RESEARCH ARTICLE

Parent Preferences for Methods and Content of Mobile Technology–Based Asthma Medication Adherence Intervention

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ABSTRACT

OBJECTIVES: Mobile technology–based asthma medication adherence interventions can be targeted to children during periods of high risk, including the transition from hospital to home or when refill behavior suggests declining adherence. Our objective was to develop insight into parent use of mobile technology and their preferences for a mobile technology–based asthma intervention.

METHODS: By using qualitative methods, 20 interviews of parents of children with asthma were conducted. The open-ended, semistructured interview guides included questions about current mobile technology use, barriers to controller medication adherence, and preferences for methods and content of a mobile technology–based asthma intervention. Using grounded theory methodology, investigators coded the transcripts and identified emerging themes.

RESULTS: Twenty parents completed interviews. Half of the children were 7 to 12 years old. Eighty percent had public insurance. Sixty-five percent had a previous hospitalization. Three major themes were identified: chronic disease management assistance, distinct preferences for risk communication, and electronic reachability. Chronic disease management assistance included parents recognizing that busy lifestyles contribute to adherence challenges and welcoming a program to assist them. Distinct preferences for risk communication included a preference for 2-way communication via text message or phone call at least monthly. Under the theme of electronic reachability, all enrolled parents had smartphones and used them daily.

CONCLUSIONS: Parents of children with asthma are open to communicating with asthma providers through mobile technology. This information can be used to inform the development of mobile technology–based interventions to improve care for children with asthma during periods of high risk, including the transition from hospital to home.

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Dr Andrews conceptualized and designed the study, conducted the initial analysis, and drafted the initial manuscript; Ms Nitchie participated in the collection of data, conducted the initial analysis, and critically reviewed the manuscript; Dr Harvey contributed to the design of the study, conducted the initial analysis, and critically reviewed the manuscript; and all authors approved the final manuscript as submitted.

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Despite their effectiveness, asthma controller medications continue to be underused even among high-risk patients with recent hospitalization.[1,2] Authors of previous studies have attempted to improve medication adherence in children and adults with asthma through technology-based modalities, including interactive voice-recognition phone calls triggered by refill patterns, home-based asthma education with adherence feedback, discharge follow-up phone calls, and electronic adherence monitoring devices with audiovisual reminders.[3–9] Efforts are underway to determine the efficacy of text message reminders coupled with adherence monitoring devices specifically aimed at improving medication adherence among children recently hospitalized or treated in an emergency department (ED) for asthma.[1] Feasibility and acceptability are suggested in early results.[1] Targeting mobile technology adherence interventions to patients at highest risk for exacerbation, such as those who are recently hospitalized, allows for a more efficient use of limited resources. Additionally, early engagement of parents of children with asthma during the design of future technology-based asthma risk communication and/or adherence promotion interventions will improve potential acceptability and effectiveness.

Our objective of this study is to use qualitative methods to develop insight into the use of mobile technology among parents of children with asthma and determine parent preferences for methods and content of an asthma risk communication and/or adherence promotion intervention. Eventually, these data can be used to inform mobile technology–based interventions aimed at improving controller medication adherence among children at high risk with asthma during the transition from hospital to home or at times of increased risk as identified by the asthma medication ratio (AMR).

METHODS

Setting

This study was approved by the institutional review board at the Medical University of South Carolina (MUSC). MUSC is a tertiary-care university-affiliated pediatric medical center with 186 inpatient beds and ~25 000 pediatric ED visits per year. The pediatric primary care clinic is a resident clinic staffed by faculty members from the division of general pediatrics and has 12 500 visits per year.

Recruitment, Enrollment, and Data Collection Procedures

We recruited parents of children with asthma from MUSC patient care areas (pediatric primary care clinic, pediatric pulmonology clinic, and children's hospital units). We targeted the child's primary caretaker for participation. Parents were approached during hospitalization or clinic visit at a time that did not interfere with clinic flow. The study was briefly outlined, and if the parent was interested, full study procedures were explained, and informed consent was obtained. Two study team members (A.L.A. and H.L.N.) completed all of the recruitment, enrollment, and interview procedures. Before the start of the interview, the parent filled out a brief questionnaire that included the child's age group, insurance status, previous ED, hospital and/or ICU visits, and controller medication classification (inhaled corticosteroid [ICS] versus ICS or long-acting β-agonist [LABA]). Each interview occurred on MUSC campus and lasted 20 to 45 minutes. Interviews were audio recorded. We provided incentive for parents to participate in the form of a $50 Visa gift card. The audio recordings were professionally transcribed and entered into Qualrus software.

