Evaluating the ASTHMAXcel Mobile Application Regarding Asthma Knowledge and Clinical Outcomes

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BACKGROUND: We sought to longitudinally assess the efficacy of the patient-facing ASTHMAXcel mobile application in improving asthma knowledge and outcomes in adults with asthma. METHODS: ASTHMAXcel is a novel smartphone application consistent with the National Asthma Education and Prevention Program, Global Initiative for Asthma, and British Thoracic Society/Scottish Intercollegiate Guidelines Network guidelines. The intervention was provided for 1-time use at baseline only. The Asthma Knowledge Questionnaire (AKQ), the Asthma Control Test (ACT), and the mini-Asthma Quality of Life Questionnaire (mini-AQLQ) were administered at baseline and at 2, 4, and 6 months thereafter. Rates of asthma-related emergency department visits, hospitalizations, and prednisone use were also evaluated. RESULTS: ACT scores increased significantly at 2, 4, and 6 months (mean scores: 15.1 vs 16.9, $P = .038$; 15.1 vs 17.2, $P = .02$; 15.1 vs 17.9, $P = .003$) after baseline. There were significant increases in AKQ scores at 4 and 6 months (11.7 vs 12.6, $P = .02$; 11.7 vs 13.1, $P = .005$) and in mini-AQLQ scores at 6 months (55.5 vs 64.2, $P = .02$). There were significant decreases in asthma-related emergency department visits at 6 months (0.6 vs 0, $P < .001$) and in hospitalizations at 4 and 6 months (0.3 vs 0.1, $P = .02$; 0.3 vs 0, $P = .002$). Prednisone use decreased at 4 and 6 months (1.2 vs 0.6, $P = .01$; 1.2 vs 0.3, $P < .001$). CONCLUSIONS: ASTHMAXcel contributes to improved asthma knowledge and outcomes and to decreased health care utilization. ASTHMAXcel is an inexpensive, scalable aid for out-patient asthma management. *Key words: asthma; emedicine; technology; patient education; asthma health care utilization; asthma knowledge; asthma quality of life; underserved populations.* [Respir Care 2020;65(8):1112–1119. © 2020 Daedalus Enterprises]

Introduction

Asthma represents a significant burden among pediatric and adult populations, and it contributes to the exponential rise in health care costs.[1,2] Approximately 10% of children and 8% of adults in the United States have been diagnosed

with asthma, which contributes to more than $80 billion in health care costs each year.[3-7] It is estimated that each person with asthma accrues an average of $3,266 in costs due to their condition, including prescription medications, out-patient visits, hospitalizations, and emergency department visits.[7] Children with asthma miss 1.8-3.8 times more school days than children without asthma, and adults and caretakers of children with asthma miss between 1.16 and 1.8 times more workdays compared to caretakers of children without asthma.[8,9] It is extremely important to develop cost-effective strategies to reduce asthma-related morbidity and mortality. To supplement existing therapeutic options for asthma, successful nonpharmacologic approaches (eg,

guideline based asthma education, promoting proper inhaler technique) have been linked to improved patient outcomes.[10-13]

Within the realm of available digital health interventions for asthma, existing patient-facing mobile applications lack comprehensiveness, guideline-based content, user-centered design, and sustained use. One meta-analysis reported that 100 of 103 apps did not have adequate information to serve as a comprehensive resource for patients.[14] Additionally, approximately 50% of the recommendations provided by these apps deviated from current guidelines and standard clinical practice.[14] A separate review of 38 apps determined that most had low scores on the Mobile App Rating Scale (MARS), indicating poor performance regarding certain subjective aspects of the app, such as functionality and aesthetics.[15,16] With the unmet need for a comprehensive and user-friendly app, it is difficult to ensure the long-term use and adherence to these digital interventions. The Asthma Mobile Health Study reports that mobile health (mHealth) apps have high attrition rates and low rates of consistent activity, especially early after initial download.[17]

Studies evaluating the efficacy of these mHealth tools have demonstrated mixed and inconclusive results. In an analysis of 2 studies of smartphone applications for self-management, one study indicated no impact on asthma symptom scores and asthma-related emergency department visits and hospitalizations, while the other reported improved asthma quality of life and lung function and reduced emergency department visits.[18] A recent randomized clinical trial conducted in a pediatric population to evaluate the efficacy of AsthmaCare (a mobile app providing treatment alerts and plans) reported no significant decreases in asthma-related emergency department visits or hospitalizations.[19] However, other studies have reported improved Asthma Control Test (ACT) scores and reduced rescue medication utilization after exposure to the application.[20,21] While asthma apps have shown promising initial results, more studies must be conducted to evaluate how to best integrate these interventions into clinical practice.

