilot of a Technology-Based Medication Adherence Intervention for African American Emerging Adults

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Abstract

Purpose—To conduct a randomized controlled pilot of a multi-component, technology-based intervention promoting adherence to controller medication in African American emerging adults with asthma. The intervention consisted of two computer-delivered sessions based in Motivational Interviewing (MI) combined with text messaged reminders between sessions.

Methods—Participants (N=48) were 18–29 years old, African American, with persistent asthma requiring controller medication. Participants had to report poor medication adherence and asthma control. Youth were randomized to receive the intervention or an attention control. Data were collected through computer-delivered self-report questionnaires at baseline, 1-, and 3-months. Ecological Momentary Assessment (EMA) via two-way text messaging was also used to collect "real time" data on medication use and asthma control.

Results—The intervention was feasible and acceptable to the target population, as evidenced by high retention rates and satisfaction scores. Changes in study outcomes from pre- to post-intervention favored the intervention, particularly for decrease in asthma symptoms, $t(42) = 2.22$, $p < .05$ (Cohen's $d = .071$).

Conclusions—Results suggest that the intervention is feasible and effective. However, findings are preliminary and should be replicated with a larger sample and more sophisticated data analyses.

Keywords

Asthma; African American; Emerging Adults; mHealth; Technology; Medication Adherence; Health Disparities; Motivational Interviewing

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Racial and ethnic minority youth tend to have poorer asthma control, marked by more frequent and severe asthma symptoms and attacks, than white youth,¹ even after controlling for socioeconomic variables.² Consistent daily use of asthma “controller” medications is the primary treatment recommendation to prevent asthma exacerbations (i.e., asthma attacks, including symptoms such as shortness of breath, excessive coughing, and difficulty breathing, typically requiring use of a rescue medication and/or medical intervention) from occurring in people with persistent asthma.³ The consequences of poor adherence include illness complications and fatal asthma exacerbations.⁴ Despite these risks, the research and intervention literature on asthma management in racial/ethnic minority adolescents and emerging adults is limited.⁵

The current project included African Americans in emerging adulthood,⁶ a developmental period (ages 18–29) marked by increased risk for illness consequences.^{7, 8} Emerging adulthood is a time of identity exploration, new social networks, independence and risk-taking, and decreased parental support.⁶ However, research focused on the transition to adulthood has been almost exclusively conducted with predominately white samples.⁹ Preliminary research indicates that minority youth may experience emerging adulthood differently than their white peers^{10, 11} and face unique challenges due to societal stereotypes.¹² This suggests that interventions need to consider developmental stage, culture, and context and be targeted specifically to minority youth.

Technology (e.g., cell phones and computers) may hold promise for delivery of targeted, brief interventions for emerging adults since most already tend to use such technologies in their daily lives.¹³ A number of successful technology-based interventions have been conducted with youth with asthma,^{14–17} though no previous studies have specifically targeted African American emerging adults. Technology-delivered interventions cannot replicate the important human elements of traditional interventions; however, they may offer tremendous advantages in terms of reach, replicability, anonymity, cost, and time. The current project utilized *Computerized Intervention Authoring Software (CIAS)*, an interactive software technology,¹⁸ to deliver a brief intervention based in the principles of Motivational Interviewing (MI).¹⁹ MI is a client-centered, goal-oriented method of communication for enhancing intrinsic motivation to change behavior through the exploration and resolution of ambivalence.²⁰ MI adaptations for youth with chronic conditions have shown strong effects^{21, 22} and one meta-analysis suggested stronger effects in studies targeting minorities.²³

The project presented here is a randomized controlled pilot of a multi-component, technology-based intervention promoting medication adherence in African American emerging adults. The goal of the study was to develop and preliminarily test the feasibility and initial efficacy of this intervention versus a comparison control in $N = 50$ youth. The intervention consisted of two CIAS-delivered motivational sessions combined with individualized text messages. Youth were randomized to the intervention or to a comparison control condition, both of which were delivered using CIAS. We expected the intervention would be feasible and acceptable to youth as evidenced by retention 80% and high client satisfaction. We hypothesized that youth in the intervention condition would show greater improvement in adherence than those in the control. We also expected that youth in the

intervention would show greater improvement in asthma control than those in the control condition.

