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Title: Anybody out there? A process evaluation of SMS sent to household TB contacts in Kampala, Uganda

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Abstract

Background: Previous studies have reported inconsistent effectiveness of SMS (short-messaging services) for improving health outcomes, but few have examined to what degree the quality, or "fidelity", of implementation may explain study results.

Objective: We sought to determine the fidelity of a one-time SMS intervention to promote uptake of TB evaluation services among household contacts of index TB patients.

Methods: From February to June 2017, we nested a process evaluation of SMS delivery within the intervention arm of a randomized controlled trial of TB contact investigation in Kampala, Uganda. Because mobile service providers in Uganda do not provide delivery confirmations, we asked household TB contacts to confirm receipt of a one-time TB-related SMS by sending an SMS reply via a toll-free "short code." Two weeks later, a research officer followed-up by telephone to confirm receipt of the one-time SMS and administer a survey. We considered participants lost-to-follow-up after three unsuccessful call attempts on three separate days over a one-week period.

Results: Of 206 consecutive household contacts, 119 had an SMS initiated from the server. Thirty-nine (33%) were children aged 5-14, including 24 (20%) girls and 15 (13%) boys. Twenty-one (18%) were adolescents or young adults, including 14 (12%) young women and seven (6%) young men. Fifty-nine (50%) were adults, including 31 (26%) women and 28 (24%) men. Of 107 (90%) participants for whom we were able to ascertain SMS receipt status, 67% (n=72) confirmed SMS receipt, including 22% (n=24) by reply SMS and 45% (n=48) during the follow-up telephone

survey. There were no significant clinical or demographic differences between those who did and did not report receiving the SMS message. 52% (n=56) reported ever reading the SMS. The cumulative likelihood of an SMS reaching its target and being read and retained by a participant was 19%.

Conclusions: The fidelity of a one-time SMS intervention to increase uptake of household TB contact investigation and linkage to care was extremely low, a fact only discoverable through a detailed process evaluation. Our findings suggest the need for systematic process monitoring and reporting of implementation fidelity in both research studies and programmatic interventions employing mobile communications to improve health.

Introduction

Mobile phone ownership in sub-Saharan Africa has increased exponentially over the last decade, becoming widespread even among those in the lowest strata of household income [1, 2]. The concurrent emergence of low-cost, easy-to-use mobile health (mHealth) applications like telephone-based short-messaging services (SMS) and chat applications like WhatsApp have facilitated a variety of new interventions to enhance communication between patients and health-care providers [3-5]. While communicating health information via mobile phones seems to be acceptable [6-8], mHealth studies have reported varying levels of success at improving patient well-being and clinical outcomes [9-16]. We hypothesize that this variability may arise from a failure to plan for, collect, or report key process measures that would help differentiate between intervention failure and implementation failure, a distinction critical to understanding the feasibility and effectiveness of mHealth interventions[17]. There is great need, both in research studies and in routine practice, for carefully performed evaluations of the *fidelity* of mHealth technologies to better understand the processes and contexts that mediate their effects on patient-centered outcomes.

Process evaluations seek to understand the degree to which interventions are delivered as actually intended – also referred to as the “fidelity” of the intervention – in order to explain why they do or do not work and how they can be adapted to fit the local context [18, 19]. Process evaluation studies may measure the dose,

frequency, and quality of interventions as actually delivered; assess participant responses to interventions; and characterize the mechanisms through which interventions work to improve outcomes [20]. For a health-communication intervention, a multi-stage process evaluation can help determine if the messages reach their intended recipient; if they are delivered in an accessible and timely manner; if recipients open and read the messages; if they respond to the messages; and if the messages achieve their desired effects on targeted health behaviors. We carried out such a process evaluation of the delivery of SMS in Uganda within a randomized, controlled trial of an SMS intervention designed to communicate results of household-based TB evaluation and promote the completion of follow-up procedures.

