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ORIGINAL PAPER

Streaming Weekly Soap Opera Video Episodes to Smartphones in a Randomized Controlled Trial to Reduce HIV Risk in Young Urban African American/Black Women

Rachel Jones · Lorraine J. Lacroix

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Abstract *Love, Sex, and Choices* is a 12-episode soap opera video series created as an intervention to reduce HIV sex risk. The effect on women's HIV risk behavior was evaluated in a randomized controlled trial in 238 high risk, predominately African American young adult women in the urban Northeast. To facilitate on-demand access and privacy, the episodes were streamed to study-provided smartphones. Here, we discuss the development of a mobile platform to deliver the 12-weekly video episodes or weekly HIV risk reduction written messages to smartphones, including; the technical requirements, development, and evaluation. Popularity of the smartphone and use of the Internet for multimedia offer a new channel to address health disparities in traditionally underserved populations. This is the first study to report on streaming a serialized video-based intervention to a smartphone. The approach described here may provide useful insights in assessing advantages and disadvantages of smartphones to implement a video-based intervention.

Keywords Cell phones · Smartphones · HIV prevention in women · Streaming video and HIV prevention · Soap opera video to reduce HIV risk · ACASI

Introduction

The infection rate for human immune deficiency virus (HIV) is 15 times higher for Black women when compared to women who are white and over 3 times the rate for Latinas [1]. Infection with HIV is among the top 10 leading causes of death in African American/Black women and girls, aged 10–54 [1]. In this regard, findings which indicate that contemporary urban women's sex scripts promote unprotected sex as a means to fulfill a range of relationship needs [2–5] are of particular concern. Unprotected sex with an infected male partner accounts for 90% of HIV transmission in 13–24 year old women, and 87% in 25–34 year old women [6]. By following sex scripts that adhere to stereotypical gender expectations, women's freedom to envision and explore choices, including condom use and partner choices, is limited [7, 8].

For these reasons, *Love, Sex, and Choices*, a 12-episode soap opera video series, was created as an approach to reduce HIV sex risk in urban women. The series portrays four archetypical female characters who face relationship dilemmas that involve high risk situations with male partners. Sexual health promotion messages are woven into familiar, emotion-laden contemporary sex scripts as an alternative to otherwise normative high risk sex scripts**.** The effect of the video series on women's HIV sex risk behavior was evaluated in a randomized controlled trial (RCT) conducted in a community sample of 238 high risk, predominately African American/Black young adult women in the urban Northeast. The video intervention was compared to 12-weekly, text-based HIV risk reduction messages.

In order to provide convenient, on-demand access to *Love, Sex, and Choices*, and to facilitate privacy and portability, the weekly video episodes were streamed to study-provided smartphones held by participants. A mobile phone platform was conceptualized and constructed to deliver the weekly video or text-based messages to the smartphones, track intervention fidelity, and facilitate attrition reduction. As of this writing, evaluation of the

R. Jones (✉) · L. J. Lacroix
College of Nursing, Rutgers,
The State University of New Jersey, Ackerson Hall,
180 University Avenue, Newark, NJ 07102, USA
e-mail: racjones@rutgers.edu

technology component of the study is completed. This is the first study to date, to report on streaming video to deliver a serialized video-based behavioral intervention on a smartphone.

Background

Smartphones and Mobile Internet Access Signal a Paradigm Shift

Computer mediated interventions designed to reduce HIV risk behavior have been favorably compared to human facilitated interventions [9–11]. A smartphone is a cell phone with Internet access and built-in applications such as email, web browsing, audio, and video players [12]. Since smartphones are taking on functions of a computer [13], an inquiry into the role that smartphones can play in delivering an intervention is a logical progression. This is particularly the case since the trend toward smartphone use is accelerating [14–16]. Sales of smartphones are predicted to outgrow that of personal computers, notebooks, and netbooks internationally [14]. According to the Pew Institute, 83% of all adults in the United States (US) own cell phones, 43% of whom use a smartphone. African Americans are more likely to own a cell phone than those who are white [15], and smartphone use among all African Americans and Latinos has grown to 44% [17]. Additionally, African Americans and 18–29 year old young adults lead in the use of cell phone applications [15]. Among 18–29 year old cell phone users, 40% have watched a video on their phone [15]. As of 2010, African Americans were statistically significantly more likely to watch video on their cell phone, access the Internet, and send or receive text, than whites [15].

The convergence of innovation in mobile technology and the rapid pace for which mobile devices have been adopted has forced a paradigm shift in normal global information and communication [14]. Wireless Internet access is rapidly becoming the choice of Internet access in the US. The trend toward increased wireless Internet access from 2009 to 2010 was highest among African Americans, who are less likely to have broadband Internet access at home [16], and among those with household incomes of less than $30,000 annually [15]. Sixty-four percent of African Americans access the Internet from a laptop or mobile phone [15] suggesting that wireless access may be a substitute for a home broadband connection [18]. Similarly, adolescents from lower income households are more likely to access the Internet using smartphones than personal computers (PC) [19]. Together, these developments suggest a break-through in the capacity to deliver health promotion on mobile devices to traditionally underserved populations.

Cell phones have been employed for a range of telehealth applications [20, 21]. To date, most studies concerned with health promotion [22–25] have utilized short message service (SMS) or texting. Additionally, short video messaging has been studied to reduce HIV risk [26] and promote smoking cessation [27, 28]. Ongoing expansion of smartphone functionalities, high speed networks, and advances in video compression have created the conditions to stream entertaining videos at television quality to smartphones, and other handheld devices [29, 30].

Entertainment–Education (EE) and the Soap Opera

Videos have been shown to be an effective medium to communicate HIV risk reduction and to promote sexual health [31–34]. Young adults are increasingly exposed to multimedia in the form of videos and computer games [35]. Video falls within the genre of EE [36] when it is purposefully designed to entertain and communicate prosocial norms and behaviors.