Method

Participants and Procedures

Youth were recruited from an urban university and an affiliated medical center. Participants had to be 18–29 years old, African American, diagnosed with persistent asthma, and prescribed a controller medication to be eligible. Participants also had to have access to a cell phone with texting capability and report <80% adherence in the past 30 days and score 19 on the Asthma Control Test.²⁴ When medication was not on hand to confirm current prescription, self-report was confirmed by contacting the pharmacy. Exclusion criteria included pregnancy, inability to understand written or spoken English, having another serious medical condition requiring regular medication, and/or an active psychiatric disorder that would interfere with study participation. The Human Investigation Committees at the university and medical center approved the project. Of 62 youth approached, 3 refused screening and 10 were ineligible, yielding a final sample of 50 who provided informed consent and 49 who were randomized (Figure 1).

The timing and flow of procedures for data collection and sessions are detailed in Figure 2. Participants completed informed consent with the research assistant. Following this, youth were oriented to the procedures for EMA. For 7 consecutive days, participants were prompted for their asthma symptoms and medication use via two-way text messages sent to their personal cell phones. Baseline data collection and session 1 occurred in the research laboratory (or an alternative location of the participant's choosing) via CIAS immediately following the EMA period. After completing the questionnaires, the computer automatically randomized them to receive either the intervention ($n = 25$) or control ($n = 24$), which was also delivered via CIAS. After completing the first intervention/control session, participants received 30 days of text messages to take controller medication (intervention) or a daily text with an asthma fact (control). Youth in the intervention condition were given the option of opting out of these text messages in keeping with the spirit of MI (e.g., emphasis on autonomy and personal choice). The second data collection and intervention session occurred one month post-baseline. Youth returned for a 3-month post-baseline data collection (no intervention session), which was preceded by 7 days of EMA. No participants were lost to follow up at 1-month, but $n = 2$ did not complete the 3-month. Youth were compensated \$200 and transportation was available.

Intervention Condition

The intervention consisted of two CIAS-delivered sessions with personalized, daily text messaged reminders to take medication delivered between these sessions. EMA via text messaging was conducted prior to the first intervention session to gather real-time data on participants' medication adherence and asthma symptoms. These data were used to tailor the intervention session for each participant. The intervention components are described below.

Computer-delivered intervention sessions and text messaged reminders—

Intervention sessions were adapted from the *Motivational Enhancement System for Adherence (MESA)*, an intervention for youth ages 16–24 starting HIV antiretroviral medication that showed great promise in pilot testing.²⁵ Intervention content and format were informed by preliminary work with African American emerging adults with asthma.^{26, 27} Sessions were provided by an animated character (e.g., “Peedy” the parrot), selected by the participant from 10 possible choices. Avatars were developed via focus groups with African Americans. There were key components to each session, consistent with the principles of MI: 1) feedback regarding medication use and symptoms, 2) feedback on readiness to improve adherence, 3) decisional balance, or pros and cons of taking medications, and 4) a summary regarding the youth’s interest in improving adherence, followed by optional goal setting. Figure 3 shows the flow and branching of session 1. Significant efforts were made to ensure that the animated character delivered the intervention in a way that had high fidelity to MI intervention delivery principles. Small amounts of appropriate psycho-education about improvements in health that can result from improvements in adherence were integrated with the motivational elements. The provision of such information is consistent with the Information-Motivation-Behavioral Skills (IMB) model, which suggests that motivational approaches are most effective in the context of sensitively provided information about a health-related behavior.²⁸ Sessions ended with optional goal setting (e.g., commit to taking controller every day) and trouble-shooting barriers. Participants were offered the choice of how and when to receive text messages between intervention sessions (e.g., what time(s) each day to receive reminders). Participants also had the option of opting out of text messages. The *CareSpeak mobile Health Manager™* (<http://www.carespeak.com/corp/solutions>) was used to deliver text messages and track message status. The length of the intervention sessions was approximately 30 minutes each, with the total duration of a visit (combined assessment and intervention) 1.5 – 2 hours.