This study was conducted at the Montefiore Asthma Center in the New York City borough of the Bronx. The Montefiore Asthma Center is characterized by a patient population with a high asthma burden. The incidence of asthma-related emergency department visits and hospitalizations in the Bronx is nearly double the rates in other boroughs of New York City and more than triple the average for the state of New York.[22,23] With the state of New York having higher rates of asthma-related emergency department visits and hospitalizations relative to the United States average, the Bronx has worse outcomes than the majority of the country.[23] This study's objectives were to evaluate asthma knowledge and clinical asthma outcomes longitudinally in adults who were administered the ASTHMAXcel mobile app.

QUICK LOOK

Current knowledge

Improvements in asthma knowledge have been associated with improved quality of life and clinical outcomes. Digital strategies are increasingly utilized for the management of asthma with support from some guidelines. However, very few digital health programs are guideline based with evidence leading to improved outcomes.

What this paper contributes to our knowledge

ASTHMAXcel is a novel, guidelines-based smartphone application designed to improve patient education and out-patient management of asthma. Subjects who used the ASTHMAXcel application demonstrated improvements in asthma knowledge, control, and quality of life over 6 months. Additionally, they had fewer asthma-related emergency department visits and hospitalizations and less prednisone use.

Methods

Study Subjects

We conducted a prospective study of adult subjects with asthma recruited from the Montefiore Asthma Center to evaluate outcomes over a 6-month time period. Subjects were men or women 18 y or older who met the following criteria: (a) a clinical history (ie, physician-diagnosed) of asthma, (b) use of daily controller inhaler medications, and (c) English-speaking. Exclusion criteria were use of oral corticosteroids in the prior 4 weeks, pregnancy, or severe cognitive or psychiatric conditions that precluded a subject from understanding and completing the study protocol. In addition, we excluded patients who had not completed all of the study visits from the subsequent main analysis sample because the data on these patients did not allow us to evaluate outcomes over time. Approval was obtained from the Institutional Review Board at the Albert Einstein College of Medicine in New York, New York. Our team discussed the potential risks and benefits with each individual, and written consent was obtained from all subjects. As incentive for study completion, each subject was given $20 at each study visit (ie, at baseline, 2 months, 4 months, and 6 months).

The ASTHMAXcel Mobile Application and Its Evaluation

To guide the development of the ASTHMAXcel mobile application, we conducted interviews with patients at the

Montefiore Asthma Center.[24] Throughout the development and administration process, we obtained patient feedback (eg, app "glitches" identified) to iteratively refine the application. The ASTHMAXcel mobile application (publicly available on the iOS and Android app stores now, but not at the time of this study) for smartphone and tablet devices is organized into 10 chapters with animated videos and personalized algorithmic content (Table 1). Following the Welcome screen, the app has Terms of Use and Privacy Policy screens followed by the Main screen with each listed chapter (Fig. 1). Each chapter, designed to reflect specific sections of the National Asthma Education and Prevention Program guidelines, has 1–2-min guideline based educational videos with voice-over narrations.[25] Additionally, all

Table 1.   ASTHMAXcel Table of Contents

Chapter 1	How Asthma Affects Your Airways
Chapter 2	Medications and How These Work
Chapter 3	Rescue Versus Controller Medications
Chapter 4	Spacer Use and Inhaler Technique
Chapter 5	Peak Flow Monitoring
Chapter 6	Asthma Action Plan
Chapter 7	Environmental Control Strategies
Chapter 8	Tobacco Smoke and Asthma
Chapter 9	Exercise-Induced Asthma
Chapter 10	Cleaning Your Inhaler, Spacer, and Nebulizer Parts

