



Iterative Development of In This toGether, the First mHealth HIV Prevention Program for Older Adolescents in Uganda

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Abstract

In Uganda, HIV prevention programming for older adolescents is noticeably lacking, even though HIV incidence rates increase dramatically from adolescence into young adulthood. Here we describe the development of In This toGether (ITG), the first-of-its-kind, comprehensive text messaging-based HIV prevention program for both sexually active and abstinent 18- to 22-year-old Ugandans. Five iterative development activities are described: (1) conducting focus groups (FGs) to better understand the sexual decision-making of older adolescents across Uganda and to gain ‘voice’ of older adolescents; (2) the drafting of intervention content based on FG data; (3) testing of the drafted content with two Content Advisory Teams (CATs) that reviewed and provided feedback on the messages; (4) alpha-testing the program among the research team; and (5) beta-testing the intervention and protocol with people in the target population. Participants were recruited nationally via Facebook and Instagram, and enrolled over the telephone by research staff. Results suggest that men were easier to reach and engage across all intervention development steps. As such, specific efforts to enroll women were made to ensure that feedback from both sexes was taken into account. FG participants said they were interested in learning more about sexual positions, how to prepare for sex, the consequences of unprotected sex, benefits of protected sex, masturbation, and how to be a good sexual partner. In both the FGs (n = 202) and CATs (n = 143) however, some noted that masturbation, oral sex, and anal sex were particularly sensitive topics. These messages were rewritten to address the cultural sensitivity. Feedback from beta test participants (n = 34) suggested that text messaging-based HIV prevention programming that is intense (e.g., 5–11 messages per day) and extends for two months, is both feasible and acceptable. In conclusion, the engagement of older adolescents at each step of the iterative intervention development process increased the likelihood that the final product would resonate with 18- to 22-year-old Ugandan youth across the country. Furthermore, social media appears to be a feasible method for recruiting national samples of Ugandan older adolescents into HIV-focused research.

Keywords HIV prevention · Older adolescents · mHealth · Uganda · Sub-Saharan Africa · Intervention development

Introduction

Despite early advances, HIV continues to be a significant public health challenge in Uganda. Since 2005, when HIV prevalence was at its lowest, rates have increased from 6.4% to 7.3% [1, 2]. This translates into 1.4 million people now

living in Uganda with HIV [3] By comparison, 0.6% (1.3 million people) are HIV positive in the US [3, 4].

Heterosexual sex is the primary mode of transmission of HIV in Uganda [2], which is likely why incidence rates increase dramatically from middle to late adolescence as young people become sexually active. Indeed, the rate of HIV among young women jumps from 1.6% among 15–17 year olds to 5.1% among 18–19 year olds and increases further to 7.1% among 20–22 year olds [1]. For males, rates also rise from 1.8 to 2.3% as they age from 15–17 years to 20–22 years of age [1]. Thus, to affect the rates of HIV incidence in Uganda, culturally salient and theoretically-driven HIV prevention programming needs to target adolescents as they age through this period of risk.

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To have maximal public health impact, HIV prevention programming should be accessible not just to those who are currently having sex, but also to those who will become sexually active in the future. Indeed, because dating is forbidden in secondary schools in Uganda—youth who are identified as being in a relationship are publicly shamed and suspended from school—late adolescence is often the time that many Ugandans have their first romantic relationship. Data suggest that one of the most influential predictors of current condom use can be condom use at first sex [5, 6]. HIV interventions with sexually inexperienced adolescents have the potential, therefore, to arm young people with the skills they need to enact HIV preventive behavior the first time and every subsequent time they have sex.

Technology can facilitate broad public health impact because of its wide reach. Indeed, text messaging is being used to improve HIV programming and services in developing countries, and indications of acceptability and feasibility are consistently noted [7–11]. The potential to affect HIV preventive behavior continues to be under-realized, however, as existing technology-based prevention programs, which typically include a handful of messages, are likely too brief to affect change [12, 13]. Intervention programs that not only go where young people “are” (i.e., literally in their hands), but also are comprehensive enough for youth to translate messaging into behavior, are needed. Moreover, few research studies capitalize on technology’s reach to develop and test interventions nationally in resource-limited settings. With Facebook being one of the most visited websites in Uganda [14, 15], it could be a useful tool in recruiting older adolescents into research activities at the national level.

Given the epidemiology of the HIV epidemic in Uganda [1], intervention during late adolescence (i.e., 18–22 years of age) is key. To this end, here we describe the development of In This toGether (ITG), the first-of-its-kind, comprehensive, text messaging-based HIV prevention program for Ugandan young people. Lessons learned from the development work described here can inform similar efforts for young people across Sub-Saharan Africa.

Iterative Methods and Results

Based on the development of previous text messaging-based interventions [16–18], we followed an iterative process to develop ITG. The process involved five main activities: (1) conducting focus groups (FGs) to better understand the sexual decision-making of older adolescents across Uganda; (2) the drafting of intervention content based on FG data; (3) testing of the drafted content with two Content Advisory Teams (CATs); (4) alpha-testing the program among the research team; and (5) beta-testing the intervention and protocol with people in the target population.

Chesapeake Institutional Review Board in the United States and Mbarara University of Science and Technology Institutional Review Board in Uganda reviewed and approved the research protocol. All participants provided informed consent before taking part in the research activities.

Eligibility Criteria

The eligibility criteria were the same for all research activities so that lessons learned would be applicable for the intended users of the ITG HIV prevention and healthy sexuality program. Specifically, participants were (a) living in Uganda; (b) 18 to 22 years old; (c) able to read English; (d) the exclusive owner of a mobile phone (i.e., were not sharing the phone with another person); (e) using text messaging for at least six months; (f) intending to keep the same phone number for the next six months; (g) able to access the Internet; and (h) able to provide informed consent.