Interview Guide Development

The interview guide was designed with expert input with the goal of focusing our conversation on electronic habits and risk communication preferences of parents of children with asthma. The final interview guide included a brief description of the AMR, how high-risk children are identified, and the general concept of communication with families at times of high risk. Questions that followed were divided into the following domains: overall asthma communication, risk communication preferences, barriers to asthma medication adherence, text message preferences, and additional comments. See Supplemental Table 5 for the interview guide. Team members reviewed early interview transcripts for relevant emerging themes and added additional interview prompts when appropriate. Specifically, these additional prompts included questions regarding parents' electronic habits and general communication preferences.

Data Analysis

Codes were developed through line-by-line analysis of the data by 3 study team members (A.L.A., J.H., and H.L.N.). A constant comparison method was used. A codebook was created and evolved over time as transcripts were analyzed. Disagreements in coding were resolved through group discussion. Data were compared and contrasted to examine the commonalities and differences across interviews and finally identify emerging themes. Throughout the analysis, memorandums were written to document the process and describe any insights gleaned from the data. Additionally, we were careful to ensure that the data accurately represented what the respondents stated. The memorandums were used to log a trail of evidence about the data and our decisions, and we were open to alternate interpretations. Interviews were conducted until we reached content saturation, determined by the redundancy of data and lack of new emerging themes.

RESULTS

Participants

Saturation was achieved, and recruitment was suspended after conducting 20 interviews with parents of children with asthma. During recruitment, an additional 12 parents were approached who declined to participate. All of the parents were mothers. Fifty percent of the children discussed were 7 to 12 years old. Eighty percent had public insurance. Thirty-five percent were on combined ICS or LABAs. Only 1 child had never been admitted to the ICU for asthma (Table 1).

Themes

Major Theme 1: Chronic Disease Management Assistance

Parents commonly reported complexities and challenges with asthma medication

TABLE 1 Child Demographic Characteristics and Preference Summary ($n = 20$)

Characteristic	*n* (%)
Child age group, y	
2–6	7 (35)
7–12	10 (50)
13–17	3 (15)
Child insurance status	
Public	16 (80)
Private	4 (20)
Controller classification	
ICS	13 (65)
ICS or LABA	7 (35)
Ever to ED for asthma	
Yes	19 (95)
No	1 (5)
Ever hospitalized for asthma	
Yes	13 (65)
No	7 (35)
Ever to the ICU for asthma	
Yes	8 (40)
No	12 (60)
Preferred mode of contact is phone call	
Yes	6 (30)
No	14 (70)
Prefer at least monthly contact	
Yes	15 (75)
No	5 (25)
Prefer contact from provider's office	
Yes	17 (85)
No	3 (15)

compliance. One mother expressed, "…it's a challenge just trying to remember what medicine you take at this time or this day, and how many, and the dosage…" Parents frequently stated that they struggle with maintaining controller medication adherence and identifying and avoiding triggers. They also often expressed a general frustration with their inability to gain control of their child's asthma despite their best efforts, "And I don't know — sometimes I'm like, 'Does it work? Because we end up here [hospital]'." Parents of older children recognized a struggle with passing on responsibility for taking controller medications to their child. They cited lifestyle factors, including early morning or late evening work schedules, parent and child school schedules, multiple children, single-parent households, relying on family members for child care, and children splitting time between 2 households, as specific barriers to controller medication adherence and trigger avoidance.

Parents expressed an interest in a program that would assist them in managing their child's asthma, particularly 1 that was focused on improved medication adherence. "I mean I would look at it as a form of a heads-up, to say that, 'Hey, we're noticing this pattern, so maybe you need to do something before it worsens'" and "Yeah because sometimes as being a mom, you forget things so it's cool to have that on my phone to remind me that, 'it's time to get that refill, girl'." Specifically, no parent participants expressed concern with the provider's office monitoring refill behavior to inform the intervention (Table 2).

Major Theme 2: Distinct Preferences for Risk Communication

Parents expressed relatively strong preferences for the mode, source, content, and frequency of risk communication. For mode, the majority of parents preferred electronic communication, either text messages, application-based messages, or e-mails. Others stated that a phone call would be their preferred method of communication, whereas parents who preferred electronic communication expressed that they do not often answer their phones, and phone calls do not fit into their lifestyle (see more detail regarding electronic habits in major theme 3).

