JPPT | Practice-Based Investigation

Can a Short Video Improve Inhaler Use in Urban Youth?

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OBJECTIVE The primary aim was to determine whether watching a short video in the inpatient setting could produce an immediate improvement in pediatric patients' asthma knowledge and inhaler technique.

METHODS This prospective, quasi-experimental, pre-post study was conducted in a single center, in Detroit, Michigan, which primarily serves an urban, African-American population. Patients were eligible if they were between 8- and 16-years-old, had asthma, and would be discharged with an albuterol metered-dose inhaler. The primary outcome was improvement in the composite score of a knowledge and technique assessment before and after watching a 5-minute video. The lead author developed the video with content validation by pharmacists, pediatricians, elementary school teachers, and a pediatric health education specialist. Secondary outcomes at 30 days included change in asthma control and whether the video was revisited after discharge.

RESULTS Thirty patients were enrolled. Their average age was 11 ± 2.1 years; they were primarily African American (83%), female (53%), and insured by Medicaid (87%). The composite score of technique assessment and written quiz increased by 3.53 (95% confidence interval [CI] 2.81 to 4.85) of a possible 16 points after watching the video. There was no significant change in asthma control at 30 days as measured by the asthma control test (2, 95% CI −0.53 to 4.53). Eight of 22 patients revisited the video after discharge.

CONCLUSIONS A brief educational video delivered during a pediatric inpatient visit in an urban medical center resulted in an immediate improvement in patients' disease knowledge and inhaler technique.

ABBREVIATIONS CI, confidence interval; MDI, meter-dose inhaler

KEYWORDS asthma; child; metered dose inhalers; patient education as topic; urban health

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Introduction

More than 7.1 million children in the United States have asthma, resulting in more than 640,000 visits to emergency departments and 157,000 inpatient admissions per year.[1,2] Reducing morbidity and costs associated with asthma exacerbations requires patient and family involvement in asthma care and adherence to medications. Patients with inadequate inhaler technique or poor adherence to therapy have worse disease control and a lower quality of life.[3] Therapeutic education interventions in pediatric patients with asthma can decrease cost of care and health care use and increase quality of life.[4–8] Education is vital to maintaining adequate control of asthma symptoms; therefore, current guidelines recommend inhaler technique be assessed and demonstrated at every encounter with a health care provider.[9,10] However, studies have demonstrated that providers assess inhaler technique in as few as 5% of visits with pediatric patients who have asthma.[11]

Asthmatic children residing in low-income, urban neighborhoods are at high risk of asthma exacerbations and experience disproportionately high rates of asthma-associated hospitalizations, emergency department visits, disability, and death.[12] African-American children are twice as likely to have asthma compared with white children and experience more asthma-related hospital admissions and mortality.[13] High rates of exposure to environmental triggers, limited access to primary and specialist care, and greater use of emergency departments contribute to health disparities in these vulnerable populations.[14] Furthermore, these patients are more likely to have parents with low health literacy and socioeconomic status, which are independent predictors of poor medication adherence, device technique, and disease control.[15,16] The community served by our hospital represents families at highest risk of poor device technique, low medication adherence, and adverse asthma outcomes.

Multimedia education has been shown to be more effective than print materials and as effective as provider demonstration in teaching patients inhaler technique.[17,18] Video education has been shown to result in immediate improvement of inhaler technique for children in the outpatient setting, but its utility in the pediatric inpatient setting has not been investigated.[19] Video education has many advantages for use in the inpatient setting. Children with chronic illness often experience fatigue, especially during stressful events, such as hospitalization.[20] Video education can be viewed and reviewed

when the child is most receptive during their hospital stay and after discharge. Additionally, this method may appeal to different learning styles through the use of novel visual aids, decrease face-to-face time required with the provider, and ensure consistency in education provided to patients.[17,21] Furthermore, video and multimedia education is consistent with the digital consecutiveness of the current generation—Generation Z—because these patients have grown up in an entirely digital age.[22] The primary purpose of this study was to determine whether a 5-minute video could be used to educate patients with pediatric asthmatic within the hospital setting.

Methods

We conducted a single-center, quasi-experimental, prospective, pre-post study of pediatric patients admitted to a 772-bed teaching hospital in Detroit, Michigan, from December 2015 to April 2016. Patients were included if they were between ages 8- and 16-years-old, were admitted to the emergency department or pediatric inpatient unit, and would be discharged with an albuterol meter-dose inhaler (MDI). Patients did not need to be admitted for a respiratory related illness. Patients were excluded if the child or parent was unable to speak English, the parent was not present for consent, or the child was unable to provide assent or to complete study procedures. The institutional review board approved the study, and informed consent and assent were obtained for each patient. The video and informed consent documents were only available in English. After obtaining informed consent, the parent was not required to participate in education or be present for the duration of the study visit.

