

Original Research

Using Video from Mobile Phones to Improve Pediatric Phone Triage in an Underserved Population

Brandi Freeman, MD, MS¹, Stephanie Mayne, MHS^{2,3},
A. Russell Localio, PhD⁴, Anthony Luberti, MD, MIS⁵,
Joseph J. Zorc, MD, MSCE⁶, and Alexander G. Fiks, MD, MSCE^{2,3,5,7}

¹Department of Pediatrics, University of Colorado School of Medicine, Aurora, Colorado.

²Center for Pediatric Clinical Effectiveness, The Children's Hospital of Philadelphia, Philadelphia, Pennsylvania.

³PolicyLab, The Children's Hospital of Philadelphia, Philadelphia, Pennsylvania.

⁴Department of Biostatistics and Epidemiology, Perelman School of Medicine, University of Pennsylvania, Philadelphia, Pennsylvania.

⁵Department of Biomedical and Health Informatics, The Children's Hospital of Philadelphia, Philadelphia, Pennsylvania.

⁶Department of Emergency Medicine, The Children's Hospital of Philadelphia, Philadelphia, Pennsylvania.

⁷Department of Pediatrics, Perelman School of Medicine, University of Pennsylvania, Philadelphia, Pennsylvania.

Abstract

Background: Video-capable mobile phones are widely available, but few studies have evaluated their use in telephone triage for pediatric patients. We assessed the feasibility, acceptability, and utility of videos sent via mobile phones to enhance pediatric telephone triage for an underserved population with asthma. **Materials and Methods:** We recruited children who presented to an urban pediatric emergency department with an asthma exacerbation along with their parent/guardian. Parents and the research team each obtained a video of the child's respiratory exam, and the research team conducted a concurrent in-person rating of respiratory status. We measured the acceptability of families sending videos as part of telephone triage (survey) and the feasibility of this approach (rates of successful video transmission by parents to the research team). To estimate the utility of the video in appropriately triaging children, four clinicians reviewed each video and rated whether they found the video reassuring, neutral, or raising concerns. **Results:** Among 60 families (78% Medicaid, 85% Black), 80% of parents reported that sending a video would be helpful and 68% reported that a nurse's review of a video would increase their trust in the triage assessment. Most families (75%) successfully transmitted

a video to the research team. All clinician raters found the video reassuring regarding the severity of the child's asthma exacerbation for 68% of children. **Conclusions:** Obtaining mobile phone videos for telephone triage is acceptable to families, feasible, and may help improve the quality of telephone triage in an urban, minority population.

Key words: asthma, emergency department, video triage

Introduction

Asthma is a leading cause of childhood hospitalization, disability, and healthcare-related cost. Pediatric asthma care in the United States is fractured with patients too often seeking nonurgent care in the emergency department (ED).¹ Asthma disproportionately affects Black and Hispanic children, and these populations have been shown to be more likely to use the ED as a routine source of sick care.² In addition, prior work suggests that many families traveling to the ED for nonurgent complaints are looking for reassurance.³ Contributing to the problem of ED overuse, telephone triage systems used in practice for an estimated 39 million calls per year may conservatively over-refer children to the ED.⁴

The use of video to enhance triage may help address these concerns. The nurse or physician providing triage may be able to determine a child's level of distress more accurately through the use of video compared with verbal questions. In addition, families may be more effectively reassured if a clinician has seen their child. Widespread mobile phone use may provide a foundation for video-enhanced triage for those who may rely on the ED for asthma care. Although disparities in access to the Internet and information technology persist,⁵ 90% of Americans are now mobile phone subscribers.⁶ "Feature" phones and "smart" phones with nonvoice functions such as still or video cameras predominate the market, with the majority of American adults owning smartphones.⁷ A 2015 Pew survey showed that 60% of Americans used their phones to take pictures or videos, indicating Americans' willingness to use these functions.⁶

Video enhancement of triage may be of particular importance for minority populations who are at higher risk of poor

asthma outcomes and high ED use. Prior studies found that African American men and women were willing to participate in e-health/m-health research^{8,9} and that African American women had high use of mobile health applications,⁹ suggesting that using mobile technology to improve healthcare is of interest to this population. However, despite likely benefits, no study in the United States has formally assessed the feasibility and utility of this technology to improve triage for an underserved pediatric population with a common chronic condition.

