You have an important message! Evaluating the effectiveness of a text message HIV/AIDS campaign in northwest Uganda

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2012

Chib, A., Wilkin, H., Ling, L. X., Hoefman, B., & Van Biejma, H. (2012). You have an important message! Evaluating the effectiveness of a text message HIV/AIDS campaign in northwest Uganda. *Journal of health communication*, 17(sup1), 146-157.

<https://hdl.handle.net/10356/100896>

<https://doi.org/10.1080/10810730.2011.649104>

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[DOI:<http://dx.doi.org/10.1080/10810730.2011.649104>].

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RUNNING HEAD: HIV Text Message Campaign in Uganda

You have an important message!

Evaluating the effectiveness of a Text Message HIV/AIDS campaign in North West Uganda

Abstract

There is a growing evidence of the impact of mobile phones in healthcare (mHealth) service delivery, but more research is needed to determine whether SMS (Short Message Service)-based campaigns are appropriate for developing countries. This pilot study explored the efficacy of a mHealth campaign using SMS as a platform to measure and disseminate HIV/AIDS knowledge and to promote HIV/AIDS testing at clinics in rural Uganda. Over a one-month period, 13 HIV/AIDS quiz questions were sent to 10,000 mobile subscribers. Despite participation incentives, only one-fifth of the mobile subscribers responded to any of the questions. The campaign had proportionately limited success in increasing knowledge levels on a mass scale, and had even less impact on behavior change. Further, the program design may be reinforcing entrenched knowledge gaps. The results suggest that we need to be conservative when considering the potential overall impact of SMS-based programs. However, we recognize the potential of mHealth tools when extended to millions of mobile phone users as part of an integrated health campaign approach. We propose several steps to improve the program design to reach a larger portion of the intended audience and increase campaign effectiveness.

You have an important message!

Evaluating the effectiveness of an SMS-based HIV/AIDS campaign in Uganda

The ubiquitous advance of mobile phones, coupled with their portability and cost-effectiveness, has led a surge in healthcare initiatives taking advantage of the benefits of convenience, immediacy and multiple modalities (Istepanian, Jovanov & Zhang, 2004; Mirza & Norris, 2007; Olla & Tan, 2008). There is a growing evidence of the impact of mobile phones in healthcare (mHealth) service delivery, particularly for improving administrative efficiencies, information transfer, social support, and remote diagnosis (Author, 2008; Berger, 2010; Blake, 2008).

This study examined the effectiveness of an SMS (Short Message Service) -based HIV/AIDS information dissemination programme conducted in Uganda. Past research shows that SMS programs have aided the accurate collection of medical records, facilitated mass dissemination of information by healthcare providers, and served reminders for adherence to medical regimens (Anta, El-Wahab, & Giuffrida, 2008; Atun & Sittampalam, 2005; Jareethum, et al., 2008; Puccio, et al., 2006). Further, such mobile technology might be particularly useful in resource-constrained settings such as the healthcare environments found in rural regions of developing countries (Mechael, et al., 2010).

SMS programs have been useful in empowering remote community healthcare workers to collect and transmit data, particularly in the domain of maternal and infant health, in Africa and Asia (Author, 2010; Berg, Wariero, & Modi, 2009; Blaschke, Bokenkamp, Cosmaciuc, Denby, Hailu, & Short, 2009; Eagle, 2009; Cell-life, 2009; FrontlineSMS, 2011; OKN, 2005; United Nations Foundation, 2009). In the sexual health context, texting services have engaged the general population in developed countries (Levine, McCright, Dobkin, Woodruff, & Klausner, 2008). However, we find that evidence of the effectiveness of SMS

for wide dissemination in developing countries a current gap in the literature (Cole-Lewis & Kershaw, 2010), particularly in terms of reporting better health-related outcomes.

Mobile Phones in Uganda

Due to increased affordability and wider network coverage, the proliferation of mobile phones has led to subscriptions reaching 5.3 billion globally, with developing countries accounting for 73% (ITU, 2010). Mobile telephony in Uganda achieved substantial growth over the past decade, growing from 126,913 (0.5% penetration) to 9.4 million (28.7% vs. Africa 41%) (ITU, 2011a). The usage of communication technologies in low-income countries, however, remains lower amongst females than males (Hafkin & Huyer, 2007; ITU, 2011b). For particular sensitive information, such as sexuality related issues, mobile telephony has become the preferred mode of communication in low-income countries (Gerster & Zimmermann, 2005). Cultural norms are stated as one of the reasons for this preference, in that taboo topics may be discussed with anonymity.

