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The utility of providing automated medication dose reminders to young children on chronic medication

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Summary

We investigated the effect of text message reminders about medication administration. The study concerned children with cystic fibrosis. We provided 20 children (aged 5–12 years) with pagers that they could customize. For the first two weeks, we sent friendly text messages (non-reminder content) near medication times to acquaint them with the use of the pager. For the second two weeks, we sent messages reminding children to take their medications. The parents completed a survey to assess the child's overall use of the pager and degree of participation in medication management. Sixteen out of 20 children completed the study. Of these, 14 children (88%) were able to help notify parents when medications were due. Children as young as seven years of age may be able to receive reminders about medication administration events. The pilot study demonstrated the feasibility of involving younger children in pager technology related to medication adherence.

Introduction

Studies of self-management in chronic conditions suggest that educational interventions to help children manage their conditions can improve symptoms, school attendance, feelings of self-control[1] and increase self-management behaviours.[2] Reminders about when medication doses are to be administered represent one potential area for child self-management. In addition to studies demonstrating efficacy in adults,[3,4] recent studies suggested that reminders given directly to adolescents are associated with better medication schedule compliance.[5–9]

Almost every household in the US has at least one mobile phone.[10] Text messaging has been used to assist patients with asthma,[7] antiretroviral therapy[3] and diabetes with mediation management.[11] However, most of these studies have focused on older children and

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adolescents, despite anecdotal reports suggesting that children who are much younger may be able to participate in the medication administration process.[12,13] These children must demonstrate that they are able to identify their medication, describe the time they should take their medication and be able to do so with little supervision from others. Despite the skill that younger children may have in self-administering medication, previous studies have not assessed the ability of these children to take more control of medication dosing – a milestone that has the potential to reduce their fragmented care.

The aim of the present study was to determine whether younger children would be interested in and capable of responding to medication reminders without parental intervention.

Methods

A four-week study was conducted in a metropolitan academic health centre, with a group of children who were 5–12 years old and diagnosed with cystic fibrosis (a chronic condition in children that does not affect their capacity to self-manage medications). The study was approved by the appropriate ethics committee.

Children and their parents were recruited if the child was on at least one regularly scheduled chronic medication and if the family was fluent in English. At enrolment, each family completed a demographic survey that included the child's age, list of medications and their daily administration schedule. Parents signed a consent form, while children signed an assent form that was read to them by the research team member. Parents also received a letter from the principal investigator to be given to a school/day care official that explained the purpose of the study and requested permission for the child to carry a pager during the day. Each child was given a standard one-way text message pager, a pager case and colourful stickers to customize its appearance. Each family was taught how to turn the pager on and off, switch the pager from audible to vibrate mode and to read messages. They also received a handout describing how to use the pager, with pictures describing each step. We chose pagers, rather than mobile phones, because of concerns expressed by school staff regarding the use of mobile phones during class, concerns about phones being harder to use and more desirable to steal and because of the inability to set up mobile phones for text messaging without activating them for voice calls.

During the first two weeks of the study, children were sent random messages meant to engage and familiarize them with the pager. Some of these messages included greetings, such as 'Good morning, Jacob!'. Other messages included the text, 'You win a prize!' At the end of each week, the study nurse called the parents to confirm that the child was carrying the pager and to enquire if the child saw the pager message about the prize. If the child recalled seeing it or if the parent recalled the child telling them about it, a prize was sent to the child via mail.

During the second two weeks of the study, children were sent up to five messages each day at medication dosing times. The reminder schedule was initially established with the parents and then reviewed weekly or more often if needed. None of the children in the study were sent more than five reminders per day. Reminders were not sent during the time the child

was supposed to be asleep. Text messages contained whatever parents recommended we call the medication. In most cases, we used the actual name of the medication, but in some cases we used a nickname, such as ‘enzymes’ or ‘morning puffer’. We did not include information about the number of pills to take or the formulation of medication. At the end of each week of the study, a research nurse called the parents to enquire if the child was still carrying the pager. During these semi-structured telephone interviews, we asked parents to describe whether and how their child was using the pager. Responses were transcribed directly from the interview for further analysis.

During the fourth week of the study, parents were asked to complete a survey to assess the overall effect of the pager on the child’s medication management. Questions included whether the child was able to carry a pager to school and if it affected medication use. At the end of the study, children were sent a $50 gift card in appreciation of their time in the study.