Given the opportunity to use mobile technology to improve telephone triage, we sought to study this technology with families who had sought care for their child for asthma in the ED. Our objective was to examine the feasibility, acceptability, and to explore the clinical utility of videos obtained from mobile devices for phone triage of asthma patients. We hypothesized that capturing videos would be feasible, acceptable, and could improve the quality of triage assessment.

Materials and Methods

STUDY DESIGN

We conducted a prospective cohort study in a population seeking asthma care in an urban children's hospital ED to assess the feasibility, acceptability, and to explore the clinical utility of videos obtained from mobile devices for telephone triage. Participants were enrolled between September 2012 and March 2013.

STUDY POPULATION AND SETTING

Subjects for this study were recruited from The Children's Hospital of Philadelphia ED, a tertiary care center in urban West Philadelphia that provides care for children at ~90,000 visits annually, 8,000 of which are for asthma.

Study staff worked with clinical providers to identify patients in the waiting room or ED rooms between the ages of 2 and 10 years who were being treated for acute asthma. To be included, families were required to be English speaking, have a mobile phone with video capability with them at the time of the visit, and receive a noncritical triage on arrival in the ED.

DATA COLLECTION

After providing written informed consent, family members completed a questionnaire that included demographic characteristics, mobile phone information (brand, phone capabilities, data plan), and Likert-scaled questions about the acceptability and feasibility of using videos from mobile phones in telephone triage. Families were then directed by a trained member of the research team to obtain a video of their child's respiratory status

and to transmit that video to the research team as an email attachment or text message. The research team also obtained a video of the child's respiratory status for quality comparison by using what was considered a top quality device (iPhone 4s; Apple Computer, Cupertino, CA) at the time of the study.

The research team member then conducted an in-person evaluation of the child's respiratory status, documenting items that can be visually assessed from the Pediatric Respiratory Assessment Measure.¹⁰ The components of the in-person assessment included: work of breathing, breathlessness, mental status/alertness, accessory muscle use, nasal flaring, respiratory rate, and overall severity. Respiratory status was rated as asymptomatic, mild, moderate, or severe based on these components. The in-person assessment was completed immediately after the videos were obtained. If a patient was scheduled to have a treatment while the research team was in the room, the in-person assessment and video were delayed so that they still captured the same time point. Each family received a \$15 gift card for participation and to offset any data transmission costs.

To simulate the process of pediatric phone triage enhanced by video, pediatric triage nurses and pediatricians viewed the videos and assessed respiratory status using the same components previously described (e.g., work of breathing, respiratory rate). The clinicians were asked to make an assessment of how the video would affect their triage of the patient by reporting whether they felt reassured, neutral, or more concerned about the child's asthma exacerbation status after viewing the video. Each clinician viewed ~40 videos and was compensated for their time. Each video was reviewed by four clinicians.

OUTCOMES

Acceptability and feasibility. We assessed acceptability to parents of using video from mobile phones in phone triage using Likert-scaled questions with face validity. Questions focused on attitudes and behaviors related to phone triage (e.g., "I find advice over the phone from my child's doctor's office helpful," "I follow the advice of my child's doctor's office over the phone"), as well as on attitudes toward using video from mobile phones in the triage process (e.g., "Sending a video of my child to the nurse would be helpful to my child's care"). For each item, the response options were scaled from 1 to 9 (1–3 = disagree, 4–6 = neutral, 7–9 = agree). Feasibility was assessed by the proportion of videos successfully transmitted to the research team. Quality of the videos was scored by the Mean Opinion Score (MOS),¹¹ which was used in the technology field for image quality from 1 (bad) to 5 (excellent). The distribution of both family and team video MOS scores was described.

Clinical utility of video recordings. After reviewing videos of patients, clinicians determined whether each video reassured them regarding the child's asthma severity, had a neutral effect, or raised concerns.