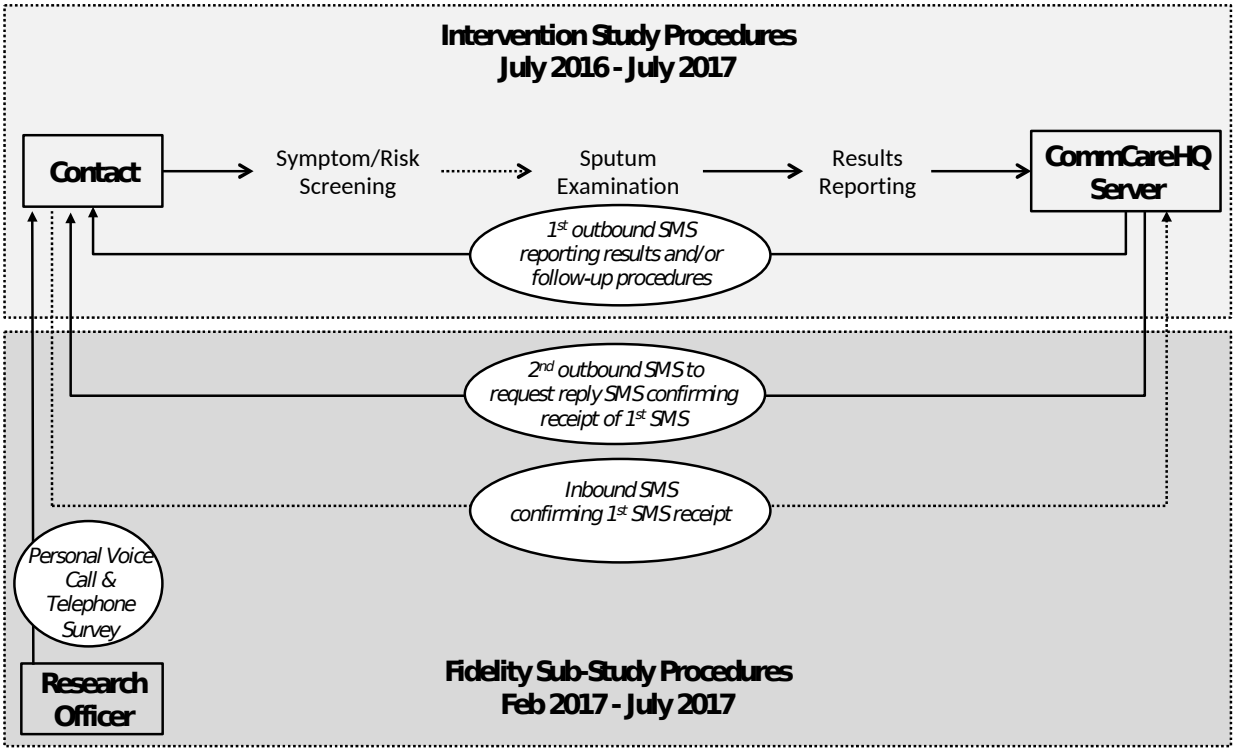
Methods

Study Population and Setting

From February to July 2017, we conducted a cross-sectional study to assess rates of receipt of SMS, time-to-delivery of SMS, and retention of SMS content among household TB contacts (Figure 1) to evaluate the fidelity of a one-time SMS intervention. We nested this study within a randomized trial (called the "parent study") of an automated SMS intervention. The goal of the intervention was to promote uptake of TB evaluation services among household contacts of index TB

patients at seven public, primary care clinics in Kampala, Uganda, a setting with a high burden of undiagnosed TB [21]. In prior work in these communities, we have found that only 20% of eligible household contacts follow-up in clinics to complete TB evaluation; contacts report TB-related stigma, distrust of clinic staff, and concerns about the time and money needed to visit clinics as the main reasons for low rates of follow-up [22, 23]. Although smartphones are uncommon in Uganda, we also found that almost all household members had access to mobile phones and SMS messages were deemed a highly acceptable way of transmitting personal health information [24]. Thus, we designed an intervention consisting of home sputum collection by community health workers (CHWs) and reporting of results by SMS to address these barriers to evaluation [25]. In the current process evaluation, we enrolled consecutive household contacts who were randomized into the intervention arm of the parent study.