Recruitment and Enrollment

The same recruitment and enrollment protocols were used for each of the research activities. Advertisements were purchased on Facebook and Instagram (FB/IG) that targeted men and women who said they were 18 to 22 years old, living in Uganda, and had set their language preferences to English. People who were interested in participating clicked on the ad and were then directed to an online screener form. The screener website described the study activity and contained a brief online survey that determined eligibility and collected demographic characteristics to help the research team ensure sample diversity (e.g., a range of educational attainment). To reduce the likelihood that people chose to take part in the research because of money rather than interest in the topic and to increase generalizability of the sample, the FB/IG ads did not mention the incentives.

Research staff then contacted potentially eligible candidates by telephone to further explain the research activity, confirm their eligibility, and enroll them into the program. At the end of the call, eligible candidates agreed or declined to consent. Ineligible candidates were thanked for their interest in the study.

Incentives

Participants in the FGs received 5000 Ugandan shillings (UGX) in mobile data as an incentive (roughly USD \$2). CAT participants received 5000 UGX in mobile data for completing the content review and another 5000 UGX in mobile data for participating in the online discussion board, for a possible total of 10,000 UGX in mobile data. Beta test participants received 15,000 UGX in mobile data.

Intervention Development Step 1: Focus Groups (FGs)

Methods

Four FGs were conducted between January and June 2016. They were stratified by sex and sexual experience: one included sexually experienced men, one included sexually inexperienced men, and two included parallel groups of women. Sexual experience was defined as having had anal, vaginal, and/or oral sex in the past 12 months. Participants in each FG were purposefully recruited to result in a diverse group in terms of geographic location (i.e., Kampala versus outside of Kampala), educational attainment (i.e., Ordinary Level or lower versus Advanced Level and higher), and current school attendance (i.e., going to school versus not).

FGs were conducted on a password-protected bulletin board website over three consecutive days. Each session contained 5–6 threads, with each thread containing 3–4 questions. Study staff familiar with FG moderation facilitated the sessions. Participants agreed to log-in two to three times each day and respond to pre-posted questions as well as to other participants' comments. The online format provided distinct benefits compared to in-person groups, such as being able to include youth from across the country, to accommodate a larger group size, to allow participants to sign on at the time convenient for them, and to negate the need for transcription as participants type in their own responses.

FG questions queried issues related to the intervention protocol, including participants' text messaging behavior, concerns about phone privacy, previous experiences with healthy sexuality interventions, ideas for the name of the intervention, and the general acceptability of a text messaging-based health intervention. We also asked about the acceptability of proposed program features: "text buddy", who is another participant with whom they can send text messages [24]; the "genie" feature, which sends on-demand information when triggered by specific key words [24]; and the "badge" feature, which sends scheduled questions to participants querying whether they have completed a certain behavior (e.g., acquiring a condom) and rewards them with a positive message and pictorial badge to affirm the behavior. We also asked about sexual decision-making and relationship experiences.

Results

1424 screeners were completed, 613 (43%) of which were eligible. Between 21 and 33 participants were enrolled in each FG. Demographic characteristics are shown in Table 1. Of those enrolled, 45 (22%) completed the study activity, as defined by answering at least one question in each FG session.

Process Experience

Although we were able to recruit a diverse sample, recruiting for the younger age bracket (18–19 years old) was more difficult than recruiting 20- to 22-year-olds. As a result, we created specific FB/IG ads to target younger youth. We also

Table 1 Demographic characteristics of participants In ITG development activities

Demographic characteristics	Focus groups (n = 202)	CATs (n = 143)	Beta test (n = 34)
Female	49% (99)	47% (67)	50% (17)
Age (M:SD)	20 (1.4)	20.3 (2.2)	19.7 (1.3)
Residing outside of Wakiso District (Kampala)	60% (121)	45% (64)	59% (20)
Education			
Primary / no formal education	0% (0)	2% (2)	0% (0)
Ordinary level	13% (26)	24% (35)	50% (17)
Advanced level	60% (122)	44% (63)	38% (13)
Tertiary	11% (23)	16% (23)	12% (4)
University	12% (25)	14% (20)	0% (0)
Do not want to answer	3% (6)	0% (0)	0% (0)
Currently in school	67% (136)	71% (101)	56% (19)
Income			
Less than 50,000 shillings	30% (60)	36% (51)	29% (10)
50,000 or more	24% (49)	34% (48)	50% (17)
Do not want to answer	46% (93)	31% (44)	21% (7)
Vaginal sex in the past 12 months	41% (83)	49% (68)	71% (24)

received fewer screeners from youth in lower education categories; and we noticed that for women especially, education and sexual experience seemed to be inexorably intertwined: More screeners were received from higher educated sexually inexperienced women, and lower educated sexually experienced women, than vice versa. We considered advertising outside of FB/IG (e.g., on the radio) to broaden our reach, particularly to lower income youth, but did not find a suitable option.

Participants required extensive outreach. Multiple phone calls and text messages were needed to encourage them to create a username in the online system. Follow-up text messages and phone calls were needed to encourage them to complete the FG questions posted each day. Almost all youth who participated did so from their cell phone, so we modified the FG website to be more mobile-friendly. Participants also shared with study staff that they had difficulty participating on weekdays because of school and work responsibilities. The third FG was conducted over the weekend and seemed to have a higher participation rate: 38% as compared to 8–32%. Another interesting experience that is different to what we have experienced in the United States [18, 19] was that some youth felt very strongly about using their real name. Even when we explained the reason why an alias was preferred (i.e., to protect their privacy), they resisted the idea of using something other than their first name. This is likely because it is culturally anormative to conceal one's identity. Using an alias was eventually added as an eligibility criteria because of the number of times the issue arose, particularly among women.

