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The Meanings in the messages: how SMS reminders and real-time adherence monitoring improve antiretroviral therapy adherence in rural Uganda

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See related paper on pages 1295 and 1301

Objective: To understand how a pilot intervention combining SMS reminders with real-time adherence monitoring improved adherence to HIV antiretroviral therapy (ART) for adults initiating treatment in rural Uganda.

Design: Qualitative study, conducted with a pilot randomized controlled trial.

Methods: Sixty-two pilot intervention study participants took part in qualitative interviews on: preferences for content; frequency and timing of SMS adherence reminders; understandings and experiences of SMS reminders; and understandings and experiences of real-time adherence monitoring. Analysis of interview data was inductive and derived categories describing how participants experienced the intervention, and what it meant to them.

Results: SMS reminders prompted taking individual doses of antiretroviral therapy, and helped to develop a 'habit' of adherence. Real-time adherence monitoring was experienced as 'being seen'; participants interpreted 'being seen' as an opportunity to demonstrate seriousness of commitment to treatment and 'taking responsibility' for adherence. Both SMS reminders and real-time monitoring were interpreted as signs of 'caring' by the healthcare system. Feeling 'cared about' offset depressed mood and invigorated adherence.

Conclusion: Although serving as reminders, SMS messages and real-time adherence monitoring also had larger emotional and moral meanings for participants that they felt improved their adherence. Understanding the larger 'meanings in the messages,' as well as their more literal content and function, will be central in delineating how SMS reminders and other adherence interventions using cellular technology work or do not work in varying contexts. Copyright © 2016 Wolters Kluwer Health, Inc. All rights reserved.

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Keywords: antiretroviral therapy, mechanisms of effect, real-time adherence monitoring, SMS

Introduction

Cellular technology is widely used globally and offers promising opportunities for improving HIV antiretroviral

therapy (ART) adherence and clinical outcomes. Mobile phones allow healthcare providers to communicate with patients remotely, thus reducing the need for costly and time-consuming travel to clinical sites. SMS text

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messaging is a concise and inexpensive form of patient communication using mobile phones.

Wireless electronic adherence monitoring devices store medications and transmit records of device openings via a cellular network. These devices provide detailed, real-time information on dosing with ART, making it possible to intervene promptly to attempt to close adherence gaps before viral rebound and subsequent drug resistance can develop [1].

A number of randomized trials have examined the impact of cellular communications on ART adherence in low- and middle-income countries. Intervention designs and adherence measurement approaches have varied substantially. Weekly and twice-weekly text message reminders have been shown to increase adherence in Kenya and Nigeria [2–4]; however, no benefit was seen with daily text messages [3] in Kenya or in other studies carried out in India, Cameroon, and Brazil [5–7]. Two trials have combined text message reminders with real-time electronic monitoring of adherence. Benefit in overall adherence was seen in one study, conducted in China [8], but not in the other, from South Africa [9]. However, a decrease in the number of sustained treatment interruptions was observed in the South African study. Acceptability and feasibility of both text messaging and real-time adherence monitoring have generally been high [6,10–13], although concerns about the monitoring devices' potential for infringing upon patient privacy have been raised in some settings [6,8,12].

To improve these interventions for more consistently positive results, it is important to understand *how* they work [14]. The importance of understanding the mechanisms through which complex health interventions produce change is increasingly being recognized [15–18], as is the value of qualitative research in contributing to this process [19–22]. Understanding mechanisms includes explicating the pathways through which intervention components lead to outcomes ('what works'), and characterizing particular populations or groups that stand to benefit especially from an intervention ('for whom/under what circumstances'). Understanding the mechanisms through which interventions based on SMS reminders and real-time monitoring impact adherence will inform both the design of future research and the integration of cellular technologies into clinical practice in settings of resource scarcity.

This article reports findings from an adherence intervention development study. The study used a pilot randomized controlled trial (RCT) design to investigate the effects of multiple types of SMS reminders combined with real-time adherence monitoring on ART adherence. All study participants were given a real-time adherence monitor and were randomized (1:1:1) to receive 'scheduled' SMS reminders (daily, weekly), reminders

'triggered' by a missed dose, or no SMS (a control group). A qualitative component examined participant experiences of intervention components.

Quantitative RCT results are reported in a companion report [23]. Here, we draw upon the qualitative data to address the question, 'how did the pilot intervention work?'