Figure 1. Schema for the SMS Fidelity Study



Procedures for Screening Household Contacts for TB in the Parent Study

According to the parent study protocol (Pan-African Clinical Trials Registration #201509000877140), participants were eligible if they were: (1) household contacts of an index TB patient; (2) able to provide informed consent; (3) not receiving TB treatment at baseline; (4) able to access a mobile phone; (5) willing to receive SMS messages containing personal health information; and (6) able to speak English or Luganda, the two most common languages in Kampala. After obtaining written informed consent from adults and parents or guardians of minors as well as assent from minors aged 8-17, CHWs screened household contacts for symptoms and other indications for evaluation for active TB. CHWs recorded clinical and demographic information using electronic tablets equipped with a customized survey application (CommCare, Dimagi, Boston, MA, USA) wirelessly linked to a

remote, cloud-based server (CommCareHQ, Dimagi, Boston, MA, USA). Afterwards, CHWs helped contacts register each mobile phone number to be used for SMS (described below) on the remote server by entering a registration code sent to the handset. Based on the results of screening, CHWs carried out additional procedures to evaluate contacts for TB and HIV [26].

Procedures for SMS Messaging within the Parent Study

CHWs recorded the results of sputum examination in the survey application, where we deployed an automated algorithm to process the relevant clinical data and assign each contact to one of four, mutually exclusive clinical categories based on required follow-up actions (Online Supplement, Table S1). Staff verified the logic underlying category assignments through systematic quality-assurance testing of all input choices and outcomes using simulated data. We then programmed the mobile survey application to deliver a category-specific SMS message of 145 characters or less (Online Supplement, Table S1), via integrated text-messaging software (CommCare Messaging, Dimagi, Boston, MA, USA). The content of the messages was developed through household focus groups and interviews, as previously described [24]. Each message addressed the participant by name in English or Luganda according to his or her preference and provided the results of TB screening and testing with instructions for follow-up. All participants within the intervention arm of the parent study were eligible to receive SMS messages. All messages sent or received as part of the study were delivered free of charge to the study participants.

Process Evaluation

For the process evaluation, we scheduled a second SMS to be sent to all household TB contacts eligible to receive SMS messages five minutes after the first SMS. The second SMS requested that the participant confirm receipt of the original SMS by sending an SMS reply via a toll-free, four-digit "short code." Two weeks later, a research officer (D.B.) telephoned all participants (or parent/guardian for children under age 15), including those who had not responded to the SMS. After obtaining verbal consent, the research officer administered a short survey to confirm SMS receipt and assess whether they recalled the information contained with the SMS. She also qualitatively recorded any unprompted comments made by participants about their overall experiences and interactions with SMS. We considered a participant a non-respondent if he or she did not respond to the SMS message within two weeks. We considered participants lost-to-follow-up after three unsuccessful call attempts on three separate days over a one-week period.

Process Measurements

To measure the fidelity of the SMS intervention, we specified four steps in the delivery of an SMS, each measured either by direct observation or by surveying participants: 1) SMS sent from the CommCare Messaging server; 2) SMS received at the mobile handset; 3) SMS read by the recipient; 4) SMS understood and retained by the recipient. We measured the completion of Step 1 directly from server logs; of

Step 2, either by receipt of a reply SMS at the messaging server, or, by surveying non-responders by telephone; and of Steps 3 and 4 by surveying all participants by telephone (See Online Supplement for the survey content, Appendices 1 and 2). A study epidemiologist (A.J.M.) and a study social scientist (M.A.H.) independently compared all responses to the retention questions to the content of the SMS. If a participant could report back any part of the message communicated within the SMS, he or she was considered to have retained the content. We also measured the time to delivery of SMS and time to reply among respondents. As a proxy measure for the time to complete Step 2, CHWs recorded the time to delivery of SMS at the time of participant registration.