Ecological Momentary Assessment (EMA)—EMA via text messages was used to assess each participant’s experiences living with asthma for 7 days prior to the first intervention session and 3-month data collection. EMA refers to methods that allow a research participant to report on symptoms, affect, behavior and cognitions in “real time” rather than rely on retrospective self-reporting.²⁹ The *CareSpeak mobile Health Manager™* was used to deliver text messages to participants and track their responses. EMA data, along with participants’ responses to questionnaires collected via CIAS, were used to tailor the intervention. For example, in the spirit of MI, participants were offered the choice to receive feedback on how many doses of medication they had missed during the EMA period and then prompted for their reaction. The EMA method and messaging content were piloted with African American emerging adults prior to the present study.²⁷

Comparison Control: Asthma Education

Control participants completed CIAS-delivered asthma education matched for length, location, and method of delivery of the intervention session. The control session was delivered by the avatar “Peedy the parrot” and included interactive features such as quizzes and responses to poll questions. Content focused on facts and myths about asthma,

controlling environmental factors, and pharmacologic management. Control participants received text messages between sessions via CareSpeak, but message content was the same for all participants and contained general facts about asthma. Control participants also received 7 days of EMA prior to the first session, but data were not used to tailor the session. This comparison condition controlled for improvement due to non-specific intervention factors such as positive expectancies due to entering treatment, positive-regard and attention from being part of the intervention project, and having opportunities to learn about asthma and asthma treatment.

Measures

Ecological Momentary Assessment

Adherence to medication and asthma control: Adherence to medication and asthma control (operationalized as asthma symptom prevalence) were measured using EMA via two-way interactive text messaging for all participants at baseline and 3-months. Participants were prompted 3 times per day (morning, mid-day, and evening) during the 7-day period to report any asthma medications they had taken and symptoms they had experienced since the last texted prompt. Separate texts were sent to prompt for adherence and symptoms and spaced to allow time for response. Each morning, participants were also asked to report the total number of doses taken of controller medications the previous day.

Self-Report Questionnaires (via CIAS)

Medication adherence: Poor adherence to controller medication in the past month was assessed using a 6-item yes/no self-report questionnaire.³⁰ For each item, the “no” response indicated better adherence (e.g., “...have you used your inhaler/nebulizer less than the doctor prescribed?”). Responses were coded so that higher total scores indicated poorer adherence. Internal consistency was high with Cronbach’s alphas of 0.79, 0.82, and 0.86 at baseline, 1-month, and 3-month data collections, respectively.

Medication adherence was also measured using a single item asking participants to report the total number of doses of controller medication they had missed over the previous 7 days. This was then compared against a participant’s prescribed number of doses and percentage of doses taken calculated.

Asthma control: Asthma control was assessed using the *Asthma Control Test* (ACT),²⁴ a 5-item questionnaire used to identify people with poorly controlled asthma. Scores range from 5 (poor control) to 25 (complete control of asthma). An ACT score > 19 indicates well-controlled asthma.

Lung functioning: Pulmonary functioning was assessed by using forced expiratory maneuvers obtained with a portable calibrated recording spirometer (KoKo) at baseline and 3-months. Forced expiratory volume in 1s (FEV1) has been demonstrated to provide reliable and reproducible information about airflow and has been correlated with clinical outcomes.³¹ All research assistants were trained by a KoKo training specialist and evaluated by the asthma specialty clinic’s respiratory therapist based on American Thoracic Society standards.

Participant satisfaction: Participants completed the 8-item *Client Satisfaction Questionnaire (CSQ-8)*³² after the second session. Items assessed a participant's satisfaction and were rated on a 4-point scale from 1 (*poor*) to 4 (*excellent*).