COVARIATES

Covariates included the type of phone available to the family, age of the parent, age of the patient, educational level of the parent, and respiratory status rating based on the in-person assessment (asymptomatic, mild, moderate, or severe).

STATISTICAL ANALYSES

We described participants' demographic, clinical, and telephone characteristics. To assess acceptability, we examined the distribution of responses and, for clarity of presentation, calculated the proportion of parents agreeing (answering 7–9 on Likert-scaled responses) to each item. Feasibility was examined by the proportion of parents able to successfully transmit a video to the research team. Next, we assessed associations between (1) demographic characteristics/phone specifications and (2) feasibility of video triage (successful transmission of a video) using *t*-tests and Mann–Whitney *U* tests for continuous variables and Fisher's exact tests for categorical variables (due to cell counts <5).¹² Finally, we calculated the proportion of videos that were of sufficient quality to be interpreted.

To evaluate the potential clinical utility of the video recordings, we calculated the proportion of cases in which all evaluating clinicians reported being reassured about the child's asthma exacerbation status after reviewing the video. We calculated proportions overall and by respiratory status assessed via in-person respiratory exam (asymptomatic, mild, moderate, severe) according to the Pediatric Respiratory Assessment Measure. All statistical analyses were done using Stata version 13 (College Station, TX) ($p < 0.05$ considered significant in all analyses). This study was approved by the Institutional Review Board of The Children's Hospital of Philadelphia.

Results

STUDY POPULATION

Demographic information on the study population is presented in *Table 1*. The majority (85%) of participants were African American, which is consistent with the neighboring community. Parents had 40% Apple and 33% Samsung phones. The majority of the phones had been obtained within the past 2 years, and most had unlimited data (72%) and/or text plans (95%).

Table 1. Characteristics of Study Population Children Presenting to the Emergency Department with Asthma Exacerbation and Their Parents (N=60 Children and 60 Parents)

	SAMPLE, N (%)
Child characteristics, N	60
Child age, mean (SD)	4.9 (2.4)
Race	
Black/African American	51 (85)
White	6 (10)
Asian	1 (2)
Other	1 (2)
Missing	1 (2)
Hispanic/Latino	5 (8)
Insurance status	
Public only	41 (68)
Private only	11 (18)
Public and private	6 (10)
None	2 (3)
Respiratory status rating ^a	
Asymptomatic	4 (7)
Mild	36 (60)
Moderate	18 (30)
Missing	2 (3)
Parent characteristics, N	60
Parent age, mean (SD)	31.7 (7.0)
Educational attainment	
<High school	6 (10)
High school degree	22 (37)
Some college/associate's degree	23 (38)
Bachelor's or higher	9 (15)
Phone characteristics	
Brand	
Apple	24 (40)
Samsung	20 (33)
Other	15 (25)
Missing	1 (2)
Obtained phone in past 2 years	47 (78)
Unlimited data plan	43 (72)
Unlimited text plan	57 (95)

^aRespiratory status rating is based on in-person assessment.

Table 2. Acceptability of Mobile Phone Video Transmission to Parents/Guardians of Children with Asthma

	AGREEING, N (%)	MEDIAN (RANGE)
In the past, I have called my child's doctor for advice before coming to the ED.	35 (58)	8 (1–9)
I find advice over the phone from my child's doctor's office helpful.	45 (75)	8 (1–9)
I follow the advice I receive from my child's doctor's office over the phone.	53 (88)	9 (1–9)
I trust the advice of my child's doctor's office over the phone.	46 (77)	8 (1–9)
I would find it hard to send the nurse a video of my child.	5 (8)	1 (1–9)
I would be too worried about my child's condition to send a video of my child to the nurse.	5 (8)	1 (1–9)
Sending a video of my child to the nurse would be helpful to my child's care.	48 (80)	8 (1–9)
I would not want to send the video to the nurse—talking is enough.	3 (5)	1 (1–9)
It is too expensive to send a video to the nurse.	3 (5)	1 (1–9)
I would trust the advice from my child's doctor's office more if they could see a video of my child.	41 (68)	7 (1–9)
It takes too much time to send the video to the nurse.	4 (7)	1 (1–9)
I would trust the advice from the nurse more after she had seen the video of my child.	39 (65)	7 (1–9)
Response options included: disagree (1–3), neutral (4–6), agree (7–9).		