The primary outcome was to determine whether watching a short video, delivered within the inpatient setting, could improve patients' asthma knowledge and inhaler technique. Secondary outcomes were to determine how many patients would revisit the video if made available to them upon discharge, characterize changes in asthma control after discharge, and determine the frequency of assessment of inhaler technique in the primary care setting.

Before the study, an educational video (approximately 5 minutes long) and a written questionnaire were developed by the investigators. The video was created to address 5 main constructs: 1) Identify acute asthma symptoms; 2) Identify common asthma triggers; 3) Recognize when to use rescue inhaler; 4) Recognize when to seek medical attention; and 5) Operate MDI using appropriate technique. Content validation was performed by 2 pharmacists, 2 pediatricians, 2 certified elementary school teachers, and 1 pediatric health education specialist. Experts were consulted at multiple points before and during video production and in the development of the written questionnaire. The video is available for access by patients and providers on YouTube (YouTube, LLC, San Bruno, CA; http://tinyurl.com/PedsAsthma). Videos were developed with Camtasia (TechSmith, Okemos, MI) using narrated screen captures.

After consent and assent were obtained, baseline demographics and clinical characteristics were collected from the medical record. The patients' asthma control was assessed using the Asthma Control Test, a validated scale (Table 1).[23] Scores range from 5 (poor control) to 25 (complete control), with a score of 19 or less indicating inadequate control requiring intervention.[23] Each patient was given a pretest consisting of an age-appropriate, written exam and an assessment of inhaler technique. All patients were assessed using an MDI with a spacer using a previously validated scale (Table 2), and questions were developed by the study investigators to assess knowledge (Table 3).[11] The technique assessment consisted of 8 independent steps. If the patient performed the entire step completely, they received the point for the step, if the step was skipped or performed partially, they received no point. The written assessment consisted of 9 questions, 8 of which were scored, and 1 control question whose answer was not provided in the video. The control question was an advanced, lung-physiology question, which was intended to be beyond the knowledge of most patients. It was included to assess testing bias, and the respondents' ability to improve on the written exam because they were familiar with the questions. Patients were assigned a score of 0 to 8 on the written exam and a score of 0 to 8 on the technique, for a total possible, composite score of 16 points.

During the study, visit patients completed the pretest, watched the 5-minute video on a tablet computer provided by the study team, and then immediately repeated the same written quiz and technique assessment. The entire initial study visit was completed in the patients' private hospital room. At completion of the initial visit, the patient was then given a card with a YouTube link to the video and their expected date for follow-up. Both the parent and the child were strongly encouraged by the study pharmacist to watch the video at home. A 30-day poststudy phone call to the child's parent was made by the study pharmacist to assess whether the patient watched the video outside the hospital, to inquire about follow-up with the child's primary care provider, and to repeat the Asthma Control Test for the time since discharge results. Patients were considered lost to follow-up after 3 failed attempts.

Based on previous literature, we expected to find a difference of 12.5% before and after education, for our study, which would equal a difference in mean score of 2 points from prevideo to postvideo composite score, which was decided *a priori* to represent a meaningful clinical difference.[19] Therefore, 13 patients would be required to perform a paired *t* test with an α error rate of 0.05 and 90% power. To meet the assumptions of the paired *t* test, we enrolled 30 patients. Continuous

Table 1. Asthma Control Test

1. In the past 4 weeks, how much of the time did your asthma keep you from getting as much done at work, school, or home?				
All of the Time	**Most of the Time**	**Some of the Time**	**A little of the Time**	**None of the Time**
☐	☐	☐	☐	☐
1	2	3	4	5
2. In the past 4 weeks, how often have you had shortness of breath?				
> 1/d	**1/d**	**3–6/wk**	**1-2/wk**	**Not at All**
☐	☐	☐	☐	☐
1	2	3	4	5
3. In the past 4 weeks, how much of the time did your asthma symptoms (wheezing, coughing, shortness of breath, chest tightness, or pain) wake you up at night or earlier than usual in the morning?				
4+ nights/wk	**2–3 nights/wk**	**1 night/wk**	**1-2 nights/wk**	**Not at All**
☐	☐	☐	☐	☐
1	2	3	4	5
4. In the past 4 weeks, how often have you used your rescue inhaler or nebulizer medication (such as albuterol)?				
≥ 3/d	**1-2/d**	**2-3/wk**	**≤1/wk**	**Not at All**
☐	☐	☐	☐	☐
1	2	3	4	5
5. How do you rate your asthma control during the past 4 weeks?				
Not Controlled at All	**Poorly Controlled**	**Somewhat Controlled**	**Well Controlled**	**Completely Controlled**
☐	☐	☐	☐	☐
1	2	3	4	5