Text Behavior

Participants reported regularly engaging with text messages in their daily lives, receiving a range of 5 to 200, and sending between 1 and 200 text messages each day. Participants also shared that incoming text messages do not necessarily disrupt their daily life. One person shared: "I just put my phone far from so that I finish with what am doing...or I put my phone in silent so that I don't get more of the messages." Another person similarly said: "I usually excuse myself and read the message or i read it immediately am done with what am doing".

Privacy

Most older adolescents said they use passwords to protect their cell phones and to keep their messages private, read sensitive messages when they are alone, and delete those they do not want anyone else to see. Some women said they do not mind reading sensitive messages in public; they expect others to mind their own business. As one woman who was not currently having sex said: "hahahahahaha oh

please! why would i hide? i scream wen am done i reply and get back to what i was doing". Funny messages are shared with others, women said. Some participants said they felt pressure by their partners to share text messages as a show of their trustworthiness, however.

Concerns About the Intervention Idea

When asked about concerns about the program (i.e., 'what could go wrong'), some talked about the potential cost they would incur to respond to program messages. Several said that if program messages with sensitive words like "penis" and "HIV" were seen by others, they might feel uncomfortable. As one man who was not currently having sex said, "questions could start flowing." Others expanded on this, suggesting that people who see intervention content on their phone may think they are into pornography, are getting involved in "bad" sexual behaviors, or have HIV. As one sexually active woman said: "one wl start biasing u,either aplayer or a prostitute." Several sexually inexperienced women said that if this happened, the program participant should be responsible for explaining the program to their friend.

When asked what kinds of information about sex that they would like to learn, participants expressed their interest in learning more about sexual positions, how to prepare for sex, the consequences of unprotected sex, benefits of protected sex, masturbation, and how to be a good sexual partner.

Feedback About Proposed Program Components

Older adolescents liked the idea of a text messaging-based HIV prevention program. One man who was not currently sexually active shared, "Its a better way to have sex education....I think this is going to be effective given the fact that people are not free to discuss sex education in public." A woman who was not currently sexually active said that people in the program could share the messages with others: "The idea of message is good because we can even discuss about it with my family members, friends and then more ideas are got through the wise conversation." Another woman who was not sexually active said, "I believe this program to act as the voice for the voiceless and not expose someone's weakness if wat they answered is funny because sex education is not an easy thing you can come up and tell someone." Many also liked the idea because text messaging is affordable.

The Text Buddy concept was acceptable to most participants. Although some shared concerns about the cost to send messages (e.g., "I could only text my buddy if I have the money to text" said a sexually inexperienced woman), others seemed to think the cost would be worth the connection and conversation. As one man who was not currently sexually

active shared: “given the current SMS rates across the common networks, that would not make me change my mind for even a second.” A sexually inexperienced woman said: “i dont mind about the costs.” When prompted about concerns, some said it would be troubling if the Buddy pushed for personal information or was intolerant.

The on-demand advice feature, “Genie,” was also received positively, although some shared concerns about the associated cost of texting the Genie. Participants suggested several topic ideas, including: how to have sex without risks of STDs and other outcomes, how to impress your girlfriend/boyfriend, the importance of condoms and how to use them, masturbation, and what to do if one’s partner’s parents do not like them.

Participants were asked to provide feedback on possible program names, including SMSenga (which references the Senga, who is traditionally a young woman’s aunt and sexual educator) and ITG—In This toGether. Participants nominated their own ideas as well (e.g., I–U for ‘Imagine You’). Overwhelmingly, participants favored the name ITG. They liked its connotation of community and its lack of sexual suggestiveness (“ITG is better because it isn’t suspicious”).

Integrating Feedback into the Program Design

Based upon respondent feedback, we developed intervention content with the aim of sending ~5 messages per day. Given the concerns about costs associated with responding to program messages, dyadic messages that asked participants to respond were kept to a minimum. Many of the topics noted to be of interest were integrated into the Genie feature, renamed as “ITGenie.”

Intervention Development Step 2: Drafting Intervention Content

Content was driven by the Information-Motivation-Behavioral Skills (IMB) model [20, 21]. According to the IMB model, HIV preventive behavior is influenced by: (1) information about how to prevent HIV, (2) motivation to consistently engage in non-risky behaviors, and (3) behavioral skills to correctly enact these behaviors. The effects of information and motivation on onset and sustainability of one’s HIV preventive behavior are mediated by behavioral skills. For example, improving one’s motivation to engage in preventive behaviors is expected to lead to an increase in HIV preventive behavioral skills, which then leads to an increase in enactment of HIV preventive behavior.

Context was tailored by participant sex and sexual experience, resulting in four ‘paths,’ one for: sexually experienced men, sexually inexperienced men, sexually experienced women, and sexually inexperienced women. Each path

included the same content; the presentation was tailored to address gender-specific perspectives and sexual experience. For instance, the same message was included in both male and female sexually experienced participant paths: “Play sex live when you are older and have been in a committed relationship with someone for years. Until then, condoms every round with every partner. Goodnight”. [Note: “Play sex live” means having unprotected sex in Uganda.] A different message was included in the sexually inexperienced paths: “I know you are waiting to play sex until you meet the right [girl/guy]. When you do, make the loving and healthy choice and use condoms every round. Goodnight!”.