HIV and AIDS in Africa/Uganda

Sub-Saharan Africa is the world's most heavily affected region, accounting for 67% of infection and 72% deaths due to HIV/AIDS (UNAIDS, 2009). Prevalence here was approximately 22.4 million, of which Uganda accounted for a million cases (Avert, 2010). Although the number of AIDS-related deaths in Uganda has decreased drastically from 120,000 in 2001 to 70,000 in 2007 (Avert, 2010), rural areas are a concern, with potential for a further rise (Guwatudde et al., 2009; Tumushabe, 2006). Rural Uganda reported an HIV prevalence rate of 9.9%, compared to the national average of 6.4%, with women (7.5%) greater than men (5%) (Uganda Bureau of Statistics and Macro International Inc. [UBIS], 2007). Women are more vulnerable to the disease due to lower levels of knowledge as compared to men, and have less freedom to make their own sexuality-related decisions.

HIV/AIDS awareness campaigns have been carried out in Uganda since the mid-1990s, primarily through radio and print media (Tumushabe, 2006). Text-based campaigns create issues since English-language literacy tends to be lower for women than men (57.7% vs. 76.8%) (CIA Factbook, n.d.). However, even after the Ugandan Ministry of Health launched a door-to-door HIV screening program and created voluntary counseling and testing clinics, an estimated 80% of Ugandans still remain un-tested.

Campaign

The Text to Change (TTC)ⁱ HIV/AIDS education campaign was designed to increase knowledge about HIV/AIDS, awareness about the regional clinic and testing centers, and HIV testing behaviors in the Arua district of Uganda. Between January 29th and February 27th 2009, text messages with HIV/AIDS multiple choice and true/false questions were sent to 10,000 mobile phone numbers. When questions were answered correctly, participants received free HIV Counseling and Testing (HCT) services and were entered into weekly drawings to win prizes including mobile phones and airtime (for more information, see Danis et al., 2010; Van Beijma, Hoefman, & Sparks, 2010). TTC aims to achieve multiple objectives for public health, namely data collection, increasing awareness of HIV/AIDS, advocating testing and counseling behaviors pertaining to HIV/AIDS, and testing the efficacy of incentives to participate.

The data collected as part of the campaign, enables us to examine the following research question: What is the effectiveness of SMS-based campaigns in improving healthcare outcomes, specifically HIV knowledge and access to HCT services?

Methodology

Text Message Questions

Thirteen questions were sent via SMS that fell into three knowledge areas: 1) HIV/AIDS disease, 2) testing; 3) HCT services. HIV knowledge questions included: *What causes AIDS?; HIV is NOT presented in: sweat, semen, blood or breast milk?; How can you tell whether one has HIV? HIV weakens an infected person's immune system (True or false?), and Do you think a healthy looking person can have HIV? (Yes/No)*. Testing knowledge included: *Why is it important to test?; If you are exposed to HIV, how long should you wait to get tested?; What if my HIV test is positive?; and If my partner tests HIV positive, does it mean I am also positive?*. HCT service knowledge was measured with *Is HIV testing at AIC accurate and confidential?; Where is the AIC centre in Arua?; How long does it take to know your HIV results at AIC?; and How much does an HIV test cost at AIC?*

Data Cleaning

Participant's mobile numbers served as unique identifiers, and were used for data - merging. Three data collection issues needed to be addressed: 1) responses that were not in the specified format; 2) multiple responses from the same number; and 3) late responses. Correct answers entered incorrectly (e.g., typing the response instead of providing the corresponding number), were re-coded. Multiple answers to a question from the same number were coded as incorrect. This conservative procedure does not account for multiple people (or the same person hoping to increase their chances in the drawings) using the same phone who responded with the correct answer or when someone answered incorrectly and then later responded with a correct answer after learning the information. Finally, since questions were dispatched during different time frames (See Table 1) without set deadlines, some responses were submitted for prior questions after a new quiz was disseminated. Consequently, where unambiguous, responses were moved to the appropriate question.

Several measures were created for analysis. First, the number of *total questions answered* by each mobile number was computed. Then, the *total answered correct* was

calculated by summing the responses to each question (coded in binary). Next, a *percentage of correct responses* variable was created to indicate the percentage of correct answers received by a mobile number out of the total number of questions answered. Finally, similar variables were created for each of the knowledge subareas; HIV/AIDS disease, testing, and HCT services.