Statistical Analysis

We performed univariate analyses of participant characteristics. We described the number of participants for whom SMS successfully reached a given step in the delivery cascade as a proportion of the number of participants for whom SMS successfully reached the previous step. We performed bivariate and multivariate analyses between participant characteristics and completion of three process measures of interest: the proportion of participants who reported SMS as received (Step 2), the proportion of participants from whom a reply SMS was sent, and the proportion of participants reporting that SMS messages were understood and retained (Step 4). We assessed the significance of these comparisons using chi-squared tests for categorical variables, and the Wilcoxon rank-sum test for

continuous variables. We fit multivariate, mixed-effects logistic regression models for the same outcomes. We included all variables clinically significant in stepwise-backwards logistic regression models at $p<0.2$ and subsequently adjusted for household-level clustering in a mixed-effects model. Although sample size was based on convenience, we constructed 95% confidence intervals to assess the precision of all study measurements. Finally, we estimated the cumulative reach of SMS (*i.e.* of an SMS message being sent, received, read, and retained) as the product of the proportions of participants, confirmed as reaching each subsequent step in the cascade, excluding those with unknown responses from the point of missingness. We performed all analyses using STATA version 14.2 (Stata Corporation, College Station, Texas).

Protection of Human Subjects

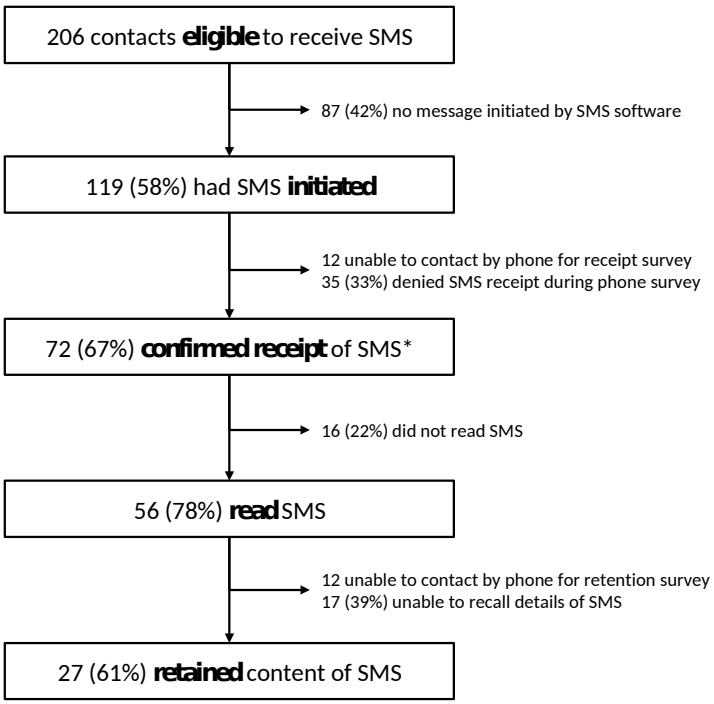
The School of Medicine Research Ethics Committee at Makerere University; the Uganda National Council for Science and Technology; and the Yale University Human Investigation Committee approved the study protocol.

Results

Step 1: SMS Sent

Of 206 consecutive household contacts randomized into the intervention arm of the parent study, 119 (58%) were sent an automated SMS message containing TB-related information from the CommCare platform (Figure 2). A total of 87 (42%) participants did not have a message sent by the server, for three different reasons. First, 79 (38%) participants in the “TB visit pending” category did not have an SMS message initiated because delivery was erroneously post-timed due to a programming error introduced while initiating this process evaluation sub-study. This affected 51 (25%) children under age 5, 15 (7%) persons living with HIV, and 13 (6%) individuals requiring a follow-up visit because of inadequate sputum collection. Second, four (2%) eligible participants did not have a message initiated due to missing data. Third, four (2%) participants did not have a message initiated due to server-related errors.

Figure 2. Flow diagram showing process measures for SMS delivery.



Abbreviations: SMS, short-messaging services.
Legend: *24 confirmed receipt by reply SMS, and an additional 48 confirmed receipt during the telephone survey.