Methods

Setting

The study took place between September 2013 and June 2015 at the Mbarara Regional Referral Hospital (MRRH), Mbarara, in rural southwestern Uganda. Study participants were not less than 18 years old, initiating ART, and living below 20 km of MRRH; all had access to a personal cell phone with reliable reception.

Qualitative research methodology

Procedures used to collect and analyze qualitative data are described below. Information on intervention design may be found in the companion report [23].

Qualitative data collection

Sixty-three individuals were identified as eligible for the RCT. One was subsequently determined to be HIV-negative and not included in the qualitative research. Qualitative data collection consisted of individual open-ended interviews. Interviews elicited information on: preferences for content; frequency and timing of SMS adherence reminders; understandings and experiences of SMS reminders; and understandings and experiences of real-time adherence monitoring.

Qualitative interviews took place at study follow-up Month 3 and after the first subsequent 48-h treatment interruption. Participants with no subsequent interruptions were interviewed at the end of the 9-month study follow-up period. One-hundred and one qualitative interviews were completed with 62 participants. Forty-one of the 101 interviews were completed at Month 3, 30 following treatment interruptions, and 30 at study exit.

Interviews were conducted in private settings in the local language (Runyankole) by Ugandan research assistants trained in qualitative data collection techniques and were audio-recorded. Immediately following each interview, research assistants summarized interview content in English as a 'debrief.' A complete English transcription was then produced from the audio recording by the research assistant who had conducted the interview. Transcripts were continuously reviewed by author E.P. for quality, including clarity, detail, English grammar and style, and formatting.

Qualitative data analysis

Analysis of interview data was inductive and used a content analytic approach [24–26]. The goal was to derive categories describing how participants experienced and interpreted the intervention, as an approach to understanding ‘how the intervention worked.’ The analysis unfolded in steps. First, authors N.W., E.P., M.T., M.W. and J.H. reviewed and discussed 10 transcripts to identify relevant content. Identified content was used to assemble a codebook. This process was iterative and involved developing labels to represent content, writing operational definitions, and selecting illustrative quotes. Following completion of the codebook, interviews were coded by authors E.P. and M.T. using ATLAS, ti software.

Coded data were used to develop categories corresponding to key aspects of participant experiences. Authors N.W., E.P., M.T. and M.W. contributed to the category development process. Category development began with repeated reviews of coded data to populate one a-priori category (SMS reminder preferences), and to identify emergent themes. Subsequent steps included specifying labels, organizing and writing descriptions of category content, and supplying evidence from the data in the form of illustrative quotes from interviewees. These steps produced initial versions of the categories, which were then reviewed and revised to improve clarity and add detail. The categories are presented as Results, below.

Institutional approvals

This study was approved by the Partners Human Research Committee, Partners Healthcare, Boston, MA; the Mbarara University of Science and Technology Institutional Review Committee, Mbarara, Uganda; and the Uganda National Council for Science and Technology, Kampala, Uganda.

Table 1. Participant characteristics.

	Study participants (N=62) N (%) or median (interquartile range)
Female	40 (65%) ^a
Median age (years)	30 (25–35)
Education	
None	5 (8%)
Primary	36 (58%)
Greater than primary	21 (34%)
Able to read English or Runyankole	60 (97%)
Median CD4 ⁺ cell count (cells/ μ l)	309 (231–397)
Depression	30 (48%)

^aNoted to be different among the randomized study arms (71% in the scheduled SMS arm, 35% in the triggered SMS arm, 86% in the control; *P*=0.03). All other characteristics were similar among study arms.

Results

Participant characteristics are shown in Table 1. The majority of study participants were female and in their early 30s. Median CD4⁺ cell count was 309 cells/ μ l (interquartile range 231–397). Nearly all were literate. Almost half scored as depressed on a locally validated, self-report measure [27].

Categories resulting from analysis of qualitative data are presented in two sections, below, entitled ‘preferences for SMS reminders,’ and ‘meanings and experiences of intervention components’.

Participant preferences for SMS reminders

Content of SMS reminders was determined individually by study participants, who were asked to select a word or phrase that would help them remember to take their medication. A default message – ‘This is your reminder’ – was offered. For scheduled reminders, participants also chose the time of day messages would be sent.

