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Patterns of usage and preferences of users for tuberculosis-related text messages and voice calls in Uganda

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Abstract

Background: Little information exists about mobile-phone usage or preferences for tuberculosis-related health communications in Uganda.

Methods: We surveyed household contacts of tuberculosis patients in urban Kampala, Uganda, and clinic patients in rural central Uganda. Questions addressed phone access, usage, and preferences for TB-related communications. We collected qualitative data about messaging preferences.

Results: We enrolled 145 contacts and 203 clinic attendees. Most contacts (58%) and clinic attendees (75%) owned a mobile phone, while 42% of contacts and 10% of clinic attendees shared one. 94% of contacts and clinic attendees knew how to receive an SMS, but only 59% of contacts ≥45 years (vs. 96% among contacts <45 years, p=0.0001). All contacts and 99% of clinic attendees were willing and capable of receiving personal-health communications by SMS. 55% of contacts preferred detailed messages disclosing test results, while 45% contacts preferred simple messages requesting a clinic visit to disclose results.

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Conclusions: Most urban household tuberculosis contacts and rural clinic attendees reported access to mobile phones and a willingness to receive tuberculosis-related personal-health communications by voice call or SMS. However, frequent phone sharing and variable messaging abilities and preferences suggest a need to tailor design and monitoring of mHealth interventions to the target recipients.

Keywords

mobile technology; information and communication technology; SMS

INTRODUCTION

Mobile phones have transformed development in low-income countries in recent years[1], especially in sub-Saharan Africa. Widely available, low-cost handsets have expanded access to and usage of mobile phones. In Uganda, mobile phone networks reach 78% of the population[2]. Pricing of voice calls and SMS has fallen since 2013[2] and mobile internet should increase as innovative service plans further reduce costs and expand access[3]. Clinicians and public-health practitioners have been quick to experiment with mobile-health (mHealth) technologies like short-messaging services (SMS) for many indications, including supply-chain management, social support to promote medication adherence, and appointment reminders[4–6]. Increasing evidence supports their use[7–9], but routine implementation remains rare. More, high-quality data is needed for scale-up[10,11], including information about mobile phone ownership[12] in key populations; access to phone networks and charging facilities[13,14]; proficiency with phones; expectations about confidentiality; messaging preferences[15,16,17]; and how these factors affect uptake and usage of mHealth interventions.

Most published data relate to HIV/AIDS, community health, and maternal and child health[18–20], with few studies of tuberculosis (TB)[21,22]. Therefore, we carried out two prospective observational studies in Uganda to characterize mobile-phone access, usage patterns, and messaging preferences for TB-related communications among rural clinic attendees and urban household contacts to TB patients. We sought to obtain results that can inform design of future mHealth interventions to improve TB case-finding.

METHODS

Study design

We carried out two cross-sectional studies among Ugandan adults. One included surveys and brief interviews with household contacts of index TB patients at seven urban primary-care clinics in Kampala, Uganda. The other surveyed general outpatients at four rural primary-care clinics offering TB diagnostic-evaluation services in central Uganda.

Study population and sampling

Household contacts: As a sub-study of a randomized, controlled trial (Pan-African Clinical Trials Registry #201509000877140) of an intervention combining home-based TB evaluation and automated SMS reminders to improve TB case-finding and linkage to care,

we enrolled household contacts, defined as anyone sharing a roof with an index TB patient within the previous three months. We initially recruited consecutive participants during a pre-trial formative phase (October-November 2014). Later, during pilot and initial enrollment phases of the trial (February-September 2016), we recruited contacts from two randomly selected households per week, excluding households of index TB patients without mobile phones. In each phase, we enrolled all available adult (age≥15) household TB contacts.

General Outpatients: We also enrolled a convenience sample of all general outpatients (age≥18) present during one-day site visits to four rural primary-care facilities occurring monthly for five consecutive months during a prospective observational study of sample referral practices for molecular-diagnostic testing for TB (December 2015-April 2016)[23].