Study Population of the Process Evaluation

Thirty-nine (33%) of the 119 participants who were sent an SMS message were children aged 5-14, including 24 (20%) girls and 15 (13%) boys. Twenty-one (18%) were adolescents or young adults, including fourteen (12%) young women, and seven (6%) young men. Fifty-nine (50%) were adults, including thirty-one (26%) women, and twenty-eight (24%) men. Median age among adult participants was 27 years of age (interquartile range (IQR) 21-37). Six percent (n=7) of the 119 participants who had an SMS message sent reported TB symptoms at the time of the interview. Fifty-five percent (n=66) preferred to receive SMS in English, while the

remainder preferred Luganda. Sixty percent (n=71) of participants personally owned the mobile phone registered for the study, while the remainder shared the phone with close relatives (27%, n=32), other household members (11%, n=13), or close friends (3%, n=3).

We reached and interviewed 95 out of 119 (80%) participants for follow-up telephone surveys; an additional 12 (10%) participants responded by SMS but could not be reached for the telephone survey. Twelve (10%) did not respond by SMS and could not be reached by telephone, leaving 107 participants with information about SMS receipt.

Step 2: SMS Received

Of the 107 participants who had available information on SMS receipt, sixty-seven percent (n=72) confirmed receiving an SMS, including 24 (22%) by reply SMS and 48 (45%) during the follow-up phone survey (Figure 2). There were no significant differences in demographic characteristics between those who reported receiving the SMS message and those who did not (Table 1). However, household contacts without TB symptoms reported receiving the SMS message more frequently than those with TB symptoms when adjusting for household effects (69% vs. 43%, cluster-adjusted odds ratio (OR) 2.9, 95% confidence interval (CI) 0.61-13.9, p=0.16), possibly due to chance.

Table 1. Demographic characteristics of participants, stratified by whether SMS was received by the participant*

Characteristic	SMS received by participant (n=72)	SMS not received by participant (n=35)	p-value[A]
Female (%)	41 (57)	20 (57)	0.98
Age			
5-14 years	24 (33)	12 (34)	0.57
15-21 years	14 (19)	4 (11)	
>21 years	34 (47)	19 (54)	
TB Symptoms Present (%)	3 (4)	4 (11)	0.15
Language of SMS (%)			0.59
English	39 (54)	17 (49)	
Luganda	33 (46)	18 (51)	
Phone Owner (%)	43 (60)	19 (54)	0.59

Abbreviations: **SMS**, short-message service text message; **IQR,** inter-quartile range,
Legend: *For 107 participants with definitive SMS receipt status; excluded 87 because SMS was not sent and 12 who were unreachable for phone survey.
[A] Chi-squared tests of significance used unless otherwise noted.

SMS Reply Sent

There were no significant differences in response to the SMS confirmation request by age, gender, or TB symptoms. However, those who preferred English as the language for SMS messages were more likely to confirm receipt via SMS message than those who preferred Luganda (27% vs 11%, cluster-adjusted OR 3.8, 95% CI 1.03-14, p=0.045). Similarly, those who personally owned a mobile phone were substantially more likely to respond with an SMS confirming message receipt than those who shared a mobile phone with another individual (28% vs. 8%, cluster-adjusted OR 6.7, 95% CI 1.3-34.9, p=0.025). In a household-adjusted multivariate model (see Online Supplement Table S2) including age, SMS language preference,

and phone ownership, only phone ownership was significantly associated with increased odds of sending an SMS reply (adjusted OR 13.2, 95% CI 1.67– 104, p=0.014).

Time to Delivery of SMS

Of the 119 participants who had a TB-related SMS sent from the CommCare server, all (n=119, 100%) were sent a registration SMS message during the initial interview with CHWs. Most registration SMS messages (n=72, 61%) took less than five minutes to arrive at the handset. An additional 10% (n=12) took from five to ten minutes to arrive, while 20% (n=24) took more than ten minutes. Finally, 9% (n=11) of registration messages were reported as never having arrived at the handset. For the 24 individuals who sent a reply SMS in response to the first TB-related SMS message, the median time between the SMS being sent and a participant sending a reply message was 35 minutes (IQR 4-139), with all but one responding within 24 hours.