chapters are consistent with the 2018 edition of the Global Initiative for Asthma (GINA) guidelines and the 2019 edition of the British Thoracic Society/Scottish Intercollegiate Guidelines Network (BTS/SIGN) guidelines, which include a section supporting the use of digital interventions for asthma self-management.[26,27] Each chapter also contained content typically delivered by the Montefiore Asthma Center's on-site in-person asthma educator including: (a) general asthma facts; (b) the role of medications (rescue vs controller) and their mechanism of action; (c) the importance of adherence to controller medications; (d) home monitoring with peak flow meters; (e) avoiding common triggers, including pest and mold control and prevention; (f) environmental control measures; (g) harmful effects of smoke exposure and the importance of smoking cessation; (h) assessing inhaler/diskus techniques (with and without mask/spacer) and teaching the correct method; (i) the importance of follow-up appointments; and (j) reviewing the Asthma Action Plan.

All educational content had been developed and reviewed by our team of asthma physicians, asthma educators, and a behavioral scientist. Several chapters also have interactive dialogue with algorithms; for example, when the app presents a question (eg, Do you smoke?) and the patient selects an answer, the app then generates a corresponding follow-up question or recommendation(s). Each chapter has an end-of-chapter summary to reinforce the presented video and algorithmic content. Upon completion of
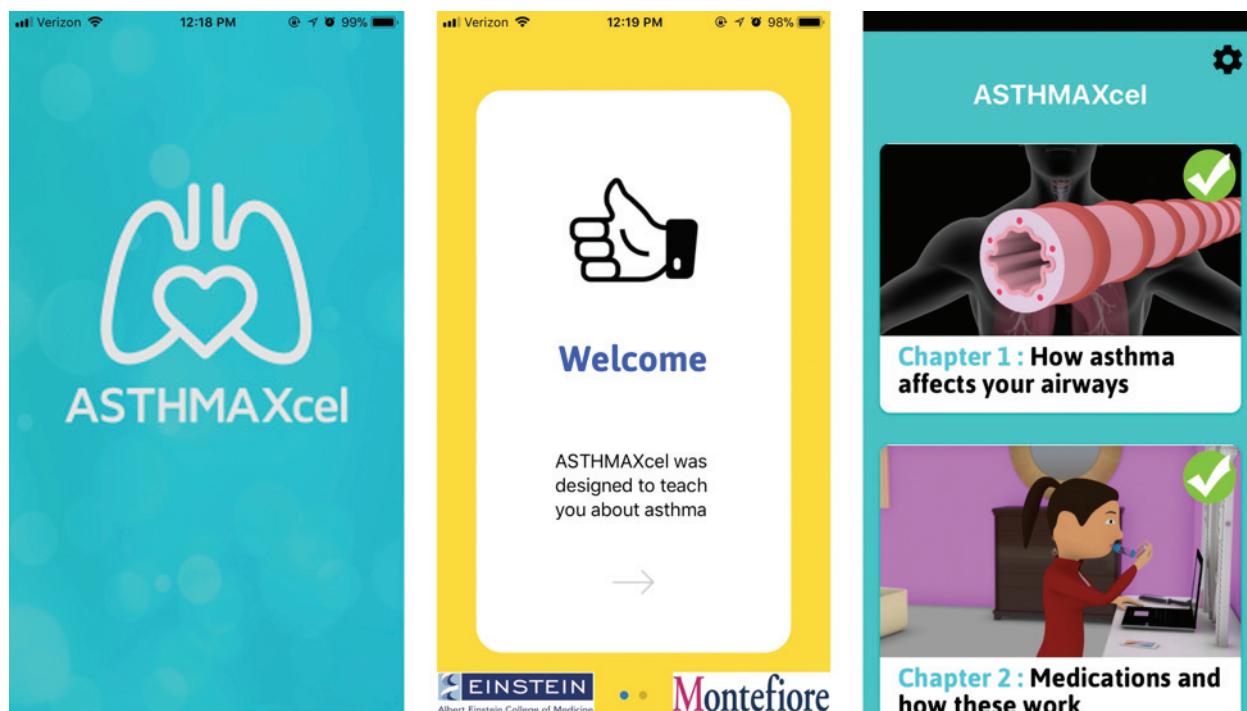

Fig. 1. Sample ASTHMAXcel images of menu and options for selecting different chapters. A check mark appears in the upper right corner of each chapter icon indicating a patient has completed the topic.

each chapter, the app tracks the individual user's progress and allows the user to review old content. While ASTHMAXcel was not available to download on online marketplaces at the time of the study, it is currently freely available on the iOS (Apple) and Android app stores. Potential users may preview the content at the project web site: https://www.asthmaxcel.net (*Accessed May 8, 2020*).