Regarding source, many parents prefer the contact to come from someone at their child's physician's office as opposed to someone from the pharmacy or the insurance company. Parents did not mind if the communication came from someone other than their primary physician as long as it was someone from within the office who could answer clinical questions. Parents had strong opinions related to messages from insurance companies in that none of the respondents preferred communication from the insurer. "I don't want the insurance company to contact me." Parents also expressed a preference for 2-way communication, meaning they did not just want a 1-way text message or an automated phone call with no ability to respond.

Parents made recommendations related to the content of the messaging. Several parents indicated they have been searching for a tool that could track the child's asthma information. Parents recommended incorporating allergen alerts, peak flow tracking, and daily medication reminders into the application.

When asked specifically about using the phrase "asthma attack" in the message, most parents agreed that although it was alarming, it was appropriate in this context, and they recommended incorporating it into the message. "Powerful message. It's an attack." "They're gonna have an attack. You need to act now." "You just have to be truthful. I believe there's no sugar coating anything when it comes to something so severe as death possibly knocking at your door. Especially for a child."

There was some variation in the preferred frequency of the messages. Many parents were comfortable or preferred at least monthly risk communication. The remaining participants only wanted to be contacted when their child was high risk, as defined by the AMR, which was explained to parents at the beginning of the interview (Table 3).

Major Theme 3: Electronic Reachability

Parents reported their current electronic habits, including how often they check their e-mail, if they use e-mail on their phone, if they change their cell phone number frequently, and their general reachability. Some participants preferred to be contacted by text message or smartphone application. "Because it's easier for me to text. If I'm at work or if I'm out and I'm in a situation where I can't take a phone call, then I can always text." Others prefer a phone call. These parents said that because they have children, they always answer the phone when it rings. The remaining stated they are okay with any method of contact (text, application, e-mail, call). Most parents reported checking their e-mail "frequently," but this could mean once a week to several

TABLE 2 Major Theme 1: Chronic Disease Management Assistance

Subtheme	Quote
Self-efficacy	"Yeah, I tried to kind of keep his lungs open and doing everything as much as I could, but it didn't work." "And I don't know; sometimes I'm like, 'Does it work? Because we end up here.'" " Also, it's a challenge just trying to remember what medicines you take at this time or this day, and how many, and the dosage…"
Older child and/or responsibility	"He says he takes it every day. I don't know, honestly." "I usually remind her, 'cause sometimes she'll forget, but she remembers when she goes to school."
Lifestyle factors	"Most of the time it's him in charge because I'm at work and I leave home at 4:00 in the morning. So mostly, I ask him every day, but…I don't know." "…if we forgot or if we were in a hurry that morning, I'd be like, 'He's fine.'" "'Cause sometimes it's just so busy (me going to school and work) so sometimes I'm just tired, and it's just sometimes it slips my mind, and then I'll remember at the last minute."
Welcoming help	"…and if there's just 1 person or 1 text message or phone call that I can get that can remind me, that's great." "That's letting me know that you're really concerned about my child; it's not just me." "It feels nice to know that somebody cares and they're calling to check up."
Privacy	"No, because I actually care what happens to my child. If I forgot I'd like to be reminded." "No. Not at all. That'd be great, since no one else is actually helping to look out for…"

times a day. Most parents reported that they have had the same phone number for several years.

A few parents reported using applications for communication with their children's teachers and rated that experience favorably and can see similarities to how an asthma application could be useful. "…it allows you to talk to every single one of her teachers…and so it lets you know if they forgot their homework or anything they do during the day and it'll send an alarm like your child got a negative point for homework…" (Table 4).

DISCUSSION

With this study, we provide insight into parental attitudes regarding mobile technology strategies used to assist their child's asthma management. Discussions were focused on current electronic habits and preferences for asthma risk communication frequency, methods, and content. Our primary findings include parents welcoming chronic disease management assistance for their children with asthma, preference for 2-way communication with a clinically trained provider either by text messages or phone, and high levels of electronic reachability through their daily use of smartphones.