In particular, a soap opera serial drama with a behavioral message can resonate with audiences [37, 38] and increase attention to these messages by evoking intense emotion [39]. High emotion stimulates audience involvement with the characters and leads to parasocial interaction, meaning, the audience relates to and becomes involved with the characters [39]. Parasocial interaction has been found to play a role in diffusing an innovation [39]. Regular viewing also enhances viewers' identification with the lead characters. The viewer assesses the advantages and disadvantages of various actions, engages with the story, discusses the storyline and feels more involved [40]. The soap opera format was used to promote mammography screening among Latinas [41]. In collaboration with the CDC, the soap opera, *The Bold and the Beautiful,* carried a subplot concerning HIV/AIDS. During the story, the National STD and AIDS hotline number was displayed and caller volume overwhelmed the Hotline [42].

The EE approach has gained popularity internationally [39, 43]. A study conducted in Tanzania to evaluate a radio soap opera to promote contraception through a highly dramatic and emotional storyline, demonstrated a statistically significant increase in contraceptive use in the broadcast area compared to a control area [39]. An increase in condom use and reduction in the number of sex partners were also demonstrated [44]. A television soap opera concerning autoimmune deficiency syndrome (AIDS) in Côte d'Ivoire showed that men and women who watched ten or more sessions were respectively 2.7 and 1.4 times as likely to use condoms compared to those who did not watch. Findings demonstrated a dosage curve, with greater

effects after viewing 10 episodes [45], indicating the need for repetition and story development. Rogers [46] suggests that soap opera videos via the Internet show promise because of the capacity to utilize multimedia, but have yet to be studied. To date, a soap opera series has not been streamed to a smartphone as an approach to promote health.

Theoretical Framework of the Intervention: Sex Script Theory and the Theory of Power as Knowing Participation in Change®

Colloquial sex scripts are a source of implicit knowledge about how to behave in situations that could involve sexual intimacy. A sex script is shaped by the environment in which a person lives, by a person's view of her or his own sexuality and by how a dyad interprets and improvises the script [47, 48]. High risk sex scripts may be triggered by emotional cues in a process involving implicit memory [49, 50], for example, engaging in unprotected sex to hold onto a male partner as a reaction to perceived threats of losing him [3, 4].

The Theory of Power as Knowing Participation in Change® means being aware of what one is choosing to do, feeling the freedom to act intentionally, and being involved in creating the changes that one intends [51]. As described above, people participate in change, but their participation is not always in a *knowing* manner [52]. Based on previous content analysis of focus groups with young urban women, sex scripts were conceptualized in the current study, as either lower or higher power sex scripts [3, 4]. For example, in a lower power sex script, a woman envisions herself as "*having to satisfy her man*." Her choices are limited to "*doing what it takes to hold onto a man*" [4]. From the perspective of this framework, if women are more powerful, meaning, they are more aware of themselves as worthy of respect, make choices intentionally, feel freedom to pursue their intentions, and involve themselves in creating change, they are less likely to follow a lower power sex script of unprotected sex with a high risk partner.

A higher power sex script is a process of expanding awareness of one's own value as a woman, the recognition that there are choices in partners, sexual behaviors, and beyond; and engaging the will to pursue these choices [3]. Higher power sex scripts consist of intentional use of condoms or abstinence, "*Use a condom or you wont go with me*" [4]. Both lower and higher power sex scripts are germane and contemporary expressions among young urban women. In the video soap opera series created for the current intervention, sexual health promotion messages were woven into familiar, emotion-laden contemporary sex scripts as an alternative to normative lower power (high risk) sex scripts**.** Others have also called for reframing the familiar sex script [53]. Using the soap opera format, the stories were grounded in urban women's own life experiences so that women may identify with the heroine's process of change [31, 39].

To this end, we created, *Love, Sex, and Choices,* and evaluated the effect of the series on reducing HIV sex risk in young adult, urban women. In this article, we discuss in detail, the development of a mobile platform to deliver the 12-weekly video episodes and the HIV risk reduction messages; including the design of the intervention, formative research, technical requirements, development, and piloting. The main study is in progress and will be reported elsewhere. It is anticipated that this report will assist the reader in assessing the advantages and disadvantages of using a smartphone to implement a video-based intervention.

Methods

Participants and Data Collection

Data collection began after receiving approval from the Rutgers University Institutional Review Board. Women aged 18–29 who were in a sexual relationship with a male partner during the past 3 months were eligible to be screened. Participants were recruited to complete the screening interview at two public housing developments, two sexually transmitted disease clinics, a community center, a storefront, and a food pantry, all located in four nearby, contiguous cities with similar demographics: Newark, Jersey City, East Orange, and Irvington, New Jersey. Trained research assistants (RAs) who were undergraduate nursing students and women of color, and trained recruiters who were women recommended for their long-time commitment to youth, assisted with recruitment.

Screening Interview Using ACASI

The on-site screening interview was conducted using audio-computer assisted self-interview (ACASI) on six laptop computers and netbooks. A wireless local area network (LAN) was configured at each site so that multiple interviews could be conducted in privacy, and at the same time, if needed. The advantages of ACASI have been well documented [54–59]. These advantages include ease of use, particularly in those with lower literacy; a subjective sense of privacy and confidentiality, and more reliable reporting of private, potentially embarrassing, or illegal behaviors when compared to face-to-face interviews. For this study, Checkbox Survey Software®, a browser-based

program, was utilized to administer the ACASI. Data were collected concerning the number of partners, any perceived partner risk behaviors (sex with other women, sex with men, and injecting drugs), vaginal and anal sex and condom use, in order to assess the frequency of unprotected sex [60] with high risk partners. Items were asked in a partner specific context, considered to be a more reliable approach [61], for up to five sex partners during the past three months to facilitate accurate memory recall [60]. Data concerning sex scripts and sexual pressure were also collected.