Subjects were administered the ASTHMAXcel intervention only at the baseline visit. The application was preinstalled on iPads and only available for one-time use on-site. During the study, subjects were not allowed to take the material home or download the app on to their personal devices. Additionally, they were not re-administered the application at subsequent visits. At baseline, we obtained basic demographic information as well as information regarding smartphone and home internet access for each subject. Ascertaining smartphone and internet access provides insights into the feasibility of distributing mobile apps such as our ASTHMAXcel intervention in the Bronx population.

At baseline (ie, preintervention) and at 2 months, 4 months, and 6 months, questionnaires were administered to evaluate asthma knowledge, asthma control, asthma quality of life, and health care utilization. Asthma knowledge was assessed through the abbreviated Asthma Knowledge Questionnaire (AKQ).[28] The AKQ score ranges from 0 to 16 and consists of questions regarding asthma management guidelines. A higher AKQ score indicates better asthma knowledge. We assessed asthma symptom burden and asthma quality of life through the ACT and the mini-Asthma Quality of Life Questionnaire (mini-AQLQ), respectively.[29,30] The ACT, which uses a 4-week recall period, is a 5-item questionnaire used to evaluate asthma control. A higher ACT score indicates better asthma control. The mini-AQLQ, which uses a 2-week recall period, is a 15-item questionnaire that evaluates asthma-related quality of life. A higher mini-AQLQ score indicates better quality of life.

Our team evaluated self-reported health care utilization to assess the impact of ASTHMAXcel on asthma burden. At each study visit, subjects reported asthma-related emergency department visits, hospitalizations, and prednisone use over the previous 2 months.

Statistical Analysis

Subject characteristics were summarized as mean ± SD for continuous variables and as frequencies and percentages for categorical variables. For the 6 outcomes (ie, AKQ, ACT, mini-AQLQ, emergency department visits, hospitalizations, and prednisone use), we summarized these values at each of the 4 time points: preintervention at baseline and at 2, 4, and 6 months postintervention. Paired *t* tests were used to compare these outcomes between each follow-up

time point (ie, 2, 4, and 6 months postintervention) and the preintervention baseline time point, separately. Pearson's correlations were computed to assess whether the changes in these outcomes were associated with age. All analyses were conducted in SAS 9.4 (SAS Institute, Cary, North Carolina), and the statistical significance level was set as $P < .05$.

Results

Subject Characteristics

A total of 55 subjects were enrolled in this study. Of these, 15 subjects did not complete the study: 12 subjects completed only the baseline visit alone, 2 subjects completed the baseline and the 2-month visit, and 1 subject completed visits up to the 4-month visit. The remaining 40 subjects completed all 4 visits. Subject characteristics were comparable between the 15 subjects who were lost to follow-up and the 40 subjects who completed the study (Table 2).

Our final analysis included the 40 subjects who completed the study. As shown in Table 2, mean ± SD subject age was 50.7 ± 12.3 y old (range 23–75 y), and 92.5% ($n = 37$) of this cohort was female. Nearly half ($n = 19$, 47.5%) were Hispanic; 2.5% ($n = 1$) and 50% ($n = 20$) were non-Hispanic White and non-Hispanic Black, respectively. A total of 17 subjects (42.5%) finished high school, 10 (25.0%) finished college, 2 (5.0%) obtained a higher degree, and 6 (15.0%) did not complete high school; 5 subjects (12.5%) reported "Other" for degree of education. Nearly all subjects ($n = 36$, 90%) had access to smartphones, and 37 subjects (94.9%) had access to the internet at home.