Findings

Descriptive statistics

Of those who answered the question about gender, 421 were male and 202 were female. While men were twice as likely to respond to the quiz questions, there were no significant differences between male ($M=5.95$) and female ($M=5.66$) participants with regard to the total number of questions answered, $t(621)=.867$, $p=.387$ or the total answered correctly, $t(621)=.968$, $p=.333$.

The average age of those responding to the age question ($n=746$) was 28 (median age=26) with ages ranging from 9 to 65 years. There was no significant correlation between age and total number of questions answered ($r=-.009$, $p=.81$) or the total number answered correctly ($r=.023$, $p=.530$), which suggests that age was not a significant factor in campaign participation or in amount of knowledge.

Response Rates and Knowledge

Of the 10,000 mobile numbers who were sent messages, 2,363 numbers responded, of which 1,954 answered the quiz questions (the rest responded to the gender and/or age questions). Quiz answers were received for an average of 2.81 ($SD=3.16$) questions per mobile number; of those, an average of 2.07 ($SD=2.65$) per mobile number were correct. The majority only answered one ($N=790$) or two ($N=337$) questions. Three-hundred-and-fifteen mobile numbers sent responses to more than half of the questions (i.e., 7 or more), with 30 responding to all 13 questions. More than half the sample (61%) answered at least one HIV

knowledge question, 46% answered at least one HIV testing knowledge question, and 45% answered at least one HCT service question.

On average, quiz question respondents got about 68% of the total questions responded to correct. Less than one-fifth (19%) did not respond to any questions correctly while almost half (44%) only provided correct answers to the questions answered. Over half had correct responses for all except two of the quiz questions and more than three-quarters were correct for more than half of the quiz questions. Table 1 shows the number of mobile numbers that responded to each question and the percentage correct. The questions answered least frequently tended to also have the lowest percentage of correct answers recorded. For example, only 286 unique mobile numbers responded to the question that asked *How can you tell whether one has HIV*, and only 45% of the responses received were correct. The most frequently missed question – *If you are exposed to HIV, how long should you wait to be tested?* (answered correctly by 8.5%)—was only answered by 314 mobile numbers. This trend was not consistent across topic areas, however, as there was a lower response rate to two of the center questions – *How long does it take to know your HIV result at AIC?* (N=352) and *Is HIV testing at AIC accurate and confidential?* (N=359) – but the people answering these questions tended to get them correct (94% and 85% respectively). On average, people responding to questions about the HCT services answered 74% correctly, with 67% getting all correct. On average, those answering the general HIV/AIDS knowledge category questions answered 74% correctly as well, with about 63% answering all questions correctly. Finally, on average 62% of people answering questions about HIV testing answered correctly, with 45% answering all questions correctly.

A series of t-tests demonstrated that, with the exception of three questions, people who answered each question correctly were more likely to answer more total questions than those who responded incorrectly (See Table 2). In addition, for each knowledge area, there

were significant positive correlations between the numbers of questions responded to in those areas and the total number of questions in the subarea that were answered correctly: HIV knowledge ($r=.907, p=.000$); HIV testing ($r=.860, p=.000$); AIC Center knowledge ($r=.930, p=.000$), suggesting that respondents who know the correct answers are more likely to answer more questions than those who do not. Additionally, there is evidence that there are relationships between the amount of knowledge known in one area and the amount of knowledge known in the other areas. There were significant positive correlations between the number of correct answers each mobile number provided for HIV knowledge and testing knowledge ($r=.607, p=.000$), HIV knowledge and center knowledge ($r=.608, p=.000$), and HIV testing knowledge and center knowledge ($r=.659, p=.000$).

Discussion

The aim of the TTC Arua SMS program was to use an easy, cost-efficient, ubiquitous mobile technology to increase knowledge levels about HIV/AIDS for the general population, and influence participants to access HCT services. In doing so, there was the objective of providing evidence for, and validating, the use of texting campaigns to a mass populace, and thereby confirm an effective mHealth tool to a broader audience of health practitioners, academics, and policy-makers.

The results of this analysis suggest that, while there is evidence of limited effects, we need to be conservative when considering the potential overall impact of such an innovative SMS tool. The campaign had proportionately limited success in increasing knowledge levels on a mass scale, and had even less effectiveness in behavior change. Further, the programme design may be reinforcing entrenched divides in terms of knowledge across various groups.