Procedures

Research officers verbally administered separate structured surveys to household contacts and general outpatients. Both explored ownership of and/or access to mobile phones; use of mobile phones for voice calls and SMS; and ability to send and/or receive SMS using a mobile phone. The household-contact survey also inquired about mobile-money transfers and language preferences for mHealth communications, and willingness to receive personal-health information or reminders by SMS or voice call. We also carried out focus-group discussions and key-informant interviews with contacts. We describe our methods for qualitative data collection and provide study instruments in the Online Supplement. We did not collect qualitative data from clinic patients.

Statistical Analysis

We summarized continuous data using means with standard deviations or medians with interquartile ranges, and categorical data using proportions. We explored associations between phone usage and key demographic variables including age, educational attainment, employment status, and gender, using logistic regression with chi-squared tests of significance. We report representative responses of contacts to the open-ended question about SMS preferences.

Protection of Human Subjects

The Makerere University School of Medicine Research Ethics Committee; the Uganda National Council for Science and Technology; the University of California San Francisco Committee on Human Research; and the Yale University Human Investigation Committee approved separate protocols for the clinic and community studies. All participants provided verbal or written informed consent.

RESULTS

Participants

We enrolled all 145 available contacts from 83 households in urban Kampala and 203 eligible patients at four rural, primary-care clinics. Among eligible index patients, we excluded 5% without a phone. Median age of contacts was 29 (interquartile range (IQR) 21–

38), and 100 (69%) were women. Median household income was approximately 16.67 USD per month (IQR 8.34–27.79, income missing for 22 households). Median age of clinic patients was 29 (IQR 24–40); 137 (67%) were women. Among clinic patients, 104 (51%) reported having primary education or less; 65 (32%) secondary; and 34 (17%) university.

Mobile Phone Access

Among 145 household contacts, 84 (58%) owned a mobile phone, while 61 (42%) shared a phone owned by a family member (74%), spouse or partner (20%), or friend (7%; Table 1). Among clinic patients, 153 (75%) owned a phone, while 21 (10%) primarily shared with a spouse (29%), other family member (57%), or friend (14%); twenty-nine (14%) neither owned nor had access to a phone, although 17 of them (59%) had previously had access to a phone (Table 2).

About three-quarters of household contacts reported keeping their phones powered on for ≥12 hours per day (average 18 hours, standard deviation 8 hours). 97% of general outpatients reported keeping their phones switched on at all times, and only 4% reported problems keeping their phones charged. 92% of contacts and 88% of general outpatients reported having a mobile-network connection either at home or work. Thirty-eight (26%) contacts had previously changed their mobile-phone number, including 14 (37%) within 6 months. Phone ownership did not differ significantly by age in either study: 50% of contacts ≥45 years owned phones versus 59% <45 years (difference 9%, 95%CI 0–32, p=0.41). Phone ownership was similar among urban female (58%) and male (58%) contacts (difference 0%, 95%CI −17 to +17, p=0.98). Significantly more rural men (86%) owned a phone than rural women (70%; difference 16%, 95%CI 5–27, p=0.01), and those with secondary education were more likely to own a mobile phone (89%) than those with primary education or less (62%, difference −28%, 95% CI −39% to −17%, p<0.001).

Usage of Mobile Phones

Most household contacts knew how to send (90%) and receive (94%) SMS. Fewer general outpatients knew how to send (70%) SMS, but the proportion capable of receiving (94%) SMS was similar to contacts (Table 3, Table 4). A plurality (44%) of contacts preferred communicating in Luganda, 20% preferred English, and 35% either language. Median days in the previous week that household contacts sent an SMS was 1 (IQR 0–2) and that they made or received a voice call were 3 (IQR 2–5); 96% of rural clinic attendees sent less than one text message per day. One-hundred fifteen (79%) contacts reported checking SMS on the day of receipt, while 30 (21%) reported waiting one-to-three days to check SMS. One-hundred thirty-two (91%) contacts had previously received a mobile-money transfer. While there were no significant differences by gender in self-reported ability to send SMS (90% for women versus 91% for men, 95%CI −9 to +11, p=0.83), younger individuals were significantly more likely to know how to send an SMS: 96% under age 45 versus 59% aged 45 and over (p=0.0001).