Results

Table 1 shows baseline characteristics of intervention and control groups. Participants ranged from 18 to 29 years of age with $M = 22.4$ ($SD = 3.8$). There were 36 females and 12 males and 43 (89.6%) described themselves as Black/African American and 5 as African American/Mixed Race. Nineteen (39.6%) had biological children (5 males, 14 females). Most had a high school degree or equivalent (50%) and 41.7% were employed part- or full-time. Twelve (25.0%) received disability, supplemental security income, and/or food assistance. Participants reported $M = 2.4$ ($SD = 3.5$) asthma exacerbations in the 4 weeks prior to study entry. Scores on the *Asthma Control Test*²⁴ ranged from 7 to 23 with $M = 14.5$ (4.0), indicating a majority of participants (89.6%) had poorly controlled asthma at baseline. Lung functioning, as forced expiratory volume (FEV-1), was $M = 80.2$ ($SD = 18.7$) percent predicted FEV-1 at baseline. Participants reported taking controller medication as prescribed $M = 68.8\%$ of the time ($SD = 29.8$) in the month before study entry based on the study screener. Participants responded to $M = 5.5$ ($SD = 1.1$) and $M = 5.3$ ($SD = 1.3$) out of 7 EMA texts per day at baseline and 3-months, respectively. No significant differences were found between intervention and control participants on any of these characteristics.

Both intervention and control groups rated the program favorably; moreover, no intervention group participants chose to opt out of text messages between sessions. Intervention group participants had $M = 3.6$ ($SD = 0.4$) overall satisfaction rating (4 possible). Control group participants had $M = 3.5$ ($SD = 0.5$) overall satisfaction. Overall score and ratings on individual scale items did not differ significantly across groups, though the item asking “How satisfied are you with the amount of help you received for taking medications?” showed a trend towards higher scores in the intervention group (intervention $M = 3.7$ ($SD = 0.5$), control $M = 3.4$ ($SD = 0.8$), *Cohen's d* = 0.5).

Because the pilot study was not powered for significance testing, we also calculated effect sizes using Cohen's *d*. Table 2 summarizes the changes from baseline to 3-months for EMA measures and changes from baseline to 1- and 3-months for self-report (CIAS) questionnaires. Change scores were calculated as post-intervention – baseline value, so that negative change scores represented change in the desired direction for all measures except the ACT and FEV-1.

Medication Adherence

Adherence measured via EMA utilized both texted prompts sent three times each day (“daily texts”) and a single texted prompt sent each morning asking about the previous day's adherence (“AM prompt”). Total doses missed, as obtained by each of these methods, was highly positively correlated at baseline (0.4, $p < .01$) and 3 month follow-up (0.7, $p < .001$). Thus, results include only the “AM prompt” data from this point forward. Both groups missed fewer doses of controller medication at 3 months than at baseline. The magnitude of the trend was greater for the intervention than control group for total doses missed, $t(44) =$

1.06 ($d = 0.35$), average doses missed per day, $t(44) = 1.05$ ($d = 0.35$), and number of days medication was missed, $t(44) = 1.56$ ($d = 0.53$), though these did not reach significance at $p .05$.

Both groups improved in self-reported poor adherence behavior at both 1- month and 3-month follow-ups. The intervention group showed larger decreases at both time points, $t(45) = 0.92$ and $t(42) = 1.30$ ($d = 0.27$ and 0.40) for 1- and 3-month change scores though group differences did not reach significance. Both groups improved in the number of doses missed in the last week at 1-month follow-up, with larger magnitude (though not statistically significant) improvement in the intervention group, $t(42) = 0.48$ ($d = 0.15$). At 3-months, both groups reported an increase in number of doses missed. This increase was somewhat greater magnitude for the intervention group, $t(41) = -0.97$, $d = 0.30$, though this was not significant.

Asthma Control

Asthma symptom prevalence was measured using texted prompts sent three times each day. To normalize data distribution, 2 large and influential outliers were deleted and data subjected to log10 transformation. Results indicated decreasing symptom frequency from baseline to 3-months. There was a larger magnitude decrease in the intervention than control group in total symptoms, $t(42) = 2.22$, $p < .05$ ($d = .071$) and average symptoms per day, $t(42) = 2.22$, $p < .05$ ($d = 0.71$).

Both groups showed improvement in self-reported asthma control (*ACT*) at both 1- and 3-months. The intervention group had larger magnitude improvements with $t(45) = -1.40$ and $t(43) = -1.67$, $d = 0.42$ and 0.51 , respectively, though these were trend-level differences.

The intervention group improved in FEV-1 percent predicted (+ 4.41%) and the control group decreased (-4.14%), $t(41) = -1.89$, $p .01$, $d = 0.59$.