Quotes from the FGs were also integrated directly into the content. For example: a sexually experienced male FG participant said, “A man seduces and is expected to act the #rooo” provided the basis for this message in the sexually experienced men’s content: “Maybe you find yourself battling on looks and money, but not love. So with that, you can’t hesitate to add a sub. Is being a #rooo worth your health though?” Another male FG participant said: “It’s common mostly in complicated relationships where no one is minding abt the other bt dei r together jst to keep d relationship flowing in the eyes of the friends.” This inspired the program message: “In complicated relationships, no one is minding about the other. They are together just to keep it flowing in the eyes of their friends.”

‘Fun facts,’ famous quotes, and proverbs also were integrated into the content to provide levity throughout the program. For example, one quote read: “As Okello Sam said: Peace is created by correct knowledge. If you don’t have knowledge then you are insecure and insecure people are the ones who cause trouble.”

The final draft of the intervention content contained 7 weeks of ‘core’ content that included 5–11 daily messages, 11 weeks of latent period messages (i.e., an inactive period between the core program and booster week in which only two messages per week are sent), and 1 week of booster messages that reviewed the core content.

Intervention Development Step 3: Content Advisory Teams (CATs)

Methods

Once program content had been drafted and the team had iterated upon it, Ugandan youth were recruited into CATs to provide feedback on the tone, salience, clarity, and appeal of the messages. Messages were roughly 160–200 characters long (i.e., more than the character maximum for a standard text message) because the aim of the first CAT was to gather feedback on the general theme / idea of each text message.

As with the FGs, CAT participants were recruited through FB/IG ads. Recruitment for each CAT was purposefully balanced on age, district, educational attainment, and currently attending or not attending school. The latter characteristic was added for CAT recruitment as it was posited to be a more accurate reflection of socioeconomic status (SES) than income or education (i.e., someone attending university might report a low income because they are not working full time, but their ability to attend university reflects a higher SES).

CATs were stratified by sex and sexual experience. Participants were assigned to read their particular content ‘path’ and give feedback about the messages’ tone, clarity, and appeal. Participants were given one week to read the content and provide feedback in an online form. After participating in this activity, they were then asked to take part in a 1.5-day online discussion. These discussions were stratified by sex assigned at birth but not sexual experience to ensure sufficient FG size.

Results

Screener data for the CAT were not available because of unexpected technical problems post-hoc. 64 participants (15 sexually experienced men, 16 sexually inexperienced men, 14 sexually experienced women, and 19 sexually inexperienced women) were enrolled into CAT 1. Thirty participants (47%), 14 men and 16 women, provided feedback on the messages.

Based upon a lower than desired response rate in CAT 1, a second CAT was convened to ensure adequate feedback. We over-recruited for CAT 2 such that 79 people (25 sexually experienced men, 20 sexually inexperienced men, 16 sexually inexperienced women, and 18 sexually inexperienced

women) were enrolled. Feedback was given by 39 participants (49%), 19 men and 20 women.

For the online discussion, 28 men created a username to access the discussion website, and 25 posted at least one comment. Among women participants, 23 created a username, and 22 posted at least one comment.

Demographic characteristics are shown in Table 1. We hoped to recruit more participants with lower education attainment than we did during the FGs, resulting in one in four (25%) of our sample having ordinary- (“O”) level (similar to ~10th grade in the US) or lower education. Two in five (21%) were not currently attending school.

Process Experience

Retention experiences in the CATs reflected our experiences during the FGs: Participants required frequent phone outreach by research staff to not only remind them to complete the online activities, but also to help them resolve technological challenges. Some participants did not have an email address, which was one of the methods we used to send links to the online research activities. Although participants could still receive the links by text message, a significant amount of staff and participant effort went into trying to facilitate email access. We also found that, compared to male participants, more female participants did not have enough data on their devices to complete the study activities. Additionally, during CAT 2, which was conducted during school holidays, some participants traveled from urban to more rural areas where they were not able to connect to the Internet with their phones.

Review of the CAT feedback revealed some confusion about the study activity among participants. Many left comments as if in conversation with the intervention

Table 2 Example content advisory council feedback

Intervention message	Selected participant comments
Everyone—those with HIV and without HIV—needs to use condoms every round. There are different types of HIV so if you have one type, you can get another type if you do not use a condom	Come on there are two types!!!!??? Of HIV Really?? I didn't know that
Oral sex (when you use your mouth on a clitoris or penis) has little to no risk. If semen or vaginal fluid are ejaculated into the mouth of someone who has oral ulcers or bleeding gums, or if the person getting oral sex has genital sores, there may be some risk	Its even disgusting But oral sex is something too immoral
Know too that masturbation is normal and does not hurt you physically. You can still have babies, will not have premature ejaculation, or other unwanted things	This is misleading because maturation is a social injustice Simply don't encourage masturbation Won't prolonged masturbation lead to secondary impotence and there for making it hard for a man to have strong sperms in the body that can impregnant
Also know that your risk for HIV is higher when you play sex and you have another STD, like gonorrhea. Your risk is also higher if you have sores on your penis. Condoms reduce this risk	But others they says that condoms can bring cancer But they say condoms cause cancer to ladies

messages, rather than providing an assessment of the messages' tone and understandability. Comments were nonetheless useful when they demonstrated disbelief or a negative reaction toward a message. Examples are shown in Table 2.

Message Tone

Most participants said that messages sounded supportive, written clearly and in 'easy' English. For example, one participant said: "the overall tone of the message was supportive, you feel being encouraged to make a choice and not being forced." On a message against HIV stigma, a sexually inexperienced female participant said "Understanding tone and not commanding". Some found the messages about how HIV is contracted to be a bit disturbing, however, and one person suggested that some messages sounded like they were coming from a school principal.