There were several aides to recall, including piping in the name of the partner associated with each item, a calendar showing the past 3 months, and automated reminders of previous responses. Participants entered their responses by tapping on a touchscreen [59, 62] and the data were entered and stored in an offsite database located on the study server. The data were secured by encryption. Uploading and downloading data were also secured by configuring the web server system to use Hyper Text Transfer Protocol Secured (HTTPS). Communication between the web server and the database system was secure since both were on the same internal network. In addition, all the wireless routers situated at each data collection site were password protected. The servers were physically secured by keeping them in a locked office.

Individuals who met the screening criteria were invited to participate in the full 6-month long study. If eligible and interested, a second informed consent was reviewed and signed.

Screening Criteria for Inclusion into the Main Study and Randomization

An automated algorithm was programmed to categorize the level of HIV sexual transmission risk based on responses to the screening ACASI [59]. Only those who engaged in high or very high sexual risk, defined as having had unprotected vaginal or anal sex with a male partner perceived to have engaged in sex with other women, sex with men, or injecting drugs, were screened into the 6-month long study. The rationale for the screening criteria of high risk was to tailor the video intervention to those engaging in high risk behaviors. Previous findings indicate the importance of both message relevance and tailoring [31, 63–65]. Out of the 505 women screened for this study, 342 were eligible, 295 agreed to participate in the main study, signed consent, and were randomized by block randomization into one of the two condition arms: the 12-episode video series *Love, Sex, and Choices* or the 12-HIV health promotion messages. Of these, 238 received the treatment and attended follow-up assessments at 3 and 6 months.

The Intervention: *Love, Sex, and Choices* Soap Opera Video Series

Formative Research

The soap opera concept was first tested in this research with the production of *A Story about Toni, Mike, and Valerie*. Based on the aforementioned content analysis of focus groups, the story was written by the principal investigator (PI) and a RA [31], and filmed by a filmmaker with professional actors. Results of a cross sectional study with a pretest–posttest randomized control group design, showed a statistically significant reduction in sex scripted expectations to engage in unprotected sex in the intervention group receiving *A Story about Toni, Mike, and Valerie*, when compared to a control group. This finding lent support for the current prospective, longitudinal study. The pilot study was conducted on small handheld computers [31]. Additionally, findings of a related study that involved tailoring the video content of *A Story about Toni, Mike, and Valerie* to the level of risk behavior categorized by the ACASI, indicated that there was no difference in acceptability between the large screen of a desktop or laptop to that of a small handheld computer with a 4.5″ screen, in completing ACASI and viewing the video [59]. This finding indicated that the small screen of the cell phone would be acceptable to view the soap opera videos.

The Current Intervention: Love, Sex, and Choices

This 12-episode series features four women; Toni, Diamond, Valerie, and Keyanna, and their constellation of relationship partners. *Love, Sex, and Choices* was written and scripted by the study team who expanded the themes that were presented in the successful and popular pilot video. The authentic situations, character, and story development were based on the content analysis and the theoretical framework of sex script theory and the Theory of Power as Knowing Participation in Change™. The series was filmed by the same filmmaker. There were casting calls and the actors auditioned for their roles. *Love, Sex, and Choices* underwent pilot testing in the target population, and was edited based on their feedback. The principles of reducing HIV risk were communicated through archetypal characters and high risk situations in relationships with men, and through the heroines' often realistic and difficult trajectory toward more powerful ways of relating [3]. Because of the need to develop the storyline and to allow enough time to assess behavior change, the series was divided into 15–20 min episodes per week that were streamed weekly for 12 weeks. The comparison group received messages in text that communicated HIV risk reduction based on HIV prevention science [66] and

written to conform with the theoretical framework. All participants accessed the videos or messages on the study-provided smartphones.

Evaluation of the Video on the Smartphone

Evaluation data specific to the video intervention group offered insight into the experience of watching the videos on the smartphone (for example, "How would you rate the quality of how the video looked on the cell phone?"). Data were also collected concerning technical performance (for example, "Did the sound and the video play at the same time?" and "How often did you have a problem with your connection….?"), and training (for example, "How often did you call for support for the issues that were not covered by the training session?") (see Table 1). The evaluation tool was developed in conjunction with the in-house technology team. The tool was pilot tested with the RAs, who were nursing students of similar demographics as the population, and in a group of four women from public housing who carried the smartphone for a week, viewed the videos, and provided feedback using the evaluation tool.

Technical Performance

The project director (PD) manually tracked the number and types of problems encountered by participants in the full sample since some of the problems concerned general smartphone use, such as, assistance with email, logging on, recharging the battery, loss, damage, and general questions on smartphone use (see Table 2). Other problems were specific to video streaming in the video intervention group. Participants contacted the PD using their personal phones, emailed using the study smartphone, or met the PD at the closest data collection site. Additional evaluation data concerning the frequency and duration of viewing the video were provided on the Helix™ Session Manager log.

Materials

Building a Mobile Platform for This Study

Streaming video requires higher bandwidth than texting [67] and involves implementing a platform that consists of several components to assure an enjoyable viewing experience. In addition to bandwidth, other considerations include: (1) the smartphone characteristics, including the operating system (OS) (i.e. Android™, Windows®, Blackberry®, or Apple®-based) [68], (2) the server operating system (i.e. Windows®, Solaris™), (3) the container format, (4) video codec, and (5) network protocol; as well as, 6) the playback environment, including the media player (i.e. Adobe®Flash, RealPlayer®).

Therefore, information technology (IT) specialists with experience in creating and streaming multimedia as well as in securing the data over a network were required for this project. The in-house university technology group served as the technical experts. Consultations were held with engineers from Verizon Wireless™, RealNetworks®, Microsoft®, and Motorola™. These consultations occurred on more than one occasion and were invaluable to troubleshoot and successfully develop the mobile platform. The advantages and disadvantages of streaming the video intervention to smartphones are shown in Table 3.