Almost half (44%) of participants chose the default message. Twenty percent chose messages that explicitly included reminder words or phrases (e.g. ‘Have you taken your pills?’). The remaining choices were neutral with respect to reminder content (e.g. ‘How has your day been?’). Twenty percent of selected messages were in English; the remainder were in the local language (Runyankole).

Participants in one RCT study arm received scheduled daily, scheduled weekly, and triggered reminders over the 9-month follow-up period. Of the three, scheduled daily messages were preferred. Because they were sent every day, usually around dosing time, participants felt these messages reduced chances of missing doses.

‘[Daily messages] were the best. They would remind me every day and I could not forget. But for the weekly ones that come only one day in the week, you need to keep reminding yourself because there is nothing to remind you. You have to keep watching the time. The daily ones are more helpful.’

–Female, Age 29, Month 3 interview

‘Triggered’ messages, in contrast, raised concerns about taking pills late. For example, triggered messages were sometimes received at inconvenient times. Participants with evening dosing times might be asleep when a triggered message arrived. This meant they would only see the reminder the next day, when they felt it was too late to take the dose.

[Messages] ‘that come much later [than dosing time] are not helpful. We sleep early and you cannot easily see those

messages. Someone can call you at night and you do not hear the call, let alone the message.'

–Male, Age 25, Treatment interruption interview

'I think receiving the message 1 or 2 h after the time I am supposed to take my medicine is not very good. I [try] never to miss taking my medicine but when I forget, there is a delay in receiving the message reminder.'

–Male, Age 36, Month 3 interview

The timing of scheduled messages was also important to participants. When choosing message times, some preferred to receive scheduled messages shortly before the intended dosing time to allow them time to prepare to take the medication (e.g. finish up their work and go home, obtain water and/or food to take with the medication). Others preferred to receive the messages at the exact time of dosing so they could take the pills immediately upon message receipt.

Meanings and experiences of intervention components

Three themes emerged from the qualitative data analysis that address meanings and experiences of intervention components for participants, and the intervention's mechanism of effect. The themes are presented below as categories entitled, 'reminding and a "habit" of adherence,' "being seen adhering": an opportunity to demonstrate commitment to treatment,' and 'feeling cared about by the clinic.'

Reminding and a habit of adherence

Participants found adherence to daily doses of ART challenging at the start of treatment. Variation in daily schedules made it difficult to remember to take pills at the same time every day. When participants received a reminder, they made efforts to take their medication immediately. Thus, the reminders served to prompt individual doses.

Daily messages helped to develop 'a habit' of good adherence. Regular, frequent reminders early in treatment helped participants grow accustomed to taking pills at the same time every day. Eventually, they came to depend less on the reminders, remembering without prompting to take their pills when daily reminders ceased.

'...for something you have not been doing, starting it can be a problem and you can easily forget. But as I had those messages, they trained me to take the medicine well. They would come every day and so I learned that behavior of keeping time. I used to make sure I had battery on my phone so that I didn't miss the message. And even when they stopped coming every day, I got used and continued to take them at the same time.'

–Female, Age 40, Month 3 interview

The monitoring device also served a reminder function. It was often kept in a location where it was seen every day. Seeing the device helped participants remember their medication dose. Specific features of the device also contributed. For example, a light blinks each time the device is opened and a signal is sent. Participants became used to seeing the light blink every day. On any given day, the realization that they 'hadn't seen the light,' became a reminder that they hadn't yet taken their ART.

'I know that every night at 10:00 pm, I am supposed to be opening that device. It blinks every time I open it. So I am now used to it blinking every day because I take my medicines every day. When I do not see the blinking in my memory, this becomes a reminder that I have not taken my medicines.'

–Male, Age 36, Month 3 interview

Being reminded through the receipt of SMS messages and use of the monitoring device motivated adherence.

Being seen adhering: an opportunity to demonstrate commitment to treatment

Participants understood that missed doses could be detected when the monitoring device was not opened at dosing time. They envisioned someone at the clinic sitting at a computer, receiving the signal in person. In other words, participants felt they were 'being seen adhering,' and that whenever they missed a medication dose, others 'would know.' One participant commented:

'You people are always there on your computers to see if I have swallowed [the medicine] or not.'

–Male, Age 50, Month 3 interview

'Being seen' meant to participants that the clinic was taking a significant interest in their well being. Having the attention of the clinic in this way was construed as an opportunity – a chance to demonstrate competence by using the device correctly, and to communicate the seriousness of one's commitment to treatment.