Salience

Participants agreed that the content talked about experiences they had had in their lives and provided actionable advice. At the same time, some participants found certain facts hard to believe. For example, the message: "If you have more than one kind of HIV in your body, it is harder for doctors to treat you." elicited a lot of skepticism and requests for more information, particularly from sexually inexperienced female participants: "elaborate", "Its brief", "HOW COMES", "There no knowledge", and "am not sure". Another message met with resistance discussed the transmissibility of STDs through oral sex.

Suggestions for Improving the Content

Some participants felt that the messages encouraged sex more than abstinence, and that more emphasis should be placed on abstinence. They also wanted to hear more about some other topics: healthy versus unhealthy relationships, including forced sex and early marriages; living with HIV and HIV stigma; and treatments for STDs. Participants also noted that some suggestions in the content were not provided with "how to" instructions.

Messages that discussed vaginal sex were neutrally received, whereas the topics of oral sex, anal sex, and masturbation drew criticism. Many felt that the content needed to be more sensitive regarding these topics. A sexually inexperienced woman said about one message: "it's ok though sounds like an encouragement for people to engage in oral sex." Not all CAT participant reviewers had strong reactions. A sexually inexperienced woman reacted to one such message with "True." Additionally, respondents noted unfamiliarity with some words (e.g., pre-cum, lube) and asked

that program features, particularly the Text Buddy and the "snooze" function be further described.

Feedback on Other Program Components

The idea of the Text Buddy, subsequently renamed to "ITG Peer", was well received ("it encourages sharing information"). When asked what type of information ITGenie should provide, many thought that messages about how to impress their partner's parents would be helpful (e.g., "give them maximum respect", "show them you care about your [girlfriend's] life"). Some participants did not approve of information being shared about masturbation ("I think masturbation WD be worsenening the situation there4 am not in support of it"). Others were more neutral about the topic ("I think it will b helpful if u inform someone d advantages en disdvantages of mastervation."). Fun facts and quotes were well-received: "WOOW, THAT'S POWERFUL AND MIND BLOWING, GREAT".

The Impact that the Messages Had on Participants

In the online discussion, participants were asked about how the messages had affected them, if at all. Some said they felt more interested in condoms and more encouraged about buying, carrying, or using them. Others said they felt less alone knowing that other young people face the same challenges. Some said their views on sex and relationship had changed ("I know now sex does not maintain a relationship"); others felt more encouraged to abstain from sex.

Integrating Feedback into the Content

Based upon CAT participant feedback, we added messages acknowledging that oral and anal sex can be uncomfortable topics: "Some people are uncomfortable talking about anal and oral sex. When it comes to HIV, we need to be open about all types of sex." We also added more messages about HIV acceptance: "If you are HIV positive, you are not alone. About 1 in 20 Ugandan women your age have HIV. We are all in this together." We added clarification about lubrication: "Buy lube at the store. It comes in a tube and makes sex better. Buy water-based lube. Things like oil, lotion, or Vaseline ruin the condom." and "pre-cum" wherever it was mentioned: "Pre-cum [the fluid on your man's penis before he orgasms] also has sperm so you can get pregnant." American words that were unfamiliar in Uganda (e.g., "snooze") were rephrased (e.g., "pause"). Messages that sounded prescriptive and from a school principal were reworded. For instance, "...Do not fear people with HIV or AIDS." became "We should not fear people with HIV or AIDS."

Intervention Development Step 4: Beta Test

Methods

Once the messages were reduced to 160 characters and finalized, the final content was 8 weeks long. The program was then alpha-tested among team members and finally beta tested with 34 older adolescents across Uganda to confirm the acceptability of the program, including its length and intensity, as well as the protocol itself, including the recruitment and enrollment plan, and delivery method of the surveys.

As with earlier development steps, participants were recruited via FB/IG and contacted via phone after submitting an online screener that suggested they were eligible. During the enrollment call, we obtained consent and sent a text message to their phone to confirm compatibility with the program and that the phone number had been entered correctly. We then sent a link to the online baseline survey. After they finished the survey, the program software randomly assigned the participant to either the intervention or an attention-matched control group that received content about healthy lifestyle topics (e.g., diet and exercise). To maximize the amount of data collected on the intervention experience, people were randomized at a 2:1 intervention-to-control group ratio.

To obtain real-time feedback about the program experience, participants were asked to complete a brief text message-based survey at the end of each week of the 8-week core program. Follow-up assessments were delivered via text messaging at the end of the core program, and online one month after the intervention finished. For all data collection efforts, study staff telephoned those who did not respond and completed the survey with them over the telephone, if needed. Participants received 5,000 UGX in mobile data for the baseline and core-end text messaging survey, each, and 10,000 UGX in mobile data for the post-intervention end survey.

Results

Between July 4 and 15, 2017, 1,970 screeners were submitted, of which 835 (42%) appeared to be eligible. Forty-three people were enrolled. Of these, 9 (21% of those enrolled) did not complete the baseline survey and so were not randomized. Twenty were randomized to the intervention, and 14 to the control group. Demographic characteristics are shown in Table 1.

Program Experience

Several people said that the incentive was too small; and many—particularly women—asked for the baseline incentive before they completed the online survey because they needed the money to buy mobile data for the survey. Technology issues also were noted. Some participants had phones

that could not open the survey link. Several also shared that the survey pages were slow to load. Program messages were inconsistently sent. For instance, some participants would not receive messages for days at a time; some would receive messages repeatedly or in a rapid cascade. Whether these challenges were due to our program software or the unstable mobile phone network in Uganda was unclear.