The SMS campaign, preceded by a mass media campaign reaching a potential audience of 5 million, was disseminated to 10,000 unique MTN subscribers (Van Beijma et al., 2010). Based on the quiz results, one might conclude that overall HIV/AIDS knowledge is fairly

high within the rural Ugandan population, compared to prior results of comprehensive knowledge (UBIS, 2007). Certainly, specific knowledge questions that scored low might be the focus of future campaigns. However, there is reason to believe that the critical health information did not reach everyone in the intended audience.

Despite the integrated campaign including outdoor and broadcast media, total participation rates for individual questions ranged between 5-10%, whilst valid participation rates were even lower (3-8%), and only 0.3% answered all questions. In total, four-fifths of the mobile numbers who received the text messages, including quiz questions, failed to participate. Of those who participated, over half got at least one question about HIV testing wrong. This last finding, despite the better knowledge about HIV testing centers, might explain the fact that TTC program prompted only 2.3% of quiz recipients to access HCT services (Van Beijma et al., 2010). This finding is in line with McGuire's (1990) hierarchy-of-effects model, a stage-based model which suggests that individuals follow a sequential progression from cognitive, through affective, to behavioral responses, and that each stage sees degradation in the response.

A further cause for concern is that the campaign may be reinforcing knowledge divides within the population by the selective strategy of employing a relatively costly medium, using only a single telecommunication carrier, by utilizing a text-based strategy in a region with potentially high illiteracy, by sending potentially sensitive information on a shared device, and by incentivizing only those recipients that already hold correct information to continue participation. The SMS campaign may be reinforcing a knowledge gap (Tichenor, Donohue, & Olien, 1970) such that those from certain groups, such as groups with higher socio-economic status, or males, will benefit more from the campaign since they are better able to acquire, process, and act upon the information provided. The authors point to a number of contributory reasons for this differential including communication skills

(attributed to better education), existing knowledge, relevant social contact, the nature of the communication medium itself; and selective exposure, acceptance and retention of information.

First, mobile telecommunication penetration rates, while steadily increasing, are limited to less than a third of the population, and it is likely that these figures are further biased against rural dwellers. Therefore it is possible that major swathes of the population, under the current situation, will be excluded from the campaign. Further, mobile ownership in sub-Saharan Africa has been seen to be highly correlated with income, literacy, and male ownership (Blumenstock & Eagle, 2010). While such a relationship is effective for a texting campaign, there would be issues in developing countries with literacy issues (Malhotra, Gardner & Rees, 2005), particularly for rural women.

It is likely that stigmatization posed a strong obstacle to participation in the program, despite findings from neighboring countries that mass media promotion efforts positively correlated to testing (Gilbert & Walker, 2010; Maughan-Brown, 2010; Sambisa, Curtis, & Mishra, 2010; Maman et al., 2009). The benefits of shared usage may be negated by the stigma associated with such a potentially sensitive topic, particularly for rural women, compounded by their lower likelihood of mobile phone ownership (Burrell, 2010).

The analysis suggests that the quiz design motivates participants to only answer questions they already know the answers to and potentially provides a disincentive to recipients who do not know the correct answer to participate. People who answered the quiz questions received confirmation that their answer was correct or incorrect, reinforcing prior knowledge or providing correct knowledge to those who did not know the correct answer, but the design failed to provide correct answers to those who did not participate. Further, there is reason to believe that there was a self-selection bias into the quizzes, because participation incentives hinged on correct knowledge, discouraging participation for those with incorrect

information, and prompting holders of correct knowledge to continue participating. This means that the program's intended audience—those who do not have correct HIV/AIDS knowledge—were less likely to receive the correct knowledge through this campaign.

While this study takes a critical perspective towards the effectiveness of SMS in meeting health objectives, we note that there is certainly evidence of limited success in a resource-constrained setting. The interactive format led to a response from as many as a tenth of recipients, to the dissemination of critical information to 2,363 respondents from the general populace, and to a 33% increase in access to HCT services, all pointing towards the potential of mHealth text campaigns (Van Beijma et al., 2010). We propose that certain steps in program design may increase the effectiveness of the campaign even further, particularly necessary when such pilot projects are scaled up. Despite the conservative approach applied to the impact on behavior change, the potential of mHealth tools can be quite tremendous when extended to millions of mobile phone users.