Criteria for Selecting the Smartphone

The team provided the smartphones for this study. Although recruitment into the study took place in four contiguous cities in the urban Northeast that were thoroughly covered by wireless networks, streaming to mobile devices under conditions with poor reception, such as the basements of large apartment buildings, could be problematic. Since this RCT was testing the effect of a theory and data-based soap opera video series intervention, the smartphone was an important extraneous variable that, if not controlled, could have contributed bias to the study findings, a concern at this stage of efficacy testing [69]. To control for this potential source of bias, smartphones were provided and returned after 12-weeks of use. The choice of smartphone was a key decision in developing the mobile platform. Since recruitment was ongoing, it was not necessary to purchase a full complement of phones. Those recruited at the beginning of the study returned the phones at 12 weeks. These phones were reset to factory settings in order to wipe out any personal data such as, photos, music, or videos. The phones were then recycled to newly recruited participants.

The criteria for selecting the cell phone were: A smartphone providing access to email and the Internet, a flexible month-to-month contract, reasonable costs for the phone and monthly plan, a large rectangular high resolution screen, an OS that allowed for flexible programming, highest available processing speed, long life battery, and a slide-out QWERTY keyboard so as not to take up screen space and to facilitate ease of logging on to the system. Somewhat of a moving target, the smartphone technology changed over the course of developing the platform. Several different phones were tested. The Motorola DROID™ A8255 with its large screen (3.7″) and Android OS was selected (see Fig. 1).

Considerations in Streaming Video, Selecting the Media Server, and Video Format

For the multimedia data streams to be useful when stored or transmitted, they must be grouped together in a

Table 1 Evaluation of the video on the cell phone ($n = 117$)

Item	*N*	%
Using the cell phone to watch the videos was:		
Not at all enjoyable	0	0
Not very enjoyable	2	1.7
Can't decide	2	1.7
Somewhat enjoyable	36	30.8
Very enjoyable	77	65.8
How would you rate the quality of how the video looked on the cell phone?		
Poor quality	6	5.1
Can't decide	10	8.5
Good-television quality	67	57.3
Very good-DVD quality	34	29.1
How difficult was it to use the cell phone in this project?		
Very difficult	0	0
Somewhat difficult	3	2.6
Don't know	1	0.9
Somewhat easy	8	6.8
Very easy	105	89.7
Using the cell phone helped me feel like I was watching the video in privacy		
Never	0	0
Don't know	4	3.4
Sometimes	0	0
Most of the time	25	21.4
All of the time	88	75.2
It felt good to be able to watch the video on the cell phone wherever I went		
Never	0	0
Don't know	5	4.3
Sometimes	1	0.9
Most of the time	19	16.2
All of the time	92	78.6
Would you participate again in a study that uses a cell phone to watch video?		
Definitely Not	0	0
Don't know	2	1.7
Maybe	3	2.6
Think so	13	11.1
Definitely yes	99	84.6
I would like to continue to watch the videos that you send on the cell phone		
Definitely not	1	0.9
Don't know	7	6.0
Maybe	2	1.7
Think so	10	8.5
Definitely yes	97	82.9
Would you tell your friends to try watching videos on the cell phone?		
Definitely not	5	4.3
Don't know	6	5.1
Maybe	5	4.3
Think so	12	10.2
Definitely yes	89	76.1
Technical		
Did the video come across choppy?		
All of the time	3	2.6
Most of the time	10	8.5
Sometimes	12	10.3
Don't know	52	44.4
Never	40	34.2
Did the sound and the video play at the same time? The video:		
Dragged behind the sound all the time	5	4.3
Dragged behind the sound most of the time	45	38.5
No, the video dragged behind sometimes	1	0.9
Played at the same time nearly always	28	23.8
Always played at the same time	38	32.5
How sharp did the video look on the cell phone screen?		
Barely could see the video	0	0
Not so sharp	10	8.5
Don't know	1	0.9
Good—almost TV quality	54	46.2
Very good—TV quality	52	44.4
The size of the screen was big enough to see the actors clearly		
Always or almost always too small	0	0
Sometimes	2	1.7
Can't decide	1	0.9
Usually	35	29.9
Always	79	67.5
How would you rate the battery life of the cell phone?		
Not adequate	0	0
Barely adequate	1	0.9
OK	26	22.2
Good	32	27.3
Very good	58	49.6
How often did you have a problem with your connection so you could not begin to watch the video?		
All of the time	1	0.9
Most of the time	8	6.8
Sometimes	2	1.7
Don't know	61	52.1
Never	45	38.5
How often were there video interruptions because there was no cell phone service?		
Often	3	2.6
Sometimes	30	25.6
Can't remember	34	29.1
Hardly ever	8	6.8
Never had interruptions	42	35.9

Table 1 continued

Item	*N*	%
Did you ever receive error messages?		
Yes	20	17.1
Don't know	82	70.1
No	15	12.8
If so, what kind of error messages?		
Connection timeout	2	1.7
Failure to connect	3	2.6
Server error	11	9.4
Other	4	3.4
How long did it take from clicking on the message to receiving the video?		
Very long time	0	0
Long time	1	0.8
Don't remember	20	17.1
Fairly short time	38	32.5
Felt like I clicked and it was there	58	49.6
Did you find it easy to access the video on the cell phone? When I clicked the link it was		
Always hard to find	0	0
Often hard to find	0	0
Sometimes hard to find	1	0.9
Usually easy to find	21	17.9
Always easy to find	95	81.2
Size of the buttons to move through though the webpages to answer your questions		
Very difficult	0	0
Somewhat difficult	4	3.4
Don't know	1	0.9
Somewhat easy	21	17.9
Very easy	91	77.8
Training		
How often did you call for support for the issues that were not covered by the training session?		
Often	1	0.9
Sometimes	17	14.5
Can't remember	10	8.5
Hardly ever	33	28.2
Never had to call for support	56	47.9
In general, how would you rate the training on the use of the cell phone?		
Not helpful	1	0.9
A little helpful	2	1.7
Can't decide	5	4.3
Somewhat helpful	19	16.2
Very helpful	90	76.9
How would you rate the training on when and how to charge the battery?		
Not helpful	1	0.9
A little helpful	3	2.6
Can't decide	6	5.1
Somewhat helpful	13	11.1
Very helpful	94	80.3
How would you rate the training on preparing you for watching the videos?		
Not helpful	1	0.9
A little helpful	1	0.9
Can't decide	4	3.4
Somewhat helpful	15	12.8
Very helpful	96	82.0