Discussion

This study demonstrated that a brief computer-delivered MI adherence intervention plus text messaging was feasible and acceptable to African American emerging adults with persistent asthma. This was evidenced by high retention rates and satisfaction scores, as is consistent with most technology-delivered MI interventions.³³ A recent meta-analysis found that technology-based interventions with behavioral components are more efficacious for youth than information-only interventions.³⁴ The current intervention used an MI approach to support autonomous motivation, build self-efficacy for taking medications as prescribed, provide feedback, and engage in goal-setting. The MI framework may have advantages over providing asthma education without regard to youth's beliefs about asthma management. MI aims to build patients' intrinsic motivation to adopt health recommendations (e.g., taking medication as prescribed) and addresses patients' ambivalence about making behavior changes.³⁵ There is evidence that providing information about healthy behaviors to someone who is not ready to change can actually inhibit change.³⁶

Changes in study outcomes from pre- to post-intervention favored the intervention condition, particularly for asthma symptom control, with effect sizes similar to those seen in meta-analyses.³⁴ Importantly, these effects were seen when comparing the intervention to a control condition that included asthma content. These positive results are generally consistent with other recent trials of MI delivered via technology for health behavior change.³³ Effect sizes were comparable to those found in the pilot of MESA, from which the present intervention was adapted.²⁵ A recent Cochrane Review of adherence studies across chronic conditions found only a small number of trials improved both medication adherence and clinical outcomes.³⁷ Results of the present study suggested improvement in both adherence and symptom control measured by self-report questionnaire, real-time data collection, and spirometry. The one exception was self-reported doses missed at 3-months. Intervention group participants reported missing about 1 more dose in the past 7 days than at baseline, but also indicated improvement in asthma symptoms. Thus, it is possible that they were simply more aware of their adherence post-intervention and more accurately reported any doses they missed, though this cannot be determined with available data.

This study used EMA to assess daily experiences living with asthma and to tailor the intervention based on recent medication use and symptom frequency. EMA has been used successfully to assess variability of asthma symptoms,³⁸ but it has not been extensively utilized as a tool for individualizing an intervention. EMA may have advantages over more traditional assessment methods, as it avoids issues of recall bias often encountered when using methods that rely on retrospective reporting. In the current study, there was some variation in reported adherence across types of assessments, though symptom reporting was more consistent. Few studies have directly compared EMA and retrospective recall methods to measure adherence and symptoms; however, studies in other areas (e.g., coping) suggest that participants tend to under-report the frequency of events when reporting using retrospective recall versus EMA.³⁹

This study is a pilot, so findings are preliminary and should be replicated with a larger sample size and more sophisticated analyses. One limitation is reliance on self-report measures. Future research should assess the validity of adherence measured by EMA via text messaging by comparing it to other measures such as pill/inhaler counts or GPS tracking. In addition, analyses included in the present study did not include an in-depth assessment of EMA data, as we plan to focus on EMA data more extensively in future work. Finally, it is possible that texting may have inadvertently served as a reminder to take medications, making accurate measurement of adherence difficult. A larger trial is necessary to confirm results, ideally with the addition of an objective measure of adherence.

The delivery of successful technology-delivered motivational interventions for improving medication adherence, such as the current intervention, could circumvent many of the barriers that prevent successful behavioral interventions from being implemented.⁴⁰ Technology-delivered interventions can be provided inexpensively and easily to unprecedented proportions of persons with a given behavioral risk factor such as poor medication adherence. These interventions could be used to dramatically and cost-effectively identify and address asthma regimen adherence issues during routine asthma or primary care, or even during an emergency department visit. Future studies should continue

to explore the efficacy of brief, technology-delivered motivational interventions in the broader population of emerging adults with chronic illness. In addition, research should continue to explore ways to tailor these brief interventions to the needs and characteristics of each participant to increase their potential impact. The present study piloted a unique, technology-delivered intervention specifically targeting adherence to controller medication in African American emerging adults with persistent asthma. The project included multiple technologies for both assessment and intervention, which may extend the impact of the brief intervention for this under-served population.