Step 3: SMS Read

Of the 107 participants for whom message receipt could be determined, 56 (52%) reported ever reading the TB-related SMS message. There were no significant differences by age, gender, TB symptoms, phone ownership, or SMS language

preference between those who read and received and those who did not read or receive the SMS message.

Step 4: SMS Retained

Sixty-one percent (n=27) of the 44 individuals who reported reading the SMS and who participated in the retention survey were able to accurately report the details of the message when prompted. No demographic or clinical characteristics were significantly associated with SMS retention. However, during the phone interviews, several individuals reported have difficulty or an aversion to reading as a reason for not having read the SMS (Table 2). Additionally, several participants described how sharing a phone prevented the intended recipient from receiving the SMS. Finally, having a poorly functioning phone or lacking comfort with retrieving SMS influenced both SMS receipt and the likelihood of a participant reading an SMS.

Table 2. Quotations from participants on their experiences with SMS messages*

Emergent Themes	**Quotations from Participants**
Difficulty Reading	"[I] did not read it because [I] was busy but [I] will ask my daughter to read it for [me]."
	"I could not have read it, I am old. However, I asked the CHW and they told me I didn't have TB."
	"I am not good at reading. It asked me about TB symptoms."
Phone Sharing	"[I] only received the [registration] code but [I] am not the owner of the phone [my] wife is."
Interactions with Phones	"I didn't receive it because my phone has been having some problems."
	"I did not pay much attention to the SMS messages that come in."
	"I don't usually check my SMS unless someone tells me they will be sending me a message."

	"Maybe the message came but I just didn't notice."

Abbreviations: **CHW,** Community Health Worker; **TB**, Tuberculosis; **SMS**, short-messaging service;
Legend: *Quotes documented by a research officer during the phone survey

Cumulative reach and retention of SMS

The cumulative likelihood of an SMS reaching its target and being read and retained by the participant was 19%. Among those for whom the messaging server successfully initiated an SMS, the cumulative likelihood of receipt and retention was 32%.

Discussion

The potential for mobile phones to improve access to evaluation and treatment for TB by enhancing communication between at-risk individuals and health care workers has generated great enthusiasm for mobile health technologies, especially SMS [27, 28]. However, data about how these interventions actually work – or do not work – in routine practice are limited [29]. In this study, we applied the powerful approach of measuring the implementation fidelity of SMS through cascade analysis, achieved through prospective cross-sectional surveys and other novel measures of SMS delivery, response, and mechanism. We have shown that multiple, frequently unobserved barriers exist to implementing an SMS intervention in a way that ensures that participants receive and comprehend the messages. Our findings

suggest the need for systematic monitoring and inclusion of a detailed process evaluation in research studies and programmatic interventions employing mobile communications to improve health.

The use of SMS to provide TB-related health information is a complex intervention, as defined by having multiple, interacting components [30]. Key ingredients of this intervention included health workers, computer servers and software, mobile telephone networks, mobile handsets, and community members for such complex interventions, a detailed process evaluation is required to understand if all elements work together as intended [20]. We found that a significant proportion of participants never received the SMS messages as intended, and that a large proportion of those who did receive the messages never read them. Even among those who did read the messages, a notable proportion were unable to accurately report the details of the message only two weeks later. Ultimately, less than a third of participants reported both receiving and retaining the TB-related information contained in the SMS messages that were sent.

SMS interventions have been evaluated across sub-Saharan Africa for their capacity to improve medication adherence [31], support the dissemination of lab results [32], and reduce missed clinic visits [33]. However, with few exceptions [34], the existing literature does not address how often SMS are received, understood, and retained by participants. In one study, which followed-up on SMS sent from a laboratory to 385

persons living with HIV in Uganda, only 72% of participants reported receiving the SMS that were sent [34]. As in our study, participant literacy and the ability of participants to independently access SMS on their phones at enrollment were associated with receiving SMS. Given these findings, future research should focus on improving accessibility to the behavioral components of the intervention through functionalities such as automated voice calling, and, more generally, on embracing human-centered approaches to the design of mHealth interventions [35].