Video intervention group only

container format, such as, Windows Media®, Real Media®, Adobe® Flash, or Quicktime®. A video codec encodes a data stream for transmission or decodes it for playback [70] by compressing video characteristics into fewer bits. The correct codec is required to stream over the network. At launch time the fastest network was the third generation (3G) network. Because there are voice and video data streams, each may be handled by different programs, processes, or hardware. A codec may also use one of several international organization standards, such as MP4 or 3GP [70]. There are a variety of video codecs available that can create compatibility problems which may result in a poor viewing experience. Additionally, there are different network protocols to consider, such as, hypertext markup language (HTML), Real Time Streaming Protocol (RTSP), or Windows Media (MMS) [29].

Episodes of *Love, Sex, and Choices* were housed on the study dedicated media server and streamed to smartphones. After extensive testing with other media server software, Helix™ Media Server by RealNetworks was chosen for several reasons. It could stream video over the RTSP network, a network designed for use in entertainment, and it enabled controlled, on-demand delivery of audio and video [68]. The Helix™ Media Server provided the capability to control the playback functions on the DROID™ video player.

The challenge was to create a video format that produced the highest quality stream on the network with the least amount of audio and video degradation. Multiple attempts to find the best format resulted in the 3GP file format, similarly used by YouTube™, a popular video streaming website frequently accessed on mobile devices. The 3GP format is designed to decrease storage and bandwidth requirements for mobile phones [68]. This file format executed successfully during testing with Helix™ Media Server.

Table 2 Problems encountered, solutions, and the number of incidences reported while using the smartphone

Problem	Solution	*N* of incidences[a]
Problem accessing email		
Did not receive emails with link	Device was restarted, received mail after reboot	30
Email inbox was not synchronized with Gmail network	Changed email settings to automatically synchronize with the Gmail network	5
User accidentally deleted message	Resent email. Adopted a new procedure to "confirm delete" before a message could be deleted	39
Access was denied, because research team was in the midst of sending out weekly emails	Participant told message would be available after 1 pm	29
Video not streaming properly (asynchronous audio video or choppy video stream)		
Server stopped syncing	Server was reset on a weekly basis	72
Poor reception; <4 bars of service	Suggested to change location; problem resolved	17
Log-in problems	Reviewed directions. Provided username and password	56
Stolen phone	Team contacted Verizon to report the phone as stolen and to suspend the line	23
No network coverage, service was shut off	User put phone into Airplane mode (all connections turned off). Reinforced instructions on how to avoid airplane mode	11
Damaged phone		
Fluid or hardware damage	Reissued a new phone; reviewed instructions on care	21
Previous user damaged phone	PD met with participant to reissue another phone	19
User set a password on the phone, and now locked out of phone—attempted to access several times so the phone locked and only PD could access	The PD unlocked the phone and advised the participant not to lock the phone or select a memorable password	33
Can't charge phone—lost charger	Issued a replacement charger	25
Battery not charging	Replaced battery	11
Phone won't charge	Damaged the USB Port	9
Forgot how to re-watch episode	Resent link to re-watch the videos	16

[a] *N* is the number of calls, emails, and/or texts to research team regarding problem

Helix™ Session Manager

The decision to stream video instead of installing an application locally on every smartphone was based on study requirements. Streaming video provided more control in that it assured that each video episode would be viewed in sequential order and that future videos could not be accessed until the following week. By streaming the videos, the team could track which episodes were watched and re-watched. All participants in the video intervention group were encouraged to re-watch videos as often as they wanted. Similarly, comparison group members were encouraged to access their written messages as often as they liked, anytime. Using the Helix™ Session Manager, the start and stop time was logged whenever a video episode was watched, providing data to support intervention fidelity (see Table 4).

Unlimited Data Only Plan

To reduce cost, the phone plan was restricted to data only so that incoming and outgoing phone calls and text messages were blocked. The cost of downloading applications was controlled since charges would be incurred against the user's credit card. Downloading applications was discouraged since these could drain the battery. Participants were free to use the phone to access personal email accounts, surf the Internet, access Facebook® and Twitter®, and take photos and videos. The assumption was that by enjoying the phones, participants would be more likely to carry the phones and complete participation in the study.

Participant Email Accounts

The DROID™ smartphones were preloaded with Google mail (Gmail™). The email settings contained the link so that the uniform resource locator (URL) could be clicked by a participant to access the weekly video or message. The Gmail™ accounts were created in advance. All email addresses were formatted the same, except for the sequential number, womens.project.user###@gmail.com. The research team also used this email address to communicate with the participant.

Table 3 Streaming weekly 15–20 min-long episodes of *Love, Sex, and Choices* to a smartphone: advantages and disadvantages