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References

1. Akinbami, OJ.; Moorman, JE.; Liu, X. Asthma prevalence, health care use, and mortality: United States, 2005–2009. US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics; 2011.
2. Lieu TA, Lozano P, Finkelstein JA, et al. Racial/ethnic variation in asthma status and management practices among children in managed medicaid. *Pediatrics*. 2002 May; 109(5):857–865. [PubMed: 11986447]
3. Janson SL, McGrath KW, Covington JK, Cheng S-C, Boushey HA. Individualized asthma self-management improves medication adherence and markers of asthma control. *Journal of Allergy and Clinical Immunology*. 2009; 123(4):840–846. 4//. [PubMed: 19348923]
4. O'Connor KS, Osborn L, Olson L, et al. Design and operation of the National Asthma Survey. *Vital and health statistics Ser 1, Programs and collection procedures*. 2008; (46):1–122. 08/. [PubMed: 18958992]
5. Bryant-Stephens T. Asthma disparities in urban environments. *The Journal of allergy and clinical immunology*. 2009 Jun; 123(6):1199–1206. quiz 1207-1198. [PubMed: 19501229]
6. Arnett, JJ. *Emerging Adulthood: The Winding Road from the Late Teens through the Twenties*. USA: Oxford University Press; 2004.
7. Arnett JJ. Afterword: Aging out of care--toward realizing the possibilities of emerging adulthood. *New directions for youth development*. 2007 Spring;(113):151–161. [PubMed: 17523528]
8. Park MJ, Paul Mulye T, Adams SH, Brindis CD, Irwin CE Jr. The health status of young adults in the United States. *Journal of Adolescent Health*. 2006; 39(3):305–317. [PubMed: 16919791]
9. Arnett JJ. Conceptions of the Transition to Adulthood Among Emerging Adults in American Ethnic Groups. *New directions for child and adolescent development*. 2003; 2003(100):63–76. [PubMed: 12955983]
10. Arnett JJ. A Fraught Passage: The Identity Challenges of African American Emerging Adults. *Human development*. 2008; 51(5–6):291–293.
11. Arnett JJ, Galambos NL. Culture and conceptions of adulthood. *New directions for child and adolescent development*. 2003 Summer;(100):91–98. [PubMed: 12955985]
12. Arnett JJ. Conceptions of the transition to adulthood among emerging adults in American ethnic groups. *New directions for child and adolescent development*. 2003 Summer;(100):63–75. [PubMed: 12955983]
13. Madden M, Lenhart A, Duggan M, Cortesi S, Gasser U. *Teens and Technology 2013*. Pew Research Center. [Accessed February 9, 2015] Available at: <http://www.pewinternet.org/2013/03/13/teens-and-technology-2013/>.
14. Nickels A, Dimov V. Innovations in technology: social media and mobile technology in the care of adolescents with asthma. *Current allergy and asthma reports*. 2012; 12(6):607–612. [PubMed: 22976493]