Asthma Knowledge, Control, and Quality of Life Scores

As shown in Table 3, mean AKQ scores were 11.7 at baseline and 12.2 at 2 months. There was a statistically significant increase in the mean AKQ score at 4 months and 6 months relative to baseline (11.7 vs 12.6, $P = .02$; 11.7 vs 13.1, $P = .005$, respectively). Mean ACT scores showed statistically significant increases relative to baseline at 2 months (15.1 vs 16.9, $P = .038$), 4 months (15.1 vs 17.2, $P = .02$), and 6 months (15.1 vs 17.9, $P = .003$). Mean mini-AQLQ scores significantly increased at 6 months when compared with baseline (55.5 vs 64.2, $P = .02$). There were no statistically significant correlations between age and the improvements in the AKQ, the ACT, and the mini-AQLQ scores at 2 months, 4 months, or 6 months versus baseline ($P > .21$).

Table 2.   Subject Characteristics

Parameter	Enrolled	Completed the Study	Lost to Follow-Up	P
Age, y	48.8 ± 12.9	50.7 ± 12.3	43.8 ± 13.4	.10
Sex				.61
Male	5 (9.1)	3 (7.5)	2 (13.3)	
Female	50 (9.9)	37 (92.5)	13 (86.7)	
Race/ethnicity				.06
Hispanic	29 (52.7)	19 (47.5)	10 (66.7)	
Non-Hispanic White	2 (3.6)	1 (2.5)	1 (6.7)	
Non-Hispanic Black	23 (41.8)	20 (50.0)	3 (20.0)	
Non-Hispanic Other	1 (1.8)	0	1 (6.7)	
Education				.45
Did not complete high school	6 (1.9)	6 (15.0)	0	
Completed high school	25 (45.5)	17 (42.5)	8 (53.3)	
Completed college	14 (25.5)	10 (25.0)	4 (26.7)	
Completed higher degree	4 (7.3)	2 (5.0)	2 (13.3)	
Other	6 (1.9)	5 (12.5)	1 (6.7)	
Smartphone access	50 (9.9)	36 (90.0)	14 (93.3)	>.99
Internet access	51 (94.4)	37 (94.9)	14 (93.3)	>.99

Data are presented as n (%) or mean ± SD. Enrolled: $n = 55$; Completed the study: $n = 40$; Lost to follow-up: $n = 15$. Continuous variables were compared using the Wilcoxon rank-sum test, and categorical variables were compared using the Fisher exact test.

Table 3.   Change in Questionnaire Responses Over Time

	Asthma Knowledge Questionnaire		Asthma Control Test		Mini-Asthma Quality of Life Questionnaire	
Baseline	11.7 ± 2.6		15.1 ± 5.6		55.5 ± 20.9	
2 months	12.2 ± 2.2		16.9 ± 5.0		59.2 ± 22.0	
4 months	12.6 ± 2.0		17.2 ± 4.4		59.3 ± 22.7	
6 months	13.1 ± 1.8		17.9 ± 4.1		64.2 ± 21.4	
Paired difference (vs baseline)		P		P		P
2 months	0.50 (0.30)	.10	1.78 (0.83)	.038	3.68 (2.62)	.17
4 months	0.88 (0.37)	.02	2.05 (0.82)	.02	3.80 (3.19)	.24
6 months	1.35 (0.46)	.005	2.80 (0.87)	.003	8.73 (3.54)	.02

Data are presented as mean ± SD or mean (standard error). $n = 40$ for each questionnaire group.

Health Care Utilization Analysis

As shown in Table 4, compared to baseline, all health care utilization end points including asthma-related emergency department visits, hospitalizations, and oral prednisone use decreased at 4 months and at 6 months. The mean frequency of emergency department visits at baseline was 0.6, and this decreased to 0.2 at 4 months with borderline statistical significance ($P = .056$). We noted a significant decrease in emergency department visits at 6 months relative to baseline (0.6 vs 0, $P < .001$). The mean frequency of asthma-related hospitalizations significantly decreased at 4 months (0.3 vs 0.1, $P = .02$) and at 6 months (0.3 vs 0, $P = .002$) compared to baseline. Mean prednisone use demonstrated statistically significant decreases compared to

baseline at 4 months (1.2 vs 0.6, $P = .01$) and at 6 months (1.2 vs 0.3, $P < .001$). There were no significant correlations between the decreased asthma-related emergency department visits, hospitalizations, and prednisone use with age at 2 months, 4 months, and 6 months versus baseline ($P > .15$).