Preferences for Mobile Health Communications

All enrolled contacts agreed to receive personal-health information via SMS; a similarly high proportion found voice calls acceptable (96%; Table 5). Almost all general outpatients

were willing to provide a phone number to the health center (n=173, 99%) and receive SMS containing test results (n=164, 94%). However, ten (6%) general outpatients subscribed to a list blocking bulk delivery of SMS ("spam"), 32 (18%) would not reply to an SMS from an unknown number, and 50 (29%) would not reply to an SMS from a health center. Also, while all 21 (100%) general outpatients who reported sharing a phone would agree to receive personal-health messages on a shared phone, six (29%) were uncomfortable doing so. With regard to SMS content, 80 (55%) household contacts preferred a detailed health message versus 65 (45%) who preferred a simple message. Participants who preferred detailed messages liked their directness and clarity, which most felt would encourage them to seek care as early as possible:

> "I prefer the last [detailed] message because when it comes to health issues there is no need to hide anything. You have to tell someone directly so that he/she can come immediately for treatment…" (Interview 8)

> "The first two [simple] messages are weak. The way I know Ugandans, you need to be open just like the last [detailed] message and you can add on that 'if you do not come TB will kill you.'" (Interview 7)

> "If you just call me to come for treatment I might somehow be doubtful but the detailed message clearly shows that I have TB." (Interview 5)

However, those who preferred a simple message wanted to be informed about their illness at a health facility.

> "……I like the simple message, I want to be told that I have TB when I am at the clinic." (Interview 10)

Contacts did not mention TB stigma or privacy in interviews or focus-group discussions about their messaging preferences.

DISCUSSION

Using mobile phones to facilitate delivery of health interventions holds considerable promise for improving health care quality in sub-Saharan Africa by increasing communication between patients and providers. Recent systematic reviews highlight extensive use of mHealth technologies, but only six publications related to TB[24,25]. Importantly, few analyses explore access, usage patterns, or preferences for mobile-phone communications concerning TB evaluation[24,25]. Here, using cross-sectional surveys of urban household contacts and rural clinic patients in Uganda, we have shown that access to and ability to use basic functions of mobile phones is high, with significant interest in receiving TB-related personal-health information and clinic-visit reminders via SMS or voice calls. However, we also found that phone-sharing is common and that proficiency, comfort, and message preferences may vary by age, gender, and geography, suggesting a need to tailor design and monitoring of mHealth interventions to the target receipients.

While previous studies have also demonstrated high levels of access to and acceptability of mobile communications in sub-Saharan Africa[18,20,26,27], the variability we identified within populations deserves attention. Specifically, we identified lower phone ownership among