Feedback About the Program Messages

Example feedback is shown in Table 3. After the first week of messages, which introduced the ITG program and presented basic information about HIV/AIDS, participants were asked about the spacing of the messages. Most said that it was fine, although one person said they came too closely together, and another said that they were spaced too far apart. When asked about the number of messages sent per day, most also said that this number was acceptable, although several said that there were too many: “The number of SMS was sometimes too much, but the SMS were good.” When asked how the program could be improved, many said that they would prefer to be messaged from a phone number that was on the same carrier as they used (e.g., MTN). A couple of participants also suggested that being able to talk to study staff would be helpful (“provide a mechanism of how we can seek clarification in case we have not got clearly a specific sms”) or each other (“The messages are also timely and educative but I suggest we have room to discuss some of the information in a more objective manner”). Participants rated the week’s messages an average of 4.6 on a scale of 1 (“awful”) to 5 (“great”).

Week 2 messages, which discussed different types of sex and how they related to HIV risk, were deemed clear and helpful. When asked about which messages were particularly helpful, one mentioned the messages about masturbation (“Message about masturbation because I always thought it is harmful”), and another mentioned messages about the withdrawal method (“Yea this message of withdrawal method can’t prevent HIV and pregnancy. It was so helpful coz e I dint know dat”). Although most people said that there was not a message that was particularly unhelpful, two objected to the language used in the week’s messages (e.g., “SMS talking about how to use condoms” because there were some crude words eg penis entering into the mouth and others.”). The week’s messages were scored an average of 4.2.

Week 3 messages focused on obtaining, carrying, and consistently using condoms. Many participants said that the messages gave them ideas about where to keep condoms and strategies for remembering to replace them periodically to ensure the condoms are still fresh. The messages also helped norm the idea of carrying condoms all the time: “Yes because I learnt that I dont need a reason to carry a condom,” one participant shared. Again, participants expressed

Table 3 Weekly feedback from beta test participants

Week 6 Questions	On a scale of 1 (strongly disagree) to 5 (strongly agree), how much do you agree: ITG taught me how to make healthier sexual decisions	This week was all about healthy relationships and communication with your partner. What did you think about the messages?	Was there a message this week that you really liked or did not like? If so, please tell me what the message was and how you feel about it	On a scale of 1 to 5, with 1 being 'awful' and 5 being 'great', how would you rate your experience with this week's messages?	What else would be helpful for me to know about your experience with the program this past week?
Participant 1	1	They were actually motivating and healthy			
Participant 2	5	The messages were so productive in teaching	Message about the body language because I didn't know the words and body can actually say opposite things	5	Some messages keep repeating themselves
Participant 3	5	The messages were extremely helpful and enlightening...they inspired me to have a beautiful relationship with my partner and gave me courage to make my relationship grow	I really liked the message on the things that create a healthy relationship for example trust because it made me reflect on my current relationship status and think of all the ways my partner and I trust one another. I was proud of myself!	5	This week's program messages have been very inspiring... it feels good knowing that on addition to the advice you still can do something on your own
Participant 4	5	They were very educative to me	Every message was educative to me	5	I got to More about a health relationship and dat not health
Participant 5	Strongly agree	Helpful	Communication building strongly in a relationship.	5	My feedback
Participant 6	Strongly agree	As usual they wea educative	This passive message I liked it Coze I fall in Datcategory		It helped me to know which category I fall in wen it comes in communication
Participant 7	Strongly agree		The message was about reading my minds was very interesting	5	The experience I got from this program the past week is to trust, how to be health in my relationship
Week 7 Questions	This week, we talked more about healthy relationships and communication with your partner. What were your thoughts about the messages?	What do you think about your ITG Peer? Have you tried ITGenie? What would be useful for me to know about either / both program features?	Was there a message from this week that was particularly helpful or interesting? Why?	On a scale of 1 to 5, with 1 being 'awful' and 5 being 'great', how would you rate your experience with this week's messages?	What else would be helpful for me to know about your experience with the program this past week?
Participant 2	The messages were good, I liked all of them	I have tried ITGenie and it works well	The message where the Lady says she is allergic to condoms was interesting because I didn't know anyone can be allergic to condoms	5	Interesting

Table 3 (continued)

Week 7 Questions	What do you think about your ITG Peer? Have you tried ITGenie? What would be useful for me to know about either / both program features?	Was there a message from this week that was particularly helpful or interesting? Why?	On a scale of 1 to 5, with 1 being 'awful' and 5 being 'great', how would you rate your experience with this week's messages?	What else would be helpful for me to know about your experience with the program this past week?
Participant 3	The messages were very informative and offered a lot to learn ITGenie is really helpful and provides very good messages but I have failed to talk to my ITG peer... we have not connected at all... maybe they should reach out	The messages on communication were very helpful because sometimes the way you communicate with your partner can render your relationship successful or not	5	This week's messages were rather few yet the topic was really sensitive so... it creates greater impact if the messages are more and about every aspect of the topic
Participant 4	I got to know what I didn't know in a relationship Dey a very educative	Yes, let us actions talk it was helpful to me	5	I acquired more skills and knowledge about the relationship, communication and how to use condoms
Participant 5	They were so helpful	Talking to the partner when you're ready to have sex	5	Feedback I think
Participant 7	Hello level 7	Yes I tried	5	
Participant 8	The sms were great!	I love the peer programme because it's user friendly though sometimes I have been having a busy schedule and failing to respond. However I have not tried ITGenie per day	5	Encourage other youth to join

the desire to talk with study staff about questions they might have about program content. Messages were scored an average of 3.7.