ACCEPTABILITY

A majority of families found video transmission to be acceptable. Specifically, 39 out of 60 parents (65%) reported that having the nurse see their child via the video would improve their trust in the phone triage system (*Table 2*). In addition, 48 parents (80%) reported that they thought that having the nurse see a video of their child would be helpful to their child's care. Few parents reported that they either would not have enough time (4, 7%) or would be too worried (5, 8%) to provide a video as part of the triage assessment. Further analysis revealed that successfully transmitting the video was not associated with higher acceptability scores (data not shown).

FEASIBILITY

Most families successfully transmitted a video to the research team (45/60, 75%). Forty-four videos (73%) were rated as sufficient quality to be evaluated. Parents with Apple phones were significantly more likely to successfully transmit a video [100% compared with 65% for Samsung phones and 47% for other phone types; relative differences of 35% (95% confidence interval: 9%, 61%) and 53% (16%, 90%), $p < 0.001$] (*Table 3*). Additionally, higher parent educational level was positively associated with successful transmission to the research team ($p = 0.04$). MOS scores ranged from 0 to 5 for the family videos, with a median of 3 indicating some differences from in-person assessment or minor problems with focus/lighting, but no difficulty in assessing overall appearance. For

the team videos, MOS scores ranged from 2 to 5, with a median of 4 indicating only minor differences from in-person assessment. The brand of phone was not associated with the quality rating for the transmitted video in this study.

CLINICAL UTILITY OF THE VIDEO RECORDINGS

After viewing the videos, most clinicians felt reassured about the child's asthma exacerbation (*Table 4*). Specifically, all raters were reassured for 40 of the 58 videos of children (68%) with a nonmissing respiratory status. Clinicians were less likely to be reassured by videos of children with a moderate respiratory assessment status compared with those with a mild or asymptomatic assessment (44% compared with 78% and 100%, respectively).

Discussion

In this study, we evaluated the acceptability, feasibility, and potential clinical utility of families providing videos from mobile devices to assist telephone triage of children with acute asthma. Overall, our results indicate that most families of low socioeconomic status in an urban setting are able and willing to transmit videos to their healthcare providers to support telephone triage and that these videos might help improve triage quality.

This study, focused on a largely African American, urban population, is consistent with prior research that found the use of mobile or Internet-based health applications to be feasible by

Table 3. Child, Parent, and Phone Characteristics Associated with Successful Transmission of Video From Parent Mobile Phone to the Clinical Team

	OBTAINED VIDEO (N=45), N (%)	DID NOT OBTAIN VIDEO (N=15), N (%)	<i>p</i> ^a
Child characteristics			
Child Age, mean (SD)	4.5 (2.1)	6.0 (2.8)	0.06
Race			0.6
Black/African American	36 (80)	15 (100)	
White	6 (13)	0 (0)	
Asian	1 (2)	0 (0)	
Other	1 (2)	0 (0)	
Missing	1 (2)	0 (0)	
Hispanic/Latino—missing for 1	5 (11)	0 (0)	0.3
Insurance status			0.5
Public only	28 (62)	13 (87)	
Private only	10 (22)	1 (7)	
Public and private	5 (11)	1 (7)	
None	2 (4)	0 (0)	
Respiratory status rating ^b			0.9
Asymptomatic	3 (7)	1 (7)	
Mild	23 (62)	8 (53)	
Moderate	13 (29)	5 (33)	
Missing	1 (2)	1 (7)	
Parent characteristics			
Parent age, mean (SD), missing for 3	31.6 (7.0)	31.9 (7.6)	0.9
Educational attainment			0.04
<High school	2 (4)	4 (27)	
High school degree	19 (42)	3 (20)	
Some college/associate's degree	16 (36)	7 (47)	
Bachelor's or higher	8 (18)	1 (7)	
Phone characteristics			
Brand			<0.001
Apple	24 (53)	0 (0)	
Samsung	13 (29)	7 (57)	
Other	7 (16)	8 (53)	
Missing	1 (2)	0 (0)	
Obtained phone in past 2 years	35 (78)	11 (79)	0.9
Unlimited data plan	31 (69)	11 (79)	0.1
Unlimited text plan	43 (96)	13 (93)	0.3

^a*p*-Values calculated using *t*-tests and Mann-Whitney *U* tests for continuous variables and Fisher's exact tests for categorical variables (due to sparse cell counts). Missing values were dropped before calculating all *p*-values.