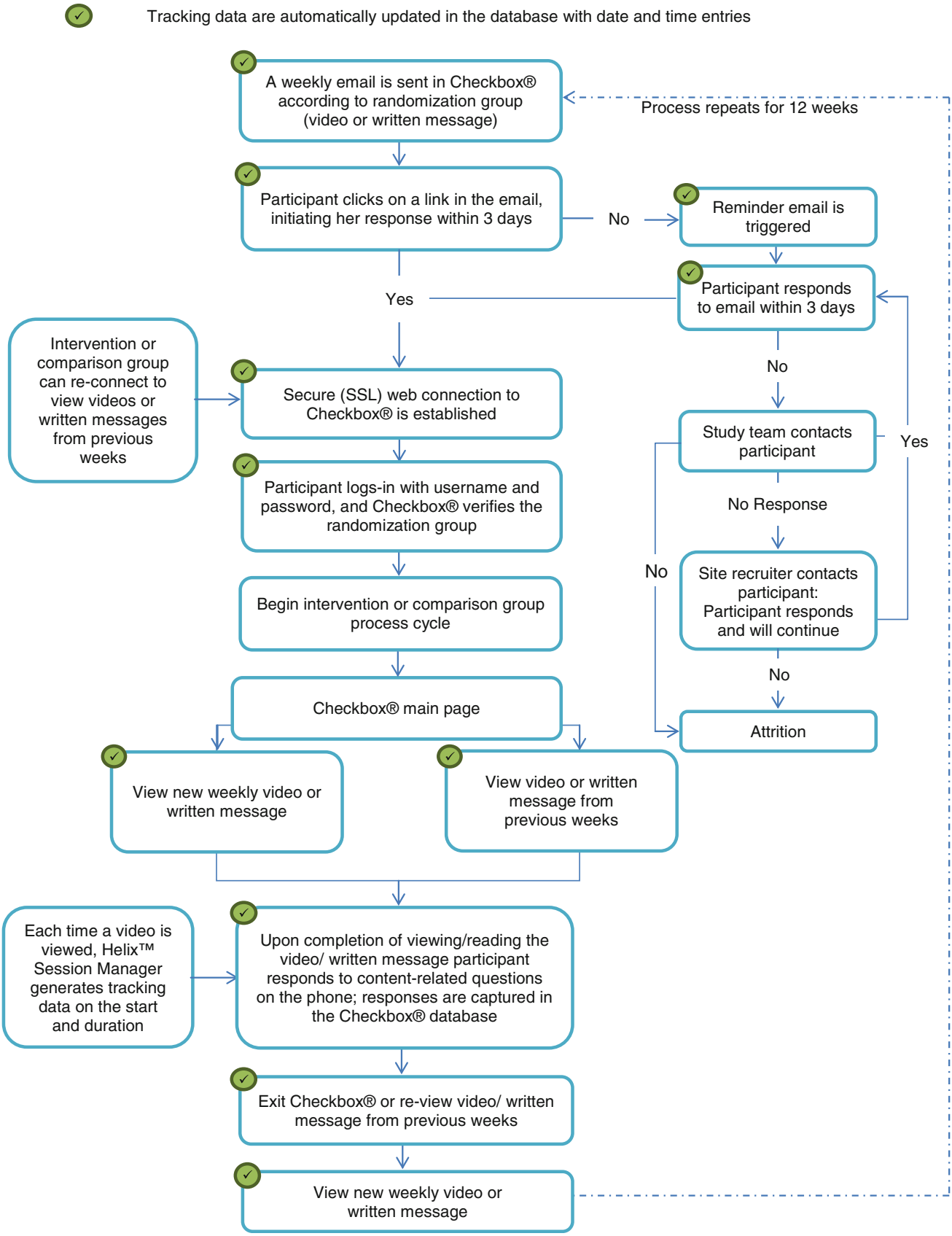
Advantages

- Participant can access the video intervention in privacy
- A smartphone is inconspicuous and portable; may be concealed in a pocket
- Participants can watch videos one or more times, on-demand
- A smartphone provides a mobile connection to the Internet, social networking, and email. Quick and easy access to the Internet for social networking increases the likelihood of carrying and using the phone for the study
- The Information Technology Specialist can troubleshoot problems and implement corrections from the server, unless the problem is with the individual smartphone
- Study team can communicate with a participant via email
- By assigning a unique static Internet protocol (IP) address, the team can track who accessed the video and written message, providing data on treatment adherence and unauthorized use
- By using a third party software (Helix™ Session Manager) the study team can track that an episode was watched, the length of time it was watched, how often and for how long an episode was re-played
- Available, cost effective month-to-month data only plan
- Standardizing the intervention assures that each participant receives the same intervention as a function of internal validity
- Inexpensive to use once it has been developed

Disadvantages

- Lengthy, potentially costly investment in the development phase
- Requires planning for extensive staged pilot testing, feedback, revision, and re-testing before launch
- Monthly phone carrying charges
- Moderate risk of phone loss: damage and theft
- Occasional asynchronous audio and video streaming of 20 min episodes on a 3G network
- Training on care and use; including charging the battery and how to limit water damage

Fig. 1 Scene from an episode of "*Love, Sex, and Choices*" on the Motorola Droid™ smartphone


Tracking data are automatically updated in the database with date and time entries
A weekly email is sent in Checkbox® according to randomization group (video or written message)
Process repeats for 12 weeks
Participant clicks on a link in the email, initiating her response within 3 days
No
Reminder email is triggered
Participant responds to email within 3 days
Yes
No
Intervention or comparison group can re-connect to view videos or written messages from previous weeks
Secure (SSL) web connection to Checkbox® is established
Study team contacts participant
Yes
Participant logs-in with username and password, and Checkbox® verifies the randomization group
No Response
No
Site recruiter contacts participant: Participant responds and will continue
Begin intervention or comparison group process cycle
No
Checkbox® main page
Attrition
View new weekly video or written message
View video or written message from previous weeks
Each time a video is viewed, Helix™ Session Manager generates tracking data on the start and duration
Upon completion of viewing/reading the video/ written message participant responds to content-related questions on the phone; responses are captured in the Checkbox® database
Exit Checkbox® or re-view video/ written message from previous weeks
View new weekly video or written message

◀ **Fig. 2** Checkbox® Survey Software was used to send weekly emails that contained a link to either the video for the intervention group or the written HIV prevention message for the comparison group. Clicking on the link brought the user to the study server website. The survey software indicated whether the message had been opened. If the email was not opened, or the video or written message was not accessed, the participant would be contacted. Specific to the video, the Helix™ Session Manager tracked onset and duration of viewing

Static Internet Protocol (IP) Addresses to Authenticate Users

The Helix™ Media Server was set-up to authenticate users according to the IP address of the smartphone. Therefore, per our request, Verizon™ assigned static IP addresses to the phones. Using this approach, the database would indicate whether an IP address from a smartphone assigned to a member of the text group had logged-on to access an episode of the video. Similarly, foreign IP addresses were blocked, as was access from a wireless network (WiFi).