Exploratory analyses of the data were conducted using Stata (StataCorp LP, Texas, USA). Comment fields were evaluated by two investigators using open coding techniques,[14] using iterative examinations of data and focused coding as key themes gradually emerged.

Results

Eighteen families with 20 children were invited to participate in the study. Informed consent was obtained and all 20 children were enrolled. Four children did not complete the study. Of these, two received pagers with technical problems and lived far enough away from the clinic that it was difficult to remedy the situation. One other child lost interest in participating, and another did not find the medication reminders to be of benefit. Sixteen children (80%) completed the study, including the final survey.

The medication management practices of the enrolled pilot group are summarised in Table 1. All parents stated that their children were able to recognize and describe their medications and that they were able to tell when someone was trying to administer the wrong medication. Sixteen (80%) of the parents stated that their child took medication without an adult supervising. The children took a median of seven prescribed medications (range 3–10). Fifty percent of children had missed at least one dose of medication in the week before enrolment and every respondent reported having to administer medications in at least one site other than their home in the past month (range 1–7).

The results for all 20 children are summarised in Table 2. Of children aged 5–6 years, one half did not complete the study due to a combination of technical difficulties and a loss of interest in carrying the device. Three of the four parents of children in this age range reported problems motivating the child to participate in self care. In contrast, in children aged 7–10 years, 14 of 16 children completed the study, with two discontinuing within two weeks because of loss of interest.

The results of the exit survey given to parents are summarised in Table 3. Of the 16 who completed the study (88%), 14 of the children were able to help notify parents when medications were due. Of the two children (both aged seven years) who could not do this, one reported the pager was more helpful at school and during outside activities, while the

other was neutral about the pager, with the comment by the mother that some electronic messages were erroneous.

A total of 11 children were able to use the pager while at school. Of these, eight (73%) were able to help with dose reminders at school. Two children were home-schooled, but were able to use the pager. Two children did not use the pager because they were too young for school. Two did not carry the pager because of school restrictions. One child was reported to have carried it secretly, due to embarrassment at being seen with the pager. One parent did not trust her child with the pager at school.

Additional features

At the end of the study, parents were asked about additional features for a medication management system that they thought would be helpful. Most (14/16 or 88%) liked the idea of the system sending parents reminders when their child missed a dose of medication. Most of the parents of children completing the study thought that the silent alarm (vibrate mode) was important for their child (85%) and that messages containing text (as opposed to images only) were an important component of the alarm/reminder (13: 80%). Finally, 10 parents (63%) believed that storing medication with the pager would be useful.

Discussion

The present study demonstrated that children as young as seven years could be given the opportunity to receive and respond to medication administration reminders. We were able to show that electronic messaging is perceived as a useful adjunct to medication management by parents of children with chronic illness, using cystic fibrosis as an example chronic illness. In particular, for those children over seven years old, parents noted changes in their child's level of engagement and were often surprised by the extent to which their child could participate in ensuring medication adherence. These results confirm similar findings of Nikander and colleagues in their studies of adherence and medication management competence in children with asthma.[13] Families and patients both felt that the reminders were helpful and all agreed that medication reminders were important due to the complexities of the medication regimen.

However, our results also demonstrate the need to assess a child's readiness for this level of engagement. Previous studies of children involved in self-care have demonstrated behaviours that could put the child at risk.[15,16] Because the children in our study were selected with the consent of parents bringing their child to a health-care setting, they were likely to be highly motivated families for whom the use of technology complemented their existing disease management strategy. Even so, there were children over seven years old who lost interest in using the pager or who were not as capable as other children of the same age. Disease-specific tools, such as the Asthma Inventory for Children, which has recently been correlated with asthma self-management, might be useful for assessing readiness for child self-care,[17] and should be considered in subsequent studies.

The present study has limited generalizability due to the small number of children at each age. The study population may have suffered from selection bias, because clinic nurses

referred patients to the research team member in the waiting room and because children were required to consent to the study. However, every child we approached agreed to participate. In addition, the study did not assess the contribution of family or other caregiver support in achieving successful use in young children. It is likely that the involvement of parents or siblings is critical for many younger patients. However, we did receive comments from parents suggesting that their child was able to receive and respond to pages with no parental involvement. The ideal infrastructure and education for supporting medication administration has not been adequately explored, although in many school and home settings, children appear to be given responsibility for managing diseases such as asthma and diabetes. The present study did not attempt to improve the self-management skills of children before providing the pagers. Validated models of self-management education, such as the PRECEDE-PROCEED model for asthma self-management,[18,19] will be useful for subsequent studies of relevant conditions.