Week 4 talked about how to make sex both exciting and healthy, and also discussed aspects of healthy relationships. Several noted the messages about flavored condoms were helpful (e.g., “Yes flavored condoms a healthy and makes sex more exciting”) as were the messages about valuing each other in relationships (e.g., “Message about respect coz I didn’t know it has an attachment of valuing someone”). Messages were scored an average of 3.6.

Week 5 talked about reasons why some people choose to have sex or not and how to talk about what one wants sexually. On a scale of 1 (strongly disagree) to 5 (strongly agree), people agreed at an average score of 4.1 as to whether they were now more likely to use condoms because of the ITG program. Two participants mentioned that the messages about not rushing to have sex were helpful (e.g., “The one which says beautiful ladies cannot get extinct. Thus I shouldn’t rush.”). Others talked about feeling more empowered about when to say yes to sex and when they could say no to sex (e.g., “Yes the message on deciding to have sex with your partner in the event that the decision is yours and you feel ready and secure with him”). Multiple people noted that they were unable to talk to their ITG Peer, however. Several had used ITGenie, to mixed reviews. Messages were scored an average of 3.7.

Week 6 messages talked about healthy relationships and communication. Participants agreed (an average of 4.2 on a 5-point Likert scale) that ITG had taught them to make healthier sexual decisions. Participants mentioned that the messages discussing different types of communication (i.e., passive, active, assertive) and body language were helpful (e.g., “Message about the body language because I didn’t know the words and body can actually say opposite things”). The importance of relationships was also noted (“the experience I got from this program the past week is to trust, how to be health in my relationship”). Messages were scored an average of 4.1.

Feedback for Week 7 was similar to Week 6. At Week 8, which was the end of the core program, participants reported reading an average of 85% of the messages that week (range 70–95%). They also said they were very likely to recommend the program to other people their age (an average of 4.7 on a 5-point Likert scale).

Preliminary Outcomes

Of the 34 randomized participants, 27 (79%) completed the one-month post-intervention follow-up survey. One person actively dropped out of the program because they did not think they had enough time for it. Although the sample size was small, outcomes data were examined for general trends.

Preliminary analyses suggested that more youth in the intervention (93%, $n = 13$) than those in the control group (77%, $n = 10$) reported being tested for HIV since they enrolled in the program ($p = 0.24$). All 23 said that their HIV test was negative. Similar trends were noted for STI testing: 36% ($n = 5$) of those in the intervention versus 23% ($n = 3$) in the control group report being tested for STIs since the beginning of the study ($p = 0.47$).

Fourteen youth said that they had had penile-vaginal sex since the beginning of the program, nine of whom also provided the number of sex acts and times they used condoms (four in the intervention and five in the control group). Similar numbers in the intervention ($n = 2$, 50%) and control ($n = 2$, 40%) groups reported having at least one condomless sex act since the beginning of the study ($p = 0.76$).

Integrating Findings Back into the Protocol for the RCT

To reduce the burden associated with the online survey, we compressed it so that it was faster to load and would use less mobile data. We also assisted participants in downloading the Mozilla Firefox application on their phones, as we found that the survey performed best on this browser. We also matched participants to study phone numbers that used the same mobile carrier as they had.

To determine whether the problems with receiving text messages were related to our software or the mobile network, we contracted Yo! Uganda Limited, a local text messaging gateway service, to help send program messages during the subsequent RCT.

Discussion

The use of text messaging to deliver behavior change content, including HIV preventive behaviors, is gaining popularity in sexual health research. Indeed, a recent meta-analysis found 35 RCTs evaluating text messaging-based prevention, detection, treatment, and knowledge outcomes for STIs, including HIV [22]. Eighteen of these 35 studies were conducted in developing economies, including Botswana, Brazil, Cameroon, Kenya, Mozambique, Nigeria, South Africa, and Uganda. Most ($n = 13$) focused on HIV-positive populations, and most ($n = 15$) were focused on appointment or medication adherence. Of the three behavior change programs, two focused on increasing HIV testing rates, and one on uptake of circumcision. Another recent systematic review identified 25 digital media interventions promoting adolescent sexual health [23]. Of these, three were tested in developing country settings, all of which were Internet-based. Thus, we believe In This toGether is the first text messaging-based HIV prevention program that delivers comprehensive

content for eight weeks, with the aim of increasing older adolescents' condom use and STI/HIV testing in a developing country setting. It also is one of the few interventions that has been developed at the national level in sub-Saharan Africa. Findings from the iterative development process provide useful lessons learned for other interventions delivered similarly and to older adolescents, and highlight the utility of engaging the target population in the development process.

The initial FGs confirmed that the intended study components, including the ITG Peer feature that has been used in developed countries [17, 24, 25], would be acceptable. Participants also shared their experiences with dating and having sex, which were then integrated directly into the program text messages. Online FGs are useful not just in illuminating the sexual decision-making of the target population, but also in providing 'voice' that can be integrated directly into program messages. This likely increases the salience of the content for those for whom the intervention is intended.

The CATs were useful in identifying specific messages, as well as topics more generally, that were confusing to older adolescents and required more attention. Messages that discussed masturbation and oral and anal sex were particularly sensitive; at the same time, some people noted them to be of interest. This difference in perspective was replicated among beta testers, some of whom appraised them neutrally, and some of whom appraised them to be uncomfortable. In this latter development step, even when people deemed the content to be difficult to engage with, no one dropped out of the study as a result. This is especially notable given that the sample included both sexually experienced and inexperienced youth. Thus, even if topics are viewed as objectionable or unexpected, these topics may nonetheless be important to include in sexual health programs and can be done so alongside acknowledgements that the information might make people uncomfortable. The strong beta test retention rate also suggests that, contrary to local norms that may discourage conversations about sex, older adolescents in Uganda—both those who were abstinent and those who were sexually active—appreciated their need for sexual health education.