Discussion

There has been growing interest in developing and validating patient-facing mobile digital tools for the self-management of chronic conditions. Asthma-related mobile applications have been inconsistently linked to improvements in clinical outcomes and decreases in health care utilization. In our study, we evaluated the impact of

Table 4. Change in Asthma Health Care Utilization Over Time

	Emergency Department Visits		Hospitalizations		Prednisone Use	
Baseline	0.6 ± 0.9		0.3 ± 0.6		1.2 ± 1.2	
2 months	0.4 ± 0.7		0.2 ± 0.4		0.8 ± 1.1	
4 months	0.2 ± 0.5		0.1 ± 0.2		0.6 ± 1.0	
6 months	0 ± 0		0 ± 0		0.3 ± 0.6	
Paired difference (vs baseline)		P		P		P
2 months	–0.20 (0.19)	.31	–0.15 (0.12)	.20	–0.35 (0.24)	.15
4 months	–0.35 (0.18)	.056	–0.25 (0.10)	.02	–0.55 (0.21)	.01
6 months	–0.55 (0.15)	< .001	–0.30 (0.09)	.002	–0.83 (0.21)	< .001

Data are presented as mean ± SD or mean (standard error). $n = 40$ for each group.

ASTHMAXcel, a novel, interactive, guidelines-based smartphone application on an adult population in the Bronx (a borough in New York City). We demonstrated that ASTHMAXcel improves asthma knowledge, control, and quality of life in an urban Bronx population. We observed that ASTHMAXcel decreased asthma-related emergency department visits, hospitalizations, and prednisone use. These findings improve upon the available literature on the management of asthma using patient-facing mobile applications.

As observed in Table 2, our subjects were largely representative of the demographic characteristics of the Bronx population, with race and ethnicity composed mostly of Hispanic and Non-Hispanic Black individuals, and the highest education degree of participants consisted mostly of high school diploma only.[31] There were some differences, however, between our subjects and the greater Bronx population. Females comprised the majority of our study, and 94.9% of our participants reported internet access at home, while 70.4% of Bronx residents have home internet access according to the 2018 census.[31] These differences in demographics are unlikely to contribute significantly to the outcomes observed in our study.

Additionally, our results suggest that ASTHMAXcel is both accessible and generalizable to the broader population. Nearly all (90%) of our study participants reported access to a smartphone device, and this finding is slightly higher than the national smartphone ownership average, which is estimated to be 77%.[32] With increasing smartphone usage across the United States, we expect many patients to be able to easily obtain ASTHMAXcel. Furthermore, when we evaluated for a correlation with age, we found no statistically significant association between improvements in any of the outcomes and age, indicating that the improvements observed in the AKQ, ACT, and mini-AQLQ scores as well as health care utilization were independent of age. Our population covered a wide age range (23–75 y), further supporting the applicability of ASTHMAXcel for the general population.

In this study, our subjects exhibited significantly increased scores on the AKQ, ACT, and mini-AQLQ from baseline to follow-up. By 6 months postintervention, all 3 questionnaires demonstrated improved mean scores.

Through the educational videos and personalized algorithms within the application, subjects improved their comprehension of the pathophysiology and management of asthma and subsequently were able to manage their condition better. Our results suggest that educational programs can concurrently improve asthma knowledge and asthma control, and thereby reinforce the findings of previous studies.[33-37] Several studies link poor asthma control with suboptimal inhaler technique, with one study citing 8 of 10 subjects performing at least 1 error in metered-dose inhaler technique.[33-35] ASTHMAXcel addresses this educational gap through a dedicated chapter on spacer use and inhaler technique (Table 1). While studies have investigated the impact of an in-person asthma educator, there are few reports that have linked the use of an asthma education smartphone application with sustained improved outcomes regarding asthma control and quality of life. One recent study reported improved ACT scores and high user satisfaction following the use of a smartphone application in a cohort of subjects with uncontrolled asthma.[20] Our study was designed to foster quality improvement and to power a subsequent randomized controlled trial. Notably, our subjects were only provided the application one time, ie, at the baseline visit. In reality, ASTHMAXcel allows for multiple viewings of educational content, thus allowing reinforcement of the presented material and possibly providing for higher long-term educational scores.