These findings build on other recent studies in which authors have attempted to improve medication adherence in children and adults with asthma through multiple technology-based modalities.[3–9] Authors of a systematic review of mobile phone interventions' efficacy in improving medication adherence in a variety of chronic diseases found that 18 of 29 studies revealed significant improvement in medication adherence after receiving a text messaging intervention.[10] Text messages from the negative studies included more basic and repetitive content, whereas those from the positive studies included varied educational and motivational content. All 8 studies in which authors used tailored or personalized messages revealed significant improvement in medication adherence. Authors of a majority of all included studies reported high levels of participant satisfaction with receiving text messages for health management.[10]

Consistent with previous studies, our study revealed parents' openness to text messages and/or electronic communication from their asthma provider as well as their preference for 2-way messaging. In developing effective mobile technology–based interventions for children with asthma, it is also important to consider asthma providers opinions on the utility, feasibility, and proposed content for these interventions. Although this is beyond the scope of our study, Hollenbach et al[11] recently sought to determine what information primary care clinicians and pulmonologists would want from a mobile health tool aimed at improving asthma management in children. Through focus groups, the authors found that both primary care physicians and pulmonologists saw a benefit to implementing a mobile health tool used to assist with asthma management. Providers specifically wanted mobile technology solutions to include information on adherence to daily therapy and data on inhaler technique. They want this data available to them at the time of an office visit but also felt it would be useful to be notified of increasing rescue medication at any time. Pulmonologists felt that using a mobile spirometer to supply intervisit lung function data would be helpful. From this study, providers favor objective data available at the time of office visits and during periods of potential high risk. To design an optimal mobile technology–based tool for parents of children with asthma, parental and provider perspectives must be reconciled, and the design must take into consideration parents' electronic habits, feasibility, and cost-effectiveness.

Using electronic messaging to improve medication adherence among high-risk children with asthma is a promising strategy, particularly in light of recent advances in the field of asthma risk prediction and the increasing availability of pharmacy dispensing data at the bedside.[12–14] Although our interview questions were focused on parents' communication with outpatient asthma providers, it will be important to consider how emergency medicine or hospitalist providers could use mobile technology to improve asthma care, because they are

TABLE 3 Major Theme 2: Distinct Preferences for Risk Communication

Subtheme	Quote
Frequency	"I would like…if I could honestly get a weekly update, I would love a weekly update." "I think a month would be good. A monthly update to check on her to see where she is. For someone that might not remember, I think it would be better monthly."
Mode	"One thing, the e-mail is paperless, and I check my e-mail every day, all day, so it's nothing that I would miss, and mail, sometime [sic] it gets lost, and I don't receive a lot of mail, and so e-mail is fine." "So I'm thinking if I'm going to use an app, I want 1 that's gonna be user friendly where I can get to where I'm trying to get down, be pretty simple and straightforward." "Because it's easier for me to text. If I'm at work or if I'm out and I'm in a situation where I can't take a phone call, then I can always text. My text is really the best because I know it's always available to me." "The call is more personal. I understand the technology of today's society. In some cases, it is useful; however, I would prefer to speak to someone if I have any questions or concerns."
Source	"Her doctor. Because I deal with them on a personal level. I think it'd be better coming from the doctor." "So I guess my answer to that would [be] whoever calls me needs to be able to answer my questions and not seek more advice." "The insurance company just doesn't seem as…unless I talk to the person continuously, it just doesn't seem as…I don't know what the word is. Personal I guess, from the insurance company." "They're [the pharmacy] helpful with medication questions like interactions and things like that, but I don't know if I would trust them enough to give me advice on his asthma or more critical care questions."
Content	"I was actually looking for an app that was some numbers that he can put in, like for his peak flow, so that I would be able to…he could put in, and I would be able to see…" "If it's an app, like I said, especially living in the South, the updates like 'today's high pollen count' or other allergies that are known going on." "Like a friendly reminder, like 'hey mom' or 'hey so and so, we just wanted to let you know that you haven't picked up,' make it friendly. 'I know you're probably busy, but you haven't picked up your child's prescription.'" "Being able probably to request refill prescriptions, being able to request appointments, like you said, those reminders about his prescriptions." "…it would be cool if you could go on and read about asthma…"
Two-way communication	"It's just more personable with a human being on the other line." "If it was a text, you'd want to be able to, like, start a dialog with that person or e-mail back or, you know, you get a message from somebody you're not sure who it is, and you'd want to be able to call them to, like, have a conversation…" "Just, like, having someone on the phone talking to someone, it's that personal touch."
"Asthma attack"	"But, yeah. Asthma attack. You just have to be truthful. I believe there's no sugar coating anything when it comes to something so severe as death possibly knocking at your door, especially for a child." "I think that's a little alarmist, but that's okay. There are some people that I'm sure need that level. We're not those people, so that might set my panic off." "No, I would keep it the same because I feel like there's nothing wrong with being blunt and to the point because an asthma attack is an asthma attack, which could kill your child. And I think it's a serious matter, and it should sound very serious."