In our study, surprisingly few individuals confirmed message receipt via SMS reply. While a previous study in Uganda reported a 70% response rate to SMS containing health education quizzes [36], another large study conducted in northern Uganda involving a one-time SMS intervention found that only 23% responded, similar to what we observed in our study [37]. Although a widely cited systematic review has previously shown that two-way SMS are more effective than one-way SMS in engaging patients [38], the focus of that review was on longitudinal SMS interventions for medication adherence, not on responses to a one-time communication. In a broader context that would include short-term SMS interventions to facilitate diagnostic evaluation and linkage to care, we hypothesize that SMS response rates – a key component of implementation fidelity – likely also depend on other components of fidelity, including the dose, intensity, and the behavioral mechanisms of the SMS intervention. Future studies should go beyond

the simple process measures that we included in our study to describe these other important mediators.

The proportion of messages reported as received in our study was unexpectedly low given the widespread use of SMS in Uganda. Additional studies of how participants access SMS are needed to understand the barriers between message initiation and participant receipt. Potential barriers at this step could include network outages and, as our qualitative data shows, malfunctioning of mobile devices and phone-sharing practices of participants. Furthermore, if mobile service providers do not provide delivery confirmations, innovative methods for assessing message receipt will be needed. In our study, simple SMS replies were an insufficient measure of receipt. Previous studies have shown higher levels of engagement when utilizing serial messaging and two-way communications [9, 10, 39, 40], rather than one-time messaging. Including quizzes or trivia may also improve participant response rates [36]. These strategies, along with more personalized SMS content [24], may increase participant engagement.

Our study had a few limitations. First, we had a limited sample size that, combined with a high proportion of messages that did not reach their intended targets or convey the information intended, limited our ability to carry-out stratified analyses to understand differences between sub-groups. This limitation is partly moderated by our collection of qualitative responses from individuals about their experiences

and interactions with the SMS messages, which illustrate the types of barriers that participants face in engaging with mHealth interventions. Second, a programming error reduced the number of individuals who received SMS, including the subgroup for whom clinic follow-up would have been requested. This error prevented us from carrying out an analysis of the effect of different message types on participant interactions with SMS messages and on participant follow-up behaviors. In addition, it may have caused us to modestly underestimate response rates, as a previous study reported lower rates of response among those with normal results than among those with abnormal results [34]. Moreover, our programming error underscores the difficulties of ensuring successful SMS initiation, even with intensive quality-assurance practices in place. Third, we waited two weeks after the triggering of the initial SMS message before attempting to contact the participants in order to avoid interfering with parent study outcomes. This design feature may have biased the observed rate of retention of information downward, as recall error may increase with time.

Our study also had several strengths. First, we had a low rate of participants lost to follow-up. We were able to interview 80% of participants by phone, and obtain at least some follow-up information from 90% of participants. Second, we applied innovative techniques to determine message receipt using SMS reply messages, although uptake of this method of message verification was extremely low. Finally, our study population included young residents of a crowded urban area with high

rates of access to mobile phones [24], making our findings likely generalizable to many urban settings in sub-Saharan Africa where health-related SMS interventions are being evaluated and implemented.

Overall, we found lower than expected levels of SMS message receipt and retention, and substantial delays in delivery. While SMS messages have the potential to ease communication between health workers and patients, improving the delivery cascade of SMS messages is imperative for the success of SMS interventions. If mobile messaging interventions are to have their full impact, innovative process measures to confirm receipt and comprehension must be developed and/or applied. With better monitoring and quality improvement strategies, SMS messaging could reach more patients more effectively, enhancing communication between patients and practitioners and building more patient-responsive health systems.

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Conflicts of Interest

The authors declare no conflicts of interest.