variables were described using the mean ± SD, and categorical variables were described as frequency distributions. Univariate analysis was used to determine all factors related to the baseline test scores and to the change in test scores (δ). The Change in Asthma Control test was analyzed with a paired *t* test and a χ^2 test. All data were analyzed using SPSS software (version 22.0, SPSS Inc., Chicago, IL), and a p-value of 0.05 or less was considered statistically significance.

Results

Forty-four patients who met the inclusion criteria were assessed for study inclusion; 14 patients were excluded, and 30 were included. Reasons for excluding patients were declined to participate (n = 9), no parent available to give consent (n = 4), and being unable to complete the study procedures because of a hearing deficit (n = 1). Of the 30 evaluable patients, 8 were lost to follow-up, for a total of 22 in the follow-up sample. Baseline characteristics are presented in Table 4. Patients had a mean age of 11 ± 2.1 years (range, 8-15 years), and 47% were male. Most patients were African American (83%) and insured by Medicaid (87%), and only 11% had a parent with a college degree. Patients had a mean of 7 ± 4.5 years since their first asthma diagnosis, and 4 ± 2.9 years using an MDI. The mean baseline score on the Asthma Control Test was 15.4 ± 4 points, with 23 patients (77%) scoring <19 points, indicating inadequate disease control. Only 1 patient was admitted for a non-respiratory diagnosis.

The primary endpoint—the composite score of the technique assessment and the written quiz—was 10 ± 2.4 (95% confidence interval [CI] 9.1 to 10.9) before and 13.9 ± 1.8 (95% CI 13.2 to 14.6) after watching the video; that represents an increase of 3.53 (95% CI 2.81 to 4.85) points and was found to be significant ($p < 0.001$). Age was positively associated with performance on the composite score at baseline ($r = 0.408$, $p = 0.025$). The mean score on technique assessment before watching the video was 4.2 ± 1.6, on a scale of 0 to 8 points; 23 patients (77%) received a score of 5 or less. The most commonly missed steps were shake the inhaler (63% incorrect), exhale normally (87% incorrect), tilt head back slightly, place holding chamber mouthpiece between lips (70% incorrect), and hold breath for 10 seconds (70% incorrect). After watching the video, the mean score improved to 6.9 ± 1 ($p < 0.001$), and only 2 patients (6%) received a score of 5 or less. The mean score on the quiz was 6.2 ± 1.6 on a scale of 0 to 8 before watching the video. After watching the video, the score improved to 7 ± 1.1, which was statistically significant ($p = 0.001$). The number of patients correctly answering the control question before and after watching the video was 4 (13%) and 2 (7%), respectively, which was not significantly different ($p = 0.39$).

Table 2. Instructions for Use of Meter-Dose Inhaler (MDI) With Spacer

1.	Remove cap from inhaler
2.	Attach inhaler into holding chamber
3.	Shake inhaler 4–6 times
4.	Exhale normally
5.	Tilt head back slightly, place holding chamber mouthpiece between lips, holding inhaler upright
6.	Press inhaler canister once to place dose in holding chamber
7.	Begin a slow, deep inhalation immediately after placing dose in holding chamber (3–4 seconds)
8.	Hold breath for 10 seconds

Follow-up was completed for 22 patients, with 8 patients lost to follow up. The study pharmacist made 3 attempts to contact each patient before designating them as "lost to follow-up." The average time between the initial visit and the follow-up phone call was 35.5 ± 4.7 days. Of the 22 follow-up patients, 8 (36%) reported watching the video at home, 3 (14%) had been readmitted to a hospital or emergency department since leaving our facility, and 16 (73%) had been to see their primary care provider. Of the 16 patients who followed up with their primary care provider, 8 (50%) reported the provider had assessed inhaler technique during the visit. The average score on the Asthma Control Test was 16.7 ± 5.3, with 11 patients (50%) scoring fewer than 19 points, indicating poor control requiring intervention. The average change in score on the Asthma Control Test was 2 ± 5.4 (95% CI −0.26 to 4.26). Using a paired test, the score on the Asthma Control Test was not significantly different than baseline ($p = 0.11$); however, fewer patients scored <19 points, meaning more patients were considered to have asthma that was controlled ($\chi^2 = 3.99$, $p = 0.046$) (Table 5).