^bRespiratory status rating is based on in-person assessment.

underserved or low-income populations.^{13–16} Our study also identified specific capabilities that may be utilized to improve communication with these families. For example, a high proportion of families in our study had unlimited text messaging plans, suggesting that costs to families associated with sharing clinical information (like videos) via text would be minimal. In addition, responses to the acceptability questions indicate that most families welcome the opportunity to transmit videos and would better trust phone advice from a health professional who could see the child. These findings are clinically relevant since prior studies have found that rates of parent noncompliance with phone triage advice for ED/urgent care are between 17% and 40%.^{4,17–20}

Our findings also highlight the potential for videos to improve the quality of the phone triage process by ensuring that children receive an appropriate triage classification. Triage currently relies exclusively on parent report and discussion with a triage nurse. We found that clinicians were frequently reassured about the status of the child's asthma exacerbation after viewing the video and that, as expected, clinicians were more likely to be reassured for children with less severe respiratory status ratings, suggesting that these videos might ultimately enhance the ability of clinicians to direct children to the right level of care. Given that many families overuse the ED,²¹ augmentation of the phone triage process with video might help families avoid unnecessary use of the ED.

Although this study explores an innovative enhancement to the phone triage process for an underserved population that has not been examined in prior studies, there are several limitations. The study was designed as a pilot with a modest sample size conducted in one ED with an English-speaking, low socioeconomic status, urban population. As such, results may not be generalizable. Further, some parent videos were of poor quality. We expect that this problem will be mitigated as the video quality of mobile phones continues to improve. We also encountered transmission

Table 4. Clinician Responses After Viewing Mobile Phone Video Recordings Made by the Research Team, Overall and by Respiratory Status

	OVERALL, <i>N</i> (%)	RESPIRATORY STATUS ^a			<i>p</i> ^b
		ASYMPTOMATIC	MILD	MODERATE	
Research team videos, <i>N</i>	58	4	36	18	
All raters were reassured ^c	40 (68)	4 (100)	28 (78)	8 (44)	0.02

Each video was reviewed by four clinician raters. After reviewing videos of patients, clinicians determined whether each video reassured them regarding the child's asthma severity, had a neutral effect, or raised concerns.

^aRespiratory status was determined by an in-person evaluation using items from the pediatric respiratory assessment measure. Respiratory status was missing for 2/60 families.

^b*p*-Value calculated using Fisher's exact test due to cell counts <5.

^cFor only one video, a reviewer was concerned after viewing the video, and, in that case, only one reviewer out of four was concerned. That child's respiratory status was rated as mild.

issues (difficulties with cellular signals in the hospital and with connecting to the WiFi network) that prevented some families in transmission of video files to the research team. Future work that builds on the present study and tests this approach with families in the community should assess how often the transfer of videos is limited by problems with Internet connectivity in that setting. As data collection occurred in 2012–2013, phone quality and familiarity of users with video technology has increased in the subsequent years. Given these changes, it is possible that the feasibility of video transmission would be higher, and quality of video transmission better, were the study repeated today.

Conclusions

We found that obtaining videos from the mobile phones of parents for use in the phone triage process was feasible and acceptable to parents and provided information that was potentially useful to improving the telephone triage process. Our results support formal testing of the use of video to enhance telephone triage for children with asthma in pediatric call centers.

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Disclosure Statement

No competing financial interests exist.

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Address correspondence to:

Alexander G. Fiks, MD, MSCE

Center for Pediatric Clinical Effectiveness PolicyLab

Department of Biomedical and Health Informatics

The Children's Hospital of Philadelphia

3535 Market Street Room 1546

Philadelphia, PA 19104

E-mail: fiks@email.chop.edu

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