The beta test also affirmed that older adolescents were willing to enroll—and stay enrolled—in an intensive text messaging program. Importantly, technological fatigue did not appear to be a problem—in the last week of the 'core' program (week 8), participants read an average of 85% of the messages. Moreover, that almost four in five participants provided data one month post-intervention end, six months after they enrolled in the RCT, suggests that measurement of intervention impact is feasible. The intensive formative work conducted in the focus groups and CATs to ensure that the program was salient appears to have resulted in consistent

participant engagement for those who beta tested the eventually developed intervention.

Some may wonder why ITG sent so many messages over a relatively short period of time (compared to delivery for an entire school year, for example). Both the intervention length and intensity were similar to mHealth sexuality programs developed in the United States for sexual minority teens [17, 26]. Another mHealth healthy sexuality program, All Youth Engaged!, was developed as an adjunct to an in-person program and included 5–7 messages over a 6-month period [27]. Keep It Up!, a well-studied online HIV prevention program for sexual minority boys that was also developed and tested in the United States, includes seven modules and one 3- and 6-month booster sessions, respectively [28]. Assuming users of Keep It Up! complete one module a week, ITG's 2-month length is in line with these other text messaging- and Internet-based HIV prevention programs. We believe that intense daily messaging is needed to affect the similar amount of knowledge transfer as is possible in a weekly in-person intervention. While the number of messages sent daily appears acceptable, future endeavors could explore whether a longer intervention period and perhaps one that included fewer messages each day would be more acceptable or better affect sustained behavior change.

The FGs and CATs were conducted online whereas the beta test was conducted via text messaging—except for the research assessments, which were conducted online or over the telephone. Given the high level of staff outreach needed to affect the completion of online research activities as compared to the lesser support needed for the text messaging program, which mainly occurred when features did not appear to be working, text messaging may be a more feasible mechanism through which research activities can be implemented in Uganda. This is perhaps because mobile data to facilitate connection to websites is expensive whereas text messages are received for free. Future intervention research should consider integrating text messaging components instead of online components where feasible and relying on other methods when not (e.g., telephone one-on-one interviews rather than online focus groups). Furthermore, activities that are web-based should have higher incentives to better offset the cost of connecting to the Internet for participants.

Important process-related lessons were also learned. Although women are typically easier to reach and engage in research in both developed [29–31] and developing countries [32], men were easier to reach and engage across all intervention development steps here. Based upon the observation that women in the beta test were more likely to request the incentive before completing the baseline survey in order to purchase sufficient data to do so, this difference may be economic: As noted above, although receiving text messages is free in Uganda, going online—either to FB/IG, from where

people were recruited, or to the online survey assessments—requires Internet data. One recent study noted that paying for mobile phone data was one way in which men initiated relationships with young adult Ugandan women [33]. Similarly, lower income youth were harder to enroll. This may mean that research conducted in settings similar to Uganda that includes Internet components are better considered for male and higher income populations until technology becomes more affordable. Or, it may mean that researchers need to be aware of this divide and pay particular attention to recruiting these harder-to-reach populations, as is done for research involving disadvantaged populations in the United States.

More generally, the number of screeners received for each research activity suggests that there is strong interest in HIV prevention programming among older adolescents, both sexually active and abstinent, in Uganda. Importantly too, social media—particularly IG/FB—appear to be feasible methods to reach and engage older adolescents across this sub-Saharan country.

Limitations

Findings should be interpreted within the study's limitations. Notably, the participation rates for the FGs and CATs were suboptimal. Although a variety of views were expressed and saturation was reached in the FGs; and sufficient feedback was received in the CATs such that older adolescents' reactions had been collected for all proposed text messages, it is possible that attrition was related to being too busy (e.g., because someone had a job) or economics (e.g., because someone lacked the money to pay for the data needed to take part in the online research activity). If this was the case, then the data collected may under-represent the views of people of lower socio-economic status. Related, until the cost of technology becomes more affordable in Uganda, cell phone-based programs that are implemented at the national level—particularly those that have Internet components—will likely be skewed towards higher income populations. Of note, when we observed that fewer screeners were being received from youth in lower education categories, we were unable to find suitable alternatives to reach this group at the national level. Again, it seems that this either means that research implemented at the national level will necessarily skew towards men and higher income populations, or more equitably, that researchers will need to pay particular attention to recruiting these harder-to-reach populations until the technology divide narrows. Finally, although English is an official language and the language used in schools [34], there are 40 indigenous languages in Uganda [35]. Given the pilot nature of the work, the intervention was developed in English. This likely skewed access to educated populations.

Future efforts should explore the possibility of adapting the intervention to other languages, particularly Luganda, which is the most widely spoken language in Uganda.

Conclusion

Results from this iterative development of In This toGether suggest that a text messaging-based HIV prevention programming that is intense (i.e., 5–11 messages per day) and extends for two months, is both feasible and acceptable to 18- to 22-year-old Ugandans across sexual experience levels. The engagement of older adolescents at each step of the iterative intervention development process increased the likelihood that the final product would resonate with older adolescents across the country and likely contributed to the high retention rate in the beta test. As mobile phones become more ubiquitous in settings such as Uganda, additional efforts to reach and engage this population using text messaging and mobile phones appears warranted.

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