Discussion

The present study demonstrated that a 5-minute educational video shown to children with asthma in an urban setting significantly improved asthma knowledge

Table 3. Learning Constructs and Assessment Questions*

Learning Construct	Question 1	Question 2
Identify acute asthma symptoms	Asthma affects the ☐ Hands ☐ **Lungs** ☐ Eyes ☐ Kidneys	Which is a symptom of asthma? ☐ Pain in the stomach ☐ **Trouble breathing** ☐ Weakness in the knees ☐ Headache
Identify common asthma triggers	Triggers make asthma ☐ Better ☐ **Worse** ☐ Stay the same	Which of the following are common triggers? ☐ Homework, pencils, paper ☐ Candy, grandparents, crayons ☐ **Cigarette smoke, pets, exercise** ☐ Showers, soap, cleaning
Recognize when to use rescue inhaler	I use my rescue inhaler when ☐ I wake up in the morning ☐ In the morning and at night ☐ **I have symptoms** ☐ I want to show my friends	Which inhalers help prevent symptoms? ☐ **Control Inhalers** ☐ Rescue Inhalers
Recognize when to seek medical attention	How will I know if my rescue inhaler worked correctly? ☐ I will feel dizzy ☐ I will feel sick to my stomach ☐ **I will be able to breathe more easily** ☐ My feet will get hot	If I have taken 2 puffs of this inhaler and do not feel better, I should ☐ **Get help from an adult** ☐ Take 2 more puffs ☐ Sit down and wait 5 min ☐ Use a different inhaler
Control question	Air sacs in the lungs are called? ☐ Epithelium ☐ **Alveoli** ☐ Bronchioles ☐ Surfactant	

*Bold answers indicate correct answers.

Table 4. Baseline Characteristics

Child Characteristics (N = 30)	
Age, mean ± SD, yr	11 ± 2.1
Sex, male, n (%)	16 (53)
Race, n (%)	
White	4 (13)
African American	25 (83)
Other	1 (3)
Insurance, n (%)	
Medicaid	26 (87)
Non-Medicaid	4 (13)
Parent education, n (%)*	
No diploma/GED	6 (21)
Diploma/GED	12 (43)
Some college	7 (25)
College degree	3 (11)
Number of siblings	2.4 (1.6)
Family member with asthma	20 (67)
New asthma diagnosis	1 (3)
Time since diagnosis, mean ± SD, yr	7 ± 4.5
Duration using MDI, mean ± SD, yrs	4 ± 2.9
Use of DPI, n (%)	1 (3)
Asthma Control Test, mean ± SD	15.4 ± 4

DPI, dry powder inhaler; MDI, meter-dose inhaler
*Two parents declined to answer.

and inhaler technique. To our knowledge, this is the first study evaluating the use of video education in a pediatric inpatient setting and patient use of the video after discharge. The video intervention was inexpensive, easy to implement, and may be considered an effective strategy for educating children regarding their asthma and inhaler technique.

The use of video for pediatric asthma education is not novel because it has been used successfully in the outpatient setting.[19] Patients using video education for asthma in the study by Carpenter et al[19] were similar in age and socioeconomic status to our sample, yet our patients were primarily African American, insured by Medicaid, and had been living with asthma longer. Despite a longer time since asthma diagnosis, patients in our study scored more than 1 point lower on the baseline asthma technique score when measured on the same scale.[19] Patients in our study demonstrated a greater improvement in technique after video intervention, displaying similar postintervention scores to patients in the previous study.[19] The sample consisted of patients seeking care at a large urban health system, and the low rate of postdischarge primary-care follow up is characteristic of a medically underserved population.[12]

The association we observed between patient age and inhaler technique is consistent with previous studies.[15,16] Study patients reported an average of 7 years since first asthma diagnosis and 4 years of MDI use, yet achieved a baseline MDI technique assessment score of 4.2 of a possible 8 points (52.5%). This finding supports the need for continued assessment of technique in patients who have long-term experience using the device. It is concerning that, although guidelines recommend inhaler technique be assessed at every visit with a health care provider, of those patients who had follow-up with their primary care physician within 30 days of discharge, only 50% had inhaler technique assessed at the visit.[24] That finding may reflect the lack of attention to inhaler technique in the community setting.