[With the monitoring device] 'you people see that I open my bottle to take medicine and that I try to charge it. Then I am sure you know that I was able to get whatever you taught me to do and I am doing it without fail. It makes me happy that I am doing what I am supposed to be doing.'

–Male, Age 44, Month 3 interview

Participants spoke of this as 'taking responsibility'.

'I take the responsibility on myself to make sure the people who gave me the device see me opening the device....'

–Male, Age 36, Month 3 interview

‘Being seen’ exerted pressure on participants. The sense of being accountable for their use of ART, already present, was intensified by real-time monitoring. Participants experienced being monitored as removing all possibility of missing doses; they felt they had no choice but to take the medication every day. Increased accountability and the desire to demonstrate ‘taking responsibility’ worked to promote adherence, as the following citation demonstrates:

‘I do not mind because I think it is good for me; I can take my medicine well knowing that I am being watched. When someone is waiting to see if you are taking your medicine, it means that they care and you should also have the responsibility to take your medicine well.’

–Male, Age 29, End of follow-up period

Feeling ‘cared about’ by the clinic

Many study participants elected to test for HIV because they felt ill. A decline in health, compounded by an HIV diagnosis, left them feeling demoralized and hopeless – expecting imminent death. Fearing discrimination, participants also often chose to hide their status from others, adding isolation to demoralization and hopelessness. Thus an HIV diagnosis led to feelings of depression.

SMS reminders and real-time adherence monitoring worked to counter these feelings, as they were interpreted as signs of caring on the part of the health system. To participants, reminders and monitoring meant that healthcare providers were investing time and effort in improving the adherence of each individual patient. This signified to participants, ‘they care about me.’

‘...I was still at my business working and I received an SMS. I read it and became happy and told myself, “These people remember me. They care about me.”’

–Female, Age 36, Month 3 interview

Feeling cared about offset depressed mood. Participants described being encouraged and ‘strengthened’ as a result of feeling they were ‘cared about.’ From this came increased confidence and determination to cope constructively with HIV infection. Good adherence was seen as central to constructive coping. In the perceived caring of providers, participants found enthusiasm and energy for adherence.

‘Every time I receive this message I feel encouraged to continue taking my medicine. Knowing that there are people who care about my health.’

–Female, Age 27, Month 3 interview

‘The SMS reminders strengthen one personally. They help me to remember the time to swallow and also to be hopeful.’

–Male, Age 46, Month 3 interview

Discussion

This qualitative analysis addressed the question: How does a pilot intervention combining SMS reminders with real-time adherence monitoring work for adults initiating ART in rural Uganda? Results reveal SMSs not only prompt individual doses, but also help to develop a ‘habit’ of adherence (scheduled daily reminders). The intervention also had larger moral and emotional meanings for participants, which themselves had relevance for adherence. ‘Being seen adhering’ represented an opportunity to demonstrate seriousness of commitment to treatment and ‘taking responsibility’ for adherence. Feeling ‘cared about’ countered feelings of depression and invigorated the adherence process (See Fig. 1).

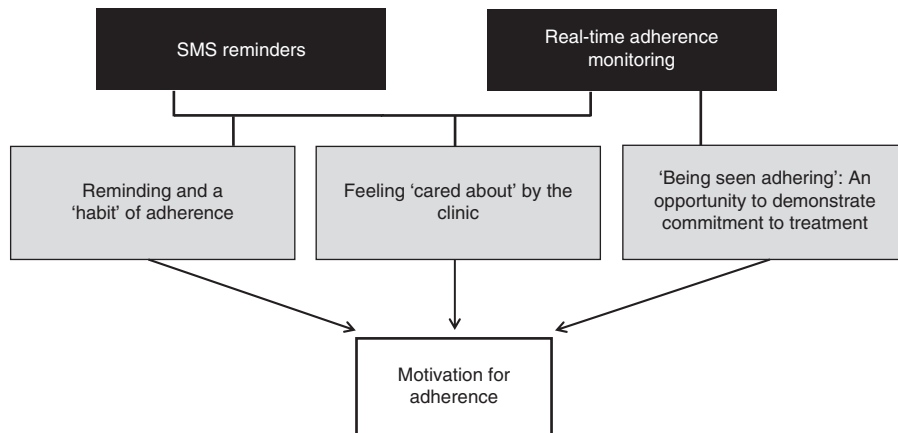


Fig. 1. Meanings and experiences of a pilot adherence intervention using SMS reminders and real-time adherence monitoring.