In conclusion, the pilot study demonstrated the feasibility of involving younger children in pager technology related to medication adherence.

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Table 1

Respondent medication administration practices (n = 20)

(a) Missed doses	
None	10
1 dose	3
2 doses	3
3 doses	1
4 doses	0
5 doses	1
6 or more doses	2
(b) Late doses	
None	14
1 dose	1
2 doses	2
3 doses	1
4 doses	0
5 doses	0
6 or more doses	2

Table 2

Enrolment

Age (y)	Completed/Enrolled (%)	Comments
5	1/2 (50)	Technical problems could not get replacement – study stopped. Child reported pager messages, but lost pager frequently.
6	1/2 (50)	Tried to get him to wear it a few times, but he would not keep up with pager or take it with him. Dropped out during week two. Child started using pager when he realized alerts were coming. Reported alerts consistently.
7	3/3 (100)	Child did well with pager, took it to school and was very helpful with bolus feeding reminders. Parent was surprised. Child kept up with pages and medicines, was intermittent about reporting pages to parent. Took pager to homes of both parents who would not let the child take it outside. One time alert went off while she was sleeping and scared her. She became reluctant to keep the pager at the bedside. Parent found the pager really helpful to remember enzymes when away from home, but the child was generally uninterested in keeping up with medications.
8	5/6 (83)	Uninterested. Stopped on Saturday. She said she did not want to do it any more when she went to her cousin's house. Child was engaged and reported all pager messages. Became embarrassed on the first day or two of wearing the pager at school. Daily routine didn't really need medication dose reminders. Very helpful for new medication (Cephalexin). Would be good for the summer. Child was hospitalized when first enrolled, so study time was extended. Child kept up with pager and experienced some difficulty in reading messages but would bring to parent to get help. Parent happy with child's ability to keep up with pager. At first was reporting pager messages but had trouble keeping up with pager. During week three, the child put the pager away and stated she did not want to carry it any more.
9	4/4 (100)	Left the pager at school one night because she put it in her desk and forgot. Child loved the responsibility of the pager, did not always report to parent, but kept up with pages and medications. Parent wasn't sure how interested the child was in the pager, but he did report getting pager messages and carried the pager. Child was engaged and enthusiastic about pager and remembering medications. It really helped her a lot to remember during school. It really helped her and teacher to remember. When she received a message she remembered to take her medicine (which surprised her parents).
10	2/3 (66)	Does not like it, sees it as a nuisance; dropped out during week one. Teacher and medication system very efficient at school, child did not see a reason to continue. Does not like carrying it. Does not like friends asking her about it. I think it has helped him grow up somewhat. At Christmas he had several comments about how he has grown up. No problems with the pager. No surprises. Child is diligent, kept up with medications and pager. Pager went off a couple of times when the child was sleeping.

Table 3

Exit survey results

Question	Strongly disagree No. (%)	Disagree No. (%)	Neutral No. (%)	Agree No. (%)	Strongly agree No. (%)
My child was able to help me remember when it was time for medicine doses.	1 (6)	1 (6)	0	8 (50)	6 (38)
I would like to have a tool like this for my child.	0	1 (6)	2 (13)	6 (38)	7 (44)
The alarm was too loud.	7 (44)	6 (38)	1 (6)	0	2 (13)
My child was able to help teachers remember when it was time for medicine doses. *	0	0	3 (27)	2 (18)	6 (55)
I would like to have a tool like this for my child to take to school.	0	0	0	6 (55)	5 (46)
FEATURES					
The text was an important part of the alarm.	0	1 (6)	2 (13)	3 (19)	10 (63)
I would like to be sent a message if a dose is missed in school or day care.	0	2 (13)	0	5 (31)	9 (56)
The silent alarm is an important feature to have.	0	2 (13)	2 (13)	2 (13)	10 (63)
I wish there was a place on the pager to store a dose of each medication.	0	2 (13)	4 (25)	5 (31)	5 (31)

* 5 children were not allowed to take the pager to school. The response represents 69% of eligible respondents.