Recommendations for improving program effectiveness include making SMS part of an integrated mass-media communication campaign, such that the reach extends to the bottom-of-the-pyramid population unable to afford mobile devices. SMS campaigns may be better delivered to target populations within institutional settings, with potentially higher participation rates, and greater chances of social influence occurring (Danis et al., 2010). For SMS blasts to the general population, it would be good to identify and over-represent certain vulnerable groups, such as those with lower incomes and women. mHealth program designers could consider advanced 3G and 4G networks to deliver visual information via MMS (Multimedia Message Service), that mitigates low literacy and text comprehension levels. Finally, the quiz should extend the answers to all recipients, not just the responding participants, who comprise a fraction of the entire potential audience.

In conclusion, there is a need to provide more evidence of the long-term sustainability of mHealth programs using SMS tools. This critical perspective suggests a need to temper the expectations that arise with the excitement surrounding innovative technologies. mHealth campaigns need to be combined with other forms of dissemination--e.g. mediated or interpersonal--in developing countries where mobile phone access and literacy disparities exist. The Arua SMS campaign is a valuable first step in providing rigorous, scientific evidence of the potential of mHealth tools as an additional arrow in the armory of health communication programs.

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Table 1. Number of unique mobile number responses out of the entire sample ($N=2,363$) and percentage of received answers that were correct

Date sent	Question	Correct Response	Type	N=	% Correct
01/29/09	What causes AIDS?	A virus called HIV	K	433	85.2
01/30/09	HIV is NOT present in: sweat, semen, blood, or breast milk?	Sweat	K	406	59.1
02/05/09	How can you tell whether one has HIV?	No specific symptoms	K	286	45.1
02/06/09	Why is it important to test?	Get care if positive; plan for your future if negative	T	406	70.9
02/07/09	If you are exposed to HIV, how long should you wait to get tested?	1 month	T	314	8.6
02/12/09	Is HIV testing at AIC accurate and confidential?	Yes	C	359	85
02/14/09	Where is the AIC centre in Arua?	At Anyafio, on Ociba road	C	593	80.3
02/20/09	How long does it take to know your HIV result at AIC?	30 minutes	C	352	93.5
02/21/09	What if my HIV test is positive?	AIC provides support via counseling, care and treatment and refer you for more specialized care	T	529	79.2
02/22/09	How much does an HIV test cost at AIC?	Free of charge with this message	C	691	70.3
02/25/09	HIV weakens an infected person's immune system?	True	K	725	83
02/26/09	Do you think a healthy looking person can have HIV?	Yes	K	833	86
02/27/09	If my partner tests HIV positive, does it mean I am also positive?	No	T	731	68

K=knowledge about HIV; T= knowledge about testing/testing efficacy; C= knowledge about testing/counseling options at AIC

Table 2. T-tests comparing those answering each question correctly and incorrectly

Questions	Incorrect Total Ans. Mean (SD)	Correct Total Ans. Mean (SD)	<i>df</i>	<i>t</i> -value	<i>p</i> -value
What causes AIDS?	4.09 (3.65)	5.64 (4.32)	96.24*	-3.04	.003
HIV is NOT present in: sweat, semen, blood, or breast milk?	5.25 (3.91)	7.13 (4.33)	371.26*	-4.61	.000
How can you tell whether one has HIV?	6.59 (3.94)	8.58 (3.88)	284	-4.28	.000
Why is it important to test?	6.68 (3.88)	7.71 (3.71)	404	-3.99	.000
If you are exposed to HIV, how long should you wait to get tested?	7.96 (3.61)	7.48 (4.30)	312	0.65	.519
Is HIV testing at AIC accurate and confidential?	5.67 (3.45)	7.58 (3.84)	357	-3.42	.001
Where is the AIC centre in Arua?	4.74 (3.47)	6.72 (3.67)	591	-5.28	.000
How long does it take to know your HIV result at AIC?	7.35 (3.65)	7.76 (3.69)	350	-0.52	.605
What if my HIV test is positive?	5.21 (3.34)	7.29 (3.49)	527	-5.62	.000
How much does an HIV test cost at AIC?	3.50 (2.80)	7.07 (3.49)	689	-12.99	.000
HIV weakens an infected person's immune system?	4.87 (3.15)	6.06 (3.70)	197.26*	-3.71	.000
Do you think a healthy looking person can have HIV?	3.63 (2.89)	5.70 (3.67)	183.05*	-6.92	.000
If my partner tests HIV positive, does it mean I am also positive?	5.72 (3.75)	5.86 (3.59)	729	-0.50	.615

* Levene's test for equality of variance showed significant differences ($p < .05$) and the results for equal variances not assumed are reported.

¹ TTC is a Dutch non-profit organization that promotes health education in Africa via mobile phones.