Part of delineating an intervention's mechanism of effect is to determine whether individual components make distinct contributions to the intended outcome, and if so, what those contributions are [15]. The qualitative data collected for this study indicate participant experiences of SMS reminders and real-time adherence monitoring were more similar than different. Both served as reminders to take medication daily. Both contributed to feeling 'cared about.' Thus both represented forms of support for study participants. 'Being seen' was associated more with monitoring than with reminders. Overall, however, distinct contributions from SMS reminders and real-time adherence monitoring were not evident in the qualitative data.

The qualitative data point to two patient populations especially likely to benefit from SMS reminder interventions. One is individuals beginning ART. In this study, participants receiving daily reminders found them helpful in developing a habit of adherence. A second population is individuals who respond to an HIV diagnosis with persisting feelings of sadness, discouragement, and/or isolation. Our qualitative data show clearly that regular text messages were construed as indications of 'caring' by the health system, and that patients felt encouraged and energized as a result. In countering feelings of depression following HIV diagnosis, SMS reminders may mitigate the impact of depression on adherence. Other studies referencing patient experiences of receiving SMS reminders for ART adherence support also characterize the messages as communicating that 'someone cares' [7,28].

In principle, linking SMS reminders to treatment interruptions identified in real-time allows immediate intervention to restore adherence, before viral rebound and drug resistance can develop. This can only take place, however, if reminders sent 'promptly' are also promptly received, and acted upon. Our qualitative data make it clear this is not always the case. Reminders sent in response to doses missed on an evening dosing schedule, for example, may come after an individual has retired for the night. These reminders will likely be seen only the next morning, if at all. Additional information on the pitfalls of translating real-time adherence intervention principles into practice will be important for maximizing effectiveness of these interventions moving forward.

Electronic adherence monitoring raises ethical questions, among them whether the 'omnipresent gaze' of providers (and/or researchers) imposes unduly on patient autonomy [29]. Clearly, participants in this study felt the 'omnipresent gaze,' and they did experience this as pressure to adhere. However, both the gaze and the resulting pressure were interpreted positively, as indications of caring and support.

It has been argued that 'the potential of mobile health is much greater than just reminders' [30]. These qualitative data make it clear that reminders themselves can be more

than 'just reminders.' When selecting message content, most participants selected phrases aimed explicitly at 'reminding.' When they actually received the messages, however, they felt not just reminded, but 'cared about.'

The feeling that 'someone cares' has also been reported for WelTel Kenya 1, an early RCT investigating the impact of SMS reminders on adherence [2,28]. Unlike this study, WelTel Kenya1 required recipients to respond to SMS messages, establishing two-way communication with clinicians. Reports of problems or failure to respond triggered a follow-up call. The result was 'frequent communication' between clinicians and patients, which was experienced as a form of support [28]. In this study, participants felt 'cared about' even though the intervention did not require or allow for responses to SMSs, suggesting two-way mobile phone communication with healthcare providers outside clinic visits may not be necessary for patients to feel connected to care.

The following limitations of this study should be noted. As a pilot study, the research is limited in scope, with a small sample drawn from a single treatment site. Although the qualitative data support a number of observations that shed light on the meaning of text-based, mobile phone adherence interventions, our analysis stops short of completely characterizing their mechanism of effect. Still, data from participants in multiple study arms allow core functions of the intervention to be identified.

The possibility that qualitative interview content may have been subject to social desirability bias must also be acknowledged. Finally, the pilot study's relatively short (9-month) follow-up period precludes inferences about the impact of the text message interventions over life-long antiretroviral treatment.

Understanding how adults initiating ART in resource-scarce settings experience SMS reminders and real-time adherence monitoring is essential to understanding the ways in which these interventions impact adherence behavior. Qualitative data suggest they do not function simply as reminders, but have larger moral and emotional meanings that themselves affect adherence. Understanding the larger 'meanings in the messages,' as well as their more literal content and function, will be central in delineating how SMS reminders and other adherence interventions making use of cellular technologies work. These lessons are critical for designing future studies, and for understanding how this technology can be applied to clinical care.

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Conflicts of interest

There are no conflicts of interest.

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