urban household contacts than among rural general outpatients. This could be explained by a selection bias if contacts present at home and enrolled were less likely to own phones than contacts not at home and not enrolled. However, we also identified lower phone ownership among rural women, lower proficiency in sending SMS among rural general outpatients and among older individuals in urban areas, and important differences in messaging preferences. This suggests a need to offer voice calls for those unable to use SMS. Another new and notable finding was that a sizeable proportion of patients in rural clinics would not reply to messages from a health center or an unknown sender. This finding is consistent with popular support in Uganda for recent national regulations against SMS "spam"[28] – unsolicited messages from third parties. Furthermore, there may be value in registering senders' numbers as contacts in participants' phones during enrollment, as a previous study suggested that allowing recipients to verify the identity of the sender could increase the number reading or replying to messages[29]. Additionally, one-third of contacts had previously changed phone numbers, further complicating delivery of longitudinal mHealth interventions. Previous studies among PLHIV highlight the importance of confidentiality when communicating about stigmatized conditions, and there are significant challenges to ensuring that SMS containing personal-health information remain private in settings like Uganda where phone sharing is common[30]. Because TB is highly stigmatized[31,32], similar concerns exist about communicating TB-related personal-health information. However, almost all participants were willing to receive TB-related personal-health information and reminders via voice calls or SMS, although nearly one-third of general outpatients surveyed were uncomfortable receiving personal-health information via SMS on a shared phone. Interestingly, contacts were almost evenly divided in their preferences between simple but vague SMS language and more detailed and direct language for communicating TB results. Participants cited preferences about when and where disclosure of a TB diagnosis should occur, but not, in our small sample, about loss of privacy from receiving communications on a shared phone. Previous research on SMS among persons living with HIV (PLHIV) has highlighted concerns about confidentiality with mobile-phone communications[18,33,34], but efforts to password-protect SMS or strip SMS of disease-specific content has been associated with reduced efficacy of SMS interventions[35]. Continued exploration of phone ownership, usage patterns, and messaging content in TB-specific populations is needed given the rapid evolution of technology, but our data do suggest that greater personalization of mHealth interventions to user preferences is desirable.

Our studies had some limitations. First, we surveyed a convenience sample of general outpatients, and household contacts were not surveyed if absent during the home visit. We also did not visit contact households for a small proportion of index patients who did not own a phone. We therefore may have overestimated phone ownership and access in contact households. A second limitation is that the household contact and clinic survey instruments were designed and implemented separately, which prevented detailed between-group comparisons. Nevertheless, our findings were complementary, and the differences between surveys did facilitate some population-specific assessments. Additionally, our surveys only collected information on voice and text messaging and did not explore other media such as online social networks. Although such functionality requires access to Internet-enabled phones, we expect these communication platforms to gain wider use in the future. Finally,

we did not collect qualitative data from rural general outpatients, which prevented exploration of other interesting survey findings.

Our studies also had several strengths. This report is one of the first to provide primary data on the preparedness of key populations for use of mobile phones for TB care. Furthermore, we recruited a variety of participants from multiple clinics and communities, representing both rural and urban populations. Together, these studies provide important and previously unavailable information about mobile-phone ownership, usage patterns, and preferences among populations relevant for TB programs, and highlight important heterogeneities within populations. We have shared this data with the Uganda National TB Programme to inform implementation strategies for household contact investigation and for communicating TB testing results by SMS when samples are referred off-site for GeneXpert molecular testing. The mHealth aspects of these strategies will be evaluated within upcoming randomized, controlled trials.

In summary, the studies presented here demonstrate high levels of access to mobile phones and interest in receiving both general and personal-health communications by mobile phone, while highlighting substantial stratification of mobile-phone ownership, ability, comfort, and messaging preferences among target populations. Mobile communications offer tremendous potential to overcome several important challenges in providing diagnostic services for TB, including drop-out from the evaluation process, limited health worker time to deliver test results, and difficulty arranging follow-up visits. However, to realize this promise, mHealth interventions should adapt to the heterogeneities that we have identified among users in order to maximize impact and equity. If such flexibility can be achieved in rigorous studies, mobile communications technologies should help the TB community realize its goal of making TB case finding and treatment more effective and patient-centered.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1.

Access to mobile phones and networks for participants in the urban, community-based study.

Characteristic n (%)*	Urban Household Contacts (n=145)
Own a mobile phone	84 (58)
Do not own but do access a mobile phone, *primarily through*	61 (42)
Spouse/Partner	12 (20)
Family member	45 (74)
Friend	4 (7)†
Number of SIM cards used regularly	
Do not own a SIM card	5 (4)
One SIM card	102 (70)
Two or more SIM cards	38 (26)
Network access at home or work	134 (92)
Ever changed mobile phone number	38 (26)
Changed number within the last 6 months	14 (37)
Average hours per day with phone powered on (SD)	18 (8)

Abbreviations: **SIM**, Subscriber Identity Module (an integrated but exchangeable circuit inserted into a mobile handset to connect and identify it to a telephone network). **SD,** standard deviation

*Unless otherwise specified.