15. Mosnaim G, Li H, Martin M, et al. The impact of peer support and mp3 messaging on adherence to inhaled corticosteroids in minority adolescents with asthma: a randomized, controlled trial. *The Journal of Allergy and Clinical Immunology: In Practice*. 2013; 1(5):485–493. [PubMed: 24565620]
16. Holtz B, Whitten P. Managing asthma with mobile phones: a feasibility study. *TELEMEDICINE and e-HEALTH*. 2009; 15(9):907–909. [PubMed: 19919198]
17. Joseph CL, Ownby DR, Havstad SL, et al. Evaluation of a web-based asthma management intervention program for urban teenagers: reaching the hard to reach. *Journal of Adolescent Health*. 2013; 52(4):419–426. [PubMed: 23299008]
18. Ondersma SJ, Chase SK, Svikis DS, Schuster CR. Computer-based brief motivational intervention for perinatal drug use. *Journal of substance abuse treatment*. 2005 Jun; 28(4):305–312. [PubMed: 15925264]
19. Miller, WR.; Rollnick, S. *Motivational interviewing: Helping people change*. Guilford press; 2012.
20. Miller WR, Rollnick S. *Motivational interviewing: Preparing people for change* Guilford. New York. 2002
21. Martins RK, McNeil DW. Review of motivational interviewing in promoting health behaviors. *Clinical psychology review*. 2009; 29(4):283–293. [PubMed: 19328605]
22. Gayes LA, Steele RG. A meta-analysis of motivational interviewing interventions for pediatric health behavior change. *Journal of consulting and clinical psychology*. 2014; 82(3):521. [PubMed: 24547922]
23. Hettema J, Steele J, Miller WR. Motivational interviewing. *Annu Rev Clin Psychol*. 2005; 1:91–111. [PubMed: 17716083]
24. Nathan RA, Sorkness CA, Kosinski M, et al. Development of the asthma control test: A survey for assessing asthma control. *Journal of Allergy and Clinical Immunology*. 2004; 113(1):59–65. 1//. [PubMed: 14713908]
25. Naar-King S, Outlaw AY, Sarr M, et al. Motivational Enhancement System for Adherence (MESA): Pilot Randomized Trial of a Brief Computer-Delivered Prevention Intervention for Youth Initiating Antiretroviral Treatment. *Journal of Pediatric Psychology*. 2013 Jul 1; 38(6):638–648. 2013. [PubMed: 23359664]
26. MacDonell K, Idalski Carcone A, Naar-King S, Gibson-Scipio W, Lam P. African American Emerging Adults' Perspectives on Taking Asthma Controller Medication: Adherence in the "Age of Feeling In-Between. *Journal of Adolescent Research*. 2014:1–18.
27. MacDonell K, Gibson-Scipio W, Lam P, Naar-King S, Chen X. Text Messaging to Measure Asthma Medication Use and Symptoms in Urban African American Emerging Adults: A Feasibility Study. *Journal of Asthma*. 2012; (00):1–5.
28. Fisher WA, Fisher JD, Harman J. The information-motivation-behavioral skills model: A general social psychological approach to understanding and promoting health behavior. *Social psychological foundations of health and illness*. 2003:82–106.
29. Shiffman S, Stone AA, Hufford MR. Ecological momentary assessment. *Annu Rev Clin Psychol*. 2008; 4:1–32. [PubMed: 18509902]
30. Brooks CM, Richards JM, Kohler CL, et al. Assessing adherence to asthma medication and inhaler regimens: a psychometric analysis of adult self-report scales. *Medical care*. 1994:298–307. [PubMed: 8145604]
31. Knudson RJ, Kaltenborn WT, Knudson DE, Burrows B. The single-breath carbon monoxide diffusing capacity. Reference equations derived from a healthy nonsmoking population and effects of hematocrit. *Am Rev Respir Dis*. 1987 Apr; 135(4):805–811. [PubMed: 3565929]
32. Larsen DL, Attkisson CC, Hargreaves WA, Nguyen TD. Assessment of client/patient satisfaction: Development of a general scale. *Evaluation and program planning*. 1979; 2(3):197–207. [PubMed: 10245370]
33. Shingleton RM, Palfai TP. Technology-delivered adaptations of motivational interviewing for health-related behaviors: A systematic review of the current research. *Patient education and counseling*.
34. Cushing CC, Steele RG. A meta-analytic review of eHealth interventions for pediatric health promoting and maintaining behaviors. *Journal of pediatric psychology*. 2010:jsq023.

35. Borrelli B, Riekert KA, Weinstein A, Rathier L. Brief motivational interviewing as a clinical strategy to promote asthma medication adherence. *Journal of Allergy and Clinical Immunology*. 2007; 120(5):1023–1030. [PubMed: 17904625]
36. Moyers TB, Martin T. Therapist influence on client language during motivational interviewing sessions. *Journal of substance abuse treatment*. 2006 Apr; 30(3):245–251. [PubMed: 16616169]
37. Nieuwlaat R, Wilczynski N, Navarro T, et al. Interventions for enhancing medication adherence. *Cochrane database of systematic reviews*. 2014; 11
38. Smyth JM, Soefer MH, Hurewitz A, Kliment A, Stone AA. Daily psychosocial factors predict levels and diurnal cycles of asthma symptomatology and peak flow. *Journal of behavioral medicine*. 1999; 22(2):179–193. [PubMed: 10374142]
39. Stone AA, Schwartz JE, Neale JM, et al. A comparison of coping assessed by ecological momentary assessment and retrospective recall. *Journal of personality and social psychology*. 1998 Jun; 74(6):1670–1680. [PubMed: 9654765]
40. Rotheram-Borus MJ, Duan N. Next generation of preventive interventions. *Journal of the American Academy of Child & Adolescent Psychiatry*. 2003; 42(5):518–526. [PubMed: 12707555]