typically seeing children at times of high risk. It is possible that clinics, health systems, or insurance providers could monitor pharmacy dispensing data to identify children at high risk for exacerbation on the basis of the AMR. The AMR (number of controller medication claims/[number of controller medication claims + number of reliever medication claims]) is an emerging asthma risk assessment tool that can estimate the risk of an ED visit or hospitalization for an asthma exacerbation on the basis of pharmacy dispensing data.[13,15–18] Individual clinical providers or case managers could then use mobile technology to communicate with parents of identified high-risk children. Ideally, this system would prevent exacerbations or reduce the severity of exacerbations by identifying declining controller medication adherence or increasing rescue medication use early. However, hospital-based providers will continue to be on the frontlines of asthma care and can use the hospitalization as an opportunity to enroll children in mobile technology programs. It is imperative that hospital-based providers and primary care providers work together to improve asthma care, particularly by communicating during high-risk transition periods. Mobile technology could be used to offer an opportunity to streamline this communication. One avenue worth future investigation is a mobile technology tool used to connect the parent, the hospital-based provider, and the primary care provider during periods of transition from hospital to home.

This study has several limitations. The interviews were conducted at a single institution, and therefore, our findings might not be generalizable to other clinical sites or geographic regions. Additionally, the absence of some demographic data, including rurality and parental educational obtainment, further contribute to limitations of our generalizability. However, our sample did represent diverse ages and included both publicly and privately insured children. Our sample also represented children with varying degrees of asthma severity as evidenced by their hospitalization histories and their current controller class (ICS versus ICS or LABA). We relied on parental report for these questionnaire responses and acknowledge that parental recall is unlikely to be completely accurate. Additionally, our discussions were focused on theoretical mobile technology interventions; thus, the caregivers participating were not able to preview an actual smartphone asthma application before participating in the interview. The

TABLE 4 Major Theme 3: Electronic Reachability

Subtheme	Quote
Smartphone access and/or use	"Well, I pretty much answer my phone. Or if I see a text message, I'll look at it. But most of the time, people just call me." "No, I answer my phone. I have 3 kids, so I can't really not answer…" "Because it's easier for me to text. If I'm at work or if I'm out and I'm in a situation where I can't take a phone call, then I can always text. I know that's one thing…can't always e-mail. My text is really the best because I know it's always available to me."
School	"I use apps for school, for them for school. …She sends me homework assignments, their grades, their behavior for the day and the week. Everyday." "…it allows you to talk to every single 1 of her teachers…and so it lets you know if they forgot their homework or anything they do during the day, and it'll send an alarm like your child got a negative point for homework. …And then if the teachers need to talk about anything, they just e-mail. …I guess through the app, and it just comes straight to me and lets me know."

majority of the interviews were conducted by the principal investigator (A.L.A.), who introduced herself as a physician. Although she was not involved in the direct clinical care of any of the parents' children, identifying as a physician could introduce a power differential that may have affected parental responses. Interviews conducted by the research assistant revealed similar findings to those conducted by the principal investigator suggesting the power differential was not a significant factor in parents' responses.

This study, combined with previously published data, could be used to inform the development of patient-centered mobile technology–based interventions to improve communication with parents of children with asthma during periods of increased risk. Ultimately, these mobile technology solutions have the potential to improve controller medication adherence, reduce asthma symptoms, and improve asthma-related quality of life. By engaging parents early in this process, we improve our chances of developing an intervention that works for families who struggle to maintain control of their child's asthma. It is suggested in our findings that parents of children with asthma struggle with achieving and maintaining medication adherence and consequently disease control. Parents welcome assistance from their physician's office in the form of 2-way mobile technology–based communication. Such a tool could be used during the critical transition from hospital to home, reinforcing the importance of coordination between primary care and hospital providers for children with chronic disease. Development of such an intervention will require an iterative process with continued parent engagement to achieve successful implementation and maximize effectiveness.

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