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ONLINE SUPPLEMENT

Table S1. TB evaluation categories and SMS message content

Priority*	Category	Indications	Message Content
1	Confirmed TB	• Any TB diagnosis based on a positive microbiologic test result or clinical evaluation	(Participant name) your tests show TB. (Participant name) please come to (health centre name) for TB treatment if you have not already.
2	TB clinic visit pending	• Person living with HIV, or • Child under age 5, or • Home sputum sample not collected when indicated, or • Indeterminate lab result	(Participant name) please come to be checked for TB at (health centre name) if you have not already.
3	Confirmed not TB	• 1 negative GeneXpert result, or • 2 or more negative smear results	(Participant name) your tests do not show TB, but if you do not get better, reply HELP (no charges apply). Tests can miss TB if done too early.
4	No TB symptoms or risk factors	• No initial risk factors or TB symptoms known or reported by participant at baseline	(Participant name) you do not currently have signs &/or symptoms of TB, but if you develop any signs or symptoms of TB reply HELP (no charges apply).

Legend: *The four categories listed above are hierarchical, so that if a participant meets criteria for more than one category, the message for the category highest in the table is sent. In addition, the automated message algorithm evaluates patient criteria daily, and if the patient criteria change so that a participant is re-classified into a higher category, that message will be sent.

Appendix 1. Follow-Up Phone Survey for participants who did not send an SMS reply.

My name is ……., I am a team member with TB contact investigation program with the Uganda National TB and Leprosy Programme and investigators from Makerere University and Yale University in the USA. A community health worker from [health center name] health center visited your home a few weeks ago to screen your household for TB symptoms. I am calling to ask a few questions as a follow-up about text messages you may have received after this visit from our study.		
1. Are you willing to answer a few questions about your text messaging experiences?	No (0) Yes (1)	1.
If participant answers No, thank participant for their time and end survey		
2. Did you receive an SMS message about TB at some point during the last 2-3 weeks? (**Skip** to Question 7 if No)	No (0) Yes (1)	2.
3. Did you read the SMS message when it first arrived?	No (0) Yes (1)	3.
4. Did you read the SMS at any point? (**Skip** to Question 7 if No)	No (0) Yes (1)	4.
5. Do you remember what the SMS message said? (**Skip** to Question 7 if No)	No (0) Yes (1)	5.
6. What did the message say? (Ask the question open ended and then place an X next to any response(s) below that match what the participant says)		
a. Participant unable to describe message		6a.
b. Participant mentioned need to return to the clinic		6b.
c. Mention of HELP keyword		6c.
d. Mention of TB unlikely or negative status		6d.
e. Mention of TB positive status		6e.
f. Other: Please specify	6f:	
7. Please list any interesting comments from the participant or issues encountered.	7.	

Appendix 2. Follow-Up Phone Survey for participant who sent an SMS reply.

My name is ……., I am a team member with TB contact investigation program with the Uganda National TB and Leprosy Programme and investigators from Makerere University and Yale University in the USA. A community health worker from [health center name] health center visited your home a few weeks ago to screen your household for TB symptoms. I am calling to ask a few questions as a follow-up about text messages you may have received after this visit from our study.		
1. Are you willing to answer a few questions about your text messaging experiences?	No (0) Yes (1)	1.
If participant answers No, thank participant for their time and end survey		
2. Within the last few weeks we sent you an SMS text message about TB that you said you received. Do you remember what that message said? (**Skip** to Question 4 if No)	No (0) Yes (1)	2.
3. What did the message say? (Ask the question open ended and then place an X next to any response(s) below that match what the participant says)		
a. Participant unable to describe message		3a.
b. Participant mentioned need to return to the clinic		3b.
c. Mention of HELP keyword		3c.
d. Mention of TB unlikely or negative status		3d.
e. Mention of TB positive status		3e.
f. Other: Please specify	3f:	
4. Please list any interesting comments from the participant or issues encountered.	4.	

Table S2. Predictors of sending a SMS reply message[A]

	Adjusted Odds Ratio (95% CI)	p-value
Age[B]	0.59 (0.31-1.11)	0.101
Personal phone ownership	13.2 (1.67-104)	0.014
SMS language		
English	2.47 (0.62-9.77)	0.199
Luganda	1	

Legend:
[A] Adjusted for household clustering
[B] Per ten-year increase in age