†Sum of percentages may exceed 100%, due to rounding.

Table 2.

Access to mobile phones and networks for participants in the rural, clinic-based study.

Characteristic **n (%)**	**Rural General Outpatients (n=203)**
Own a mobile phone	153 (75)
Do not own but do access a mobile phone, *primarily through*	21 (10)
Spouse/Partner	6 (29)
Family member	12 (57)
Friend	3 (14)
Number of SIM cards used regularly[§]	
Do not own a SIM card	3 (2)
One SIM card	76 (44)
Two or more SIM cards	95 (55)
Network access at home or work[§]	153 (88)
Phone always switched on[§]	168 (97)
Able to keep phone battery charged[§]	167 (96)

Abbreviations: **SIM**, Subscriber Identity Module (an integrated but exchangeable circuit inserted into a mobile handset to connect and identify it to a telephone network). **SD,** standard deviation

[§]Only for the 174 who own or have access to a mobile phone

Table 3.

Patterns of usage of mobile phones among those who own or have access to a phone for participants in the urban, community-based study.

Characteristic n (%)*	Urban Household Contacts (n=145)
Able to retrieve an SMS message from a phone	136 (94)
Ability to read an SMS message	140 (97)
Able to send an SMS message	131 (90)
Able to type using a mobile phone keyboard	140 (97)
Preferred language for SMS	
English only	30 (21)
Luganda only	64 (44)
Either English or Luganda	51 (35)
Number of days taken before checking SMS	
Check on the same day as message received	115 (79)
Check after 1–3 days	30 (21)
Median number of days making a voice call in the last week (IQR)	3 (2–5)
Previously received a mobile money transfer	132 (91)

Abbreviations: IQR, Inter-quartile range; SMS, short messaging services (also known as text messaging).

*Unless otherwise specified.

Table 4.

Patterns of usage and acceptability of mobile phones among those who own or have access to a phone for participants in the rural, clinic-based study.

Characteristic n (%)	Rural General Outpatients (n=174)
Ability to receive an SMS message	164 (94)
Able to send an SMS message	121 (70)
Willing to receive any test results via SMS text message	164 (94)
Willing to provide telephone number to health center	173 (99)
Read messages from numbers unknown or not in contact list	142 (82)

* Missing response for 23 participants

Table 5.

Acceptability of mobile phones personal-health communications for participants in the urban, community-based study.

Characteristic n (%)*	Urban Household Contacts (n=145)
Willing to receive via SMS	
Laboratory test result	144 (99)
New request to come to clinic	145 (100)
Reminder to come to clinic	145 (100)
Reminder to take medicine	145 (100)
Willing to receive health information by voice call	
Laboratory test result	138 (96)¶
New request to come to clinic	139 (96)
Reminder to come to clinic	138 (96)¶
Reminder to take medicine	139 (96)
Number of SIM cards preferred for health-related SMS**	
Prefer to receive SMS on one SIM card	30 (79)
Prefer to receive SMS on multiple SIM cards	8 (21)
Number of SIM cards preferred for health voice call**	
Prefer not to receive voice calls	3 (8)
Prefer to receive calls on one SIM card	28 (74)
Prefer to receive calls on multiple SIM cards	7 (19)
Preferred type of health message	
Simple	65 (45)
Detailed	80 (55)

Abbreviations: IQR, Inter-quartile range. SIM, Subscriber Identity Module (an integrated but exchangeable circuit inserted into a mobile handset to connect and identify it to a telephone network). SMS, short messaging services (also known as text messaging).

*Unless otherwise specified.

¶Missing for 1 respondent.

**For those with >1 SIM (n=38)