Implications and Contribution

Technology-delivered interventions can be provided cheaply and easily to unprecedented proportions of persons with a given behavioral risk factor such as poor adherence. This study pilots a technology-delivered intervention specifically targeting adherence in African American emerging adults with persistent asthma.

Figure 1.
CONSORT Flow Diagram

Figure 2.
Flow of Study Procedures

Figure 3.
Intervention Session 1 Content Overview

Table 1

Baseline Characteristics of Intervention and Control Group Participants

Baseline Characteristics (<i>M,SD</i>):	Intervention	Control	Tests for group differences
Age (years)	21.8 (4.0)	23.1 (3.4)	$t(46) = 1.23, p = .23$
Biological sex (% females)	65.2%	84.0%	$\chi^2(1,48) = 2.24, p = .13$
Asthma exacerbations (past month)	1.8 (2.0)	2.4 (4.6)	$t(46) = 0.54, p = .59$
<i>Asthma Control Test</i> score ^{<i>I</i>}	14.0 (3.1)	14.4 (3.1)	$t(46) = 0.35, p = .73$
FEV-1 % predicted	80.0% (21.6)	80.4% (15.7)	$t(44) = 0.07, p = .94$
% controller doses taken	68.4% (32.0)	69.2% (28.2)	$t(46) = -.093, p = .93$

Note:

^{*I*} Score > 19 indicates well-controlled asthma

Table 2

Changes in Medication Adherence and Asthma Symptoms from Baseline

Change from baseline (<i>M,SD, 95% CI</i>):	Intervention	Control	<i>p</i>	<i>Cohen's d</i>
<i>EMA (3-month follow-up):</i>				
Total doses missed	-1.65 (5.2), [-4.10, 0.80]	-0.22 (2.5), [-1.46, 1.01]	.30	0.35
Average doses missed/day	-0.30 (0.98), [-0.76, 0.15]	-0.01 (0.75), [-0.44, 0.31]	.30	0.35
Number days missed 1+ dose	-1.35 (2.89), [-2.70, 0.002]	-0.18 (1.19), [-0.79, 0.43]	.13	0.53
Total asthma symptoms (Log10)	-0.38 (0.50), [-0.60, -0.15]	-0.05 (0.41), [-0.25, 0.15]	.03	0.71
Average asthma symptoms/day (Log10)	-0.05 (0.07), [-0.09, -0.22]	-0.01 (0.06), [-0.36, 0.02]	.03	0.71
<i>Self-Report Questionnaires:</i>				
Poor adherence behavior (1-month follow-up)	-0.84 (1.46), [-1.55, -0.18]	-0.36 (2.08), [-1.53, 0.76]	.37	0.27
Poor adherence behavior (3-month)	-0.68 (1.09), [-1.16, -0.20]	-0.23 (1.23), [-0.90, 0.45]	.20	0.40
Doses missed in last week (1 month)	-0.84 (1.89), [-1.70, 0.06]	-0.58 (1.64), [-1.45, 0.23]	.63	0.15
Doses missed in last week (3 month)	1.09 (3.99), [-0.89, 2.53]	0.10 (2.34), [-0.89, 1.44]	.34	0.30
Asthma control (1 month)	2.00 (3.00), [1.27, 3.60]	0.64 (3.68), [-1.05, 2.38]	.17	0.42
Asthma control (3 month)	2.26 (3.45), [0.77, 3.75]	0.45 (3.81), [-1.48, 1.95]	.10	0.51
<i>Lung Functioning (3-month follow-up):</i>				
FEV-1 percent predicted	4.41 (12.89), [-1.30, 10.12]	-4.14 (16.60), [-11.7, 3.41]	.07	0.59

Notes: Cohen's d: 0.2 = small, 0.5 = medium, 0.8 = large