Procedures

Weekly Email Messages

Checkbox Survey Software®, was used to send weekly emails. Using Checkbox®, each participant was sent an email message via Gmail™ every Monday to the assigned phone. The emails were dispatched to participants based on their group assignment (intervention vs. comparison) and the week of participation (one through 12). The emails contained links to the video intervention or the written message. Data in Checkbox® indicated whether and when the message had been opened. The participant could not progress to the next video or message until the previous one was completed. However, each participant could review any previous video episode or message any time. This 24/7 access gave participants the flexibility to view their messages at their own convenience. As shown in Fig. 2, if the message sent at the beginning of the week was not accessed, a follow-up reminder email was sent in 2 days. If a participant did not respond, she was called or texted at her contact number or contacted by the local recruiter. The reminder emails and calls, depicted in Fig. 2 as part of the attrition reduction plan, were highly effective as indicated by adherence to picking up the messages and logging onto the video or written message.

Watching and Replaying Different Versions of the Video Episodes

Each episode of *Love, Sex, and Choices*, had four versions. Version A was the original video that was linked to the weekly email. On Version A the team had inactivated the fast forward button to prevent fast forwarding through an episode. Immediately after watching Version A, the participant was asked "*Do you want to watch the video again?*" If she did, she was asked to select a reason (for example, "*due to a household interruption"*) and then watched Version B. If after viewing an episode, a participant answered 2 out of 3 content-related questions incorrectly (as described in the next section), she watched Version C. Version D was elective re-watching after she completed the video and questions for the week. All versions were exactly the same except Versions B through D had all the play-back controls available (pause, rewind, and fast forward).

Content Related Questions Completed on the Smartphone After Each Episode

Upon completing each episode, participants responded to three content related questions (such as, "*Who was Valerie messing with?*"). The number of correct responses (two out of three) provided further evidence that the episode was watched. One question was asked after the written message for the comparison group. Participants entered their responses by selecting their answer on the phone touch-screen or by using the navigation button on the keyboard.

Training on How to Use the Smartphone

Individual training was conducted after the participant completed the screening and baseline surveys. The PD conducted a 15-min long, face-to-face individual training in order have the opportunity for a hands-on practice session and to encourage questions. An instruction manual that had been developed by the PD was reviewed during the session. Included, was how to operate the phone, access the emails, trouble shooting tips, and the procedure to follow if the phone was damaged, lost, or stolen. On the back cover of the manual, the label with the participant's assigned username and password was affixed. Instructions also included returning the phone at the 3 month interview and that an honorarium would be provided at that time. Every participant was provided contact information and encouraged to contact the PD by phone, text, or email. However, participants often returned to the recruitment site the following week if they had concerns. It was stressed that the video or message should not be shared with other people. The value of their participation in contributing to knowledge about women's health was stressed.

Internal and Pilot Testing

Internal and pilot testing was ongoing over several months. Each time a component changed, all aspects of

the platform required testing. A 20-min video clip was tested in various file formats. Testing was performed at different times of the day to assess the effect of traffic within the wireless network that could affect video streaming and in different types of environments, such as basements. The 12 episodes were converted from raw video formats to the final 3GP.

After preliminary testing by the IT team, four RAs who were undergraduate nursing students of similar demographics as the target population were asked to bring the cell phones with them to their homes in urban environments for 5 days. For the purpose of testing, emails were sent daily with the URL embedded in the note, in order to click and access the video stream. The results indicated several problems with asynchronous audio and video, choppy video, and freezing. In addition, two of the RAs reported that some of the questions asked after the video were confusing and required editing. Data from the pilot test indicated that most videos were streamed late at night (55%) followed by the afternoon (37%). All four reported that the phone was easy to use. Three of four reported that the training was helpful.

Based on the results, further adjustments to buffering were made and the questions were edited. Next, four women who lived in an urban public housing development tested the phones for 6 days. Two video episodes were streamed daily for 6 days according to the procedure described above. Two of the four women reported that video occasionally dragged behind audio. As a result of the pilot test, further adjustments were made. All reported that it was very enjoyable to watch the video on the phone. Most videos were streamed during the late night hours (60%) followed by the afternoon hours (20%). Three of the four found the training to be helpful and the phone easy to use. Finally, a meeting was held with local recruiters from each site who advised that a label be placed on each phone that read "Property of Women's Project" to allay a partner's suspicion of how the participants came to carry the phone.

Implementation

After screening and consenting to participate in the 6-month long study, the participant was assigned the cell phone for the duration of 12 weeks. To protect the phone, each phone was encased in a Body Glove® protective case, and a screen protector on the display. Also issued were a charger, headphones, and the aforementioned instruction manual. Randomization was performed after leaving the recruitment site by the PD who was blinded to the group assignment. Participants were randomized to study arms in blocks of size 4 and 6. The size of each block was randomly determined.

Results

Sample Description

This was a high risk sample of 238, 18–29 year old urban women, with a mean age of 22, who had been screened into the study based on criteria of unprotected vaginal or anal sex with a male partner whom they perceived to have engaged in a risk behavior. The majority of the sample was African American ($n = 210$, 88.2%), the next largest group was Latina or Caribbean ($n = 19$, 8%). Most ($n = 147$, 61.8%) were unemployed. About one-fourth ($n = 62$) completed 11th grade or less. Eighty-six (36%) completed 12th grade, and 78 (32.8%) completed 1 or 2 years of college. Just over half the sample ($n = 135$, 57%) did not have children, 67 (28.3%) had one child, the rest had two or more children. Nearly the entire sample ($n = 220$, 92.4%) provided a cell phone number as the primary method of contact.