Health education videos can be a valuable educational tool because they are portable, can be viewed multiple times at the individual's convenience, are widely appealing, can be individualized to specific patient characteristics, and are effective for use with individuals who have lower literacy rates.[21,25,26] It is estimated that 47% of adults in Detroit, Michigan, are functionally illiterate, which is greater than the national average.[27,28] The low-literacy rates in our community, combined with the increasing popularity of digital media devices in this generation, may contribute to a preference for multimedia education in this population.[5,27] In addition, the patient educational videos provide an alternative to printed handouts for a low-literacy population.

A significant time investment is required for the creation, editing, revision, and testing of these videos to ensure appropriate acquisition of knowledge and skill. Although the development of a 5-minute video may appear to be a minor undertaking, more than 100 hours were spent on video creation and testing. To overcome that challenge, a pharmacy resident assumed responsibility for the project, which was beneficial for patients, the resident, and the institution. The pharmacy resident developed skills in prospective trial design, obtaining institutional review board approval and informed consent, and conducting statistical analyses, patient education, and video production. We believe this type of residency project is feasible, interesting, ethical, and relevant and has potential to improve patient care.[29] Residency programs should consider this type of project when developing potential project lists.

This study has several limitations. Patients were only enrolled when the investigator was on site, and neither patients nor study personnel were blinded to the intervention. We did not have a usual-care comparator group, although we did have a control question to ensure patients did not naturally improve test scores by taking the test multiple times. In addition, the study was only powered to detect a difference in knowledge and technique before and after watching the video. The small sample size limited ability to assess clinical endpoints, such as the Asthma Control Test. Short-term

Table 5. Results

Steps	Before	After	p value
Technique, mean ± SD	4.2 ± 1.6	6.9 ± 1	< 0.001
Steps, n (%)			
1. Remove cap	30 (100)	30 (100)	
2. Attach inhaler to spacer	22 (73)	30 (100)	
3. Shake inhaler 4–6 times	11 (37)	26 (87)	
4. Exhale normally	4 (13)	18 (60)	
4. Tilt head back, place mouthpiece between lips	9 (30)	24 (80)	
5. Press canister once	25 (83)	28 (93)	
6. Slow deep inhalation (3–4 sec)	15 (50)	24 (80)	
7. Hold breath for 10 sec	9 (30)	25 (83)	
8. Quiz, mean ± SD	6.2 ± 1.6	7 ± 1.1	0.001
Questions by learning construct, n (%)			
1. Identify acute asthma symptoms	27 (90)	29 (97)	
2. Identify common asthma triggers	25.5 (85)	26.5 (88)	
3. Recognize when to use rescue inhaler	17 (57)	22 (73)	
4. Recognize when to seek medical attention	23.5 (78)	28 (93)	
Control	4 (13)	2 (7)	
Composite, mean ± SD	10 ± 2.4	13.9 ± 1.8	< 0.001

improvement in technique would be expected to improve clinical performance; however, we did not observe significant improvement in asthma control. Although most patients' asthma control improved, some patients' control did not improve or declined. That variability in response most likely reflected the patients' underlying disease process, the impact of which could be better assessed in a larger study. Furthermore, the duration of patient follow-up was short (mean, 35 days) and loss to follow-up was high. Because of that, we were not able to evaluate the effect outcomes, such as the number of visits to providers for asthma exacerbations or medication adherence. Loss to follow-up is common in this population, and educational studies in similar populations had similar follow-up rates of 60% to 75%.[5,25] Children and adolescents in Detroit, Michigan, experience high rates of daily stressors and are at greater risk for chronic conditions, such as asthma, for which they often seek care at urban emergency departments.[30] The transient nature of our patient population may explain the inability to contact some of the patients for follow-up. Family disorganization and stress are associated with poor asthma control in children and may have affected some patients.[31] In the future, other strategies should be explored to increase revisiting of education, such as text messaging the video link to the patient.

In conclusion, we were able to show an immediate improvement in patients' disease knowledge and inhaler technique after watching a 5-minute video. That intervention was inexpensive, easy to implement, and presented an opportunity to improve outcomes of asthma treatment in an underserved community. The educational technique has the potential to improve asthma-related morbidity and mortality in this vulnerable population at risk for asthma exacerbation; however, long-term impact remains to be determined. Our long-term research goal was to identify strategies to detect, treat, and prevent adverse health effects from asthma exacerbation in high-risk urban youth. We plan to implement the use of video education and inhaler assessment throughout our hospital and associated clinics. The potential for such interventions to affect pediatric asthma morbidity and mortality has been demonstrated.[4–8] Future studies should measure the long-term effect of this low-cost, educational intervention on clinical outcomes within this at-risk, vulnerable urban population.

ARTICLE INFORMATION

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