In addition to the increases in ACT, AKQ, and mini-AQLQ scores, subjects using the ASTHMAXcel application also demonstrated decreased health care utilization at 4 months and 6 months compared to baseline. These results are clinically meaningful given the severe health and economic burden of asthma in the Bronx.[22,23] With less time spent being hospitalized due to asthma, patients are likely to experience a reduction in health care costs and missed school and work days. Minimizing missed workdays is critical for patients, especially in our study population, because the Bronx is an underserved urban community with low socioeconomic status and a median annual income of approximately $35,000.[31] With reduced prednisone use, providers are able to decrease the deleterious side effects

associated with steroids. This impact on health care utilization is consistent with prior studies reporting educational programs leading to reduced asthma-related emergency department visits and hospitalizations.[36-38] Decreased health care utilization implies reduced health care costs for both patients and the health care system. Asthma education programs have been linked to such cost-savings.[37-40] Two of these studies reported statistically significant decreases in costs primarily due to a reduction in hospitalizations and income lost to sick days, and one study noted significant cost reduction due to decreased emergency department visits.[38-40] Given the reduction in health care utilization observed in our study, implementation of the ASTHMAXcel mobile health application can serve as a potentially cost-effective and rapidly scalable method to manage asthma.

Increased knowledge of one's disease likely will confer benefits beyond improving asthma control and decreasing health care utilization. Empowering patients through informative technology-based devices has been theorized to improve self-confidence and psychologic support in the context of asthma through the self-determination theory.[41] The self-determination theory has been applied as a model for engaging patients in the management of chronic conditions by fulfilling 3 principles: autonomy, competence, and relatedness.[42] There seemed to be a demand from asthma patients for a smartphone app that would allow for autonomous improvement in the management of their asthma.[41] Evoking the principles of the self-determination theory has been associated with improved control in analogous chronic conditions where patient education is sometimes lacking, such as diabetes.[43] While not directly ascertained in our study, it is possible that ASTHMAXcel may facilitate more permanent behavior change and improved long-term outcomes according to the self-determination model.

Future directions for research include extending the length of study to confirm the long-term impact of ASTHMAXcel beyond 6 months. Furthermore, we are currently studying a gamified version of ASTHMAXcel in a pediatric population. Younger patients are likely to benefit from using mobile smartphone applications, and a pediatric version could enable children and teenagers to share their experience of living with asthma with their peers.[44] Within social settings such as a school environment, mobile technology tools can help prevent the isolation of kids with asthma and prevent social anxiety.[41] Our team has developed and released a pediatric version (ASTHMAXcel Adventures) of ASTHMAXcel with games, quizzes, and videos.

This study has several limitations. First, enrolling a more diverse and larger patient population would help evaluate the generalizability of our results. Our subject population was 92.5% female, and the average age of the subjects was 50.7 y. Additionally, seasonal fluctuations in asthma severity may influence the effect seen in our study. However, this effect is likely mitigated by recruitment throughout the year with data from baseline visits distributed throughout all seasons. Another limitation of our study is its single-arm design. Upcoming studies will implement the ASTHMAXcel in a randomized controlled trial with 2 arms to compare efficacy against a standardized human educator or usual care group with regard to asthma outcomes. We are currently extending ASTHMAXcel to be used in distinct clinical settings (eg, primary care, inpatient).

Conclusions

Effective care and asthma education for adult asthma patients remains a high priority. This study reports on the results of utilizing a novel mobile health application for the management of adult subjects with asthma. Subjects using the ASTHMAXcel application demonstrated significantly improved ACT, AKQ, and mini-AQLQ scores at follow-up visits relative to baseline. Subjects using the ASTHMAXcel application also demonstrated lower rates of health care utilization as measured by asthma-related emergency department visits, hospitalizations, and prednisone use at 4 months and 6 months.

ASTHMAXcel is a free, educational tool available to all patients with a smartphone on iOS and Google Play app stores. In busy out-patient practices where time for anticipatory guidance and appropriate counseling may be limited, providing patients with engaging and interactive resources to navigate and manage their asthma will benefit both patients and providers. Although ASTHMAXcel is not designed to replace proper counseling, it can act as a powerful aid to reinforce concepts established by providers and to clarify proper techniques and use of medications. Our study identifies ASTHMAXcel as a useful adjunct for outpatient asthma management.

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