Nearly the entire sample ($n = 235$, 98.7%) engaged in unprotected vaginal sex and 105 (44.1%) had unprotected anal sex with a male partner they perceived to engage in sex with other women. Of those who perceived their male partner to have engaged in sex with men, 69 (29%) engaged in unprotected vaginal sex, and 49 (20.6%) had unprotected anal sex. Of those who perceived their male partner to inject drugs, 62 (26%) engaged in unprotected vaginal sex, and 41 (17.2%) had unprotected anal sex.

Using the Smartphone to Watch the Videos: Evaluation by the Video Intervention Group

Results reported here concern the evaluation of the mobile platform to deliver the 12-video episodes. Nearly all the 117 participants in the video intervention group enjoyed watching the video on the cell phone ($n = 113$, 96.5%), thought it was easy to access the video ($n = 116$, 99.1%), thought using the cell phone for the project was easy ($n = 113$, 96.5%), thought the video looked sharp on the screen ($n = 106$, 90.6%) and thought the screen was big enough to see the actors clearly ($n = 114$, 97.4%). Nearly all ($n = 113$, 96.6%) reported that using the cell phone made them feel like they were watching the video in privacy, and that it felt good to watch the video on the phone wherever they went ($n = 111$, 94.8%). Most wanted to continue watching the videos on the cell phone ($n = 107$, 91.4%), would participate in a study to watch the videos on a cell phone again ($n = 112$, 95.7%) and would tell their friends to watch the videos on the phone ($n = 101$, 86.3%). Training on how to use the phone was rated as helpful or very helpful ($n = 109$, 93.1%). Results of the evaluation of the streaming video, cell phone use, and training are reported in Table 1.

However, 45 (38.5%) of the 117 in the video group indicated that the sound dragged behind the video most of the time, and a few ($n = 5$, 2.1%), all of the time. In order to assess whether the occurrence was brief in a scene or disruptive to comprehension, the team reviewed the Helix^{TM} Session log.

Since, the study was designed to allow participants to re-play an episode with the playback controls, the logs would show which version of the episode (B, C, or D) was replayed by each participant and for how long. Additionally, the team reviewed the survey data to determine whether responses to two out of three of the content related questions asked after the video were answered correctly. Both of these approaches would provide data to suggest whether or not the intervention was received as intended. Episodes 1, 2, and 11 were reviewed because these represented early and later progression through the intervention. Of the 50 who reported asynchronous sound and video, 23 watched episode #1 once, 14 watched twice, 11 watched three or more times. Only 2 watched half of the episode. Of note, 34 of the 50 (68%) answered the content-related questions for episode #1 correctly. For episode #2, most of the 50 ($n = 32$) watched the episode once, 12 twice, and six watched three or more times. This time, all but one answered the questions correctly. Similarly, for episode #11, most ($n = 33$) watched it one time, 9 twice, 6 three or more times, and 2 did not watch the episode in its entirety. Again, all but one answered the questions correctly. The study design also provided for participants who wanted to replay video version B to indicate the reason why they replayed. Version B of episodes 1, 2, and 11 was streamed a total of 36 times, but 41 reasons were provided (more than one reason could be provided). Thirteen (31%) of those instances were because the participant experienced a household interruption, eight (20%) of those instances was to check something that occurred earlier in the episode, twelve (29%) instances were due to a problem with the video, and eight a problem with the phone (20%). To corroborate further, when rating the quality of how the video looked on the cell phone, only 6 (5.1%) of the entire intervention group of 117 indicated poor quality, compared to 101 (86.3%) indicating good to very good DVD quality video. Finally, there were no statistically significant correlations between reporting asynchronous video and sound with, "I would like to continue watching the videos" ($r = 0.01$, $p = 0.92$), and "Could watching the videos make it more likely that women will use condoms?" ($r = 0.03$, $p = 0.75$). Therefore, whereas, 50 reported problems with asynchronous voice and video, most replayed the episode and responded to the questions correctly, particularly after the first episode, suggesting many took the opportunity to replay and received the intervention as intended.

Data concerning the context of video viewing indicated that majority viewed when they were alone ($n = 104$, 88.9%) and that only 17 (14.5%) watched with friends or family most or all the time. Most never watched around their male partner ($n = 90$, 69.2%), some did a couple of times ($n = 20$, 17%). The majority viewed the videos on the smartphone at home ($n = 97$, 83%), and never or just a couple of times watched on the smartphone outside ($n = 108$, 92.3%). Therefore, most viewed the videos on the smartphone at home and in privacy.

Tracking Video Usage

The main purpose of the Helix^{TM} Session log was to determine whether the episode was viewed in its entirety. Results shown in Table 4 indicate the mean percent that each video episode was watched. These findings indicate that at most, only 1 or 2 participants of the 117 in the video group missed an episode, and nearly all the participants watched each episode fully once or more than once, meaning they replayed a scene or re-watched the whole episode.

Problems Using the Smartphone: Reported by the Intervention and Comparison Groups

Details for the numbers and types of problems that were reported to the team are shown in Table 2. Since the same participant may have experienced a problem more than once, the table describes the number of incidents, not the number of participants. On the server side, early in the study several participants called in describing problems with streaming video. The solution was to restart the server. On the user side, a common problem was misplaced log-in information that was addressed by contacting the PD. Participants would also unintentionally delete the email with the link to the video or text. This was addressed by the team setting the "confirm delete" feature ON. Additionally, some entered their own password to lock the phone and prevent access by friends or family. Then, if they made several unsuccessful attempts to unlock their phone, the phone was locked permanently. The PD would meet to unlock the phone and advise the participant to select a combination she would easily recall.

Lost, Stolen, and Damaged Cell Phones

The cell phones were used to deliver the intervention or comparison treatment to 238 participants for a total period of just over 1 year. At the start of the study, the inventory consisted of 161 phones. On completion, 55 were still in operating condition. An additional 47 were damaged but not repaired either because the repairs were too costly or

Table 4 Frequency of watching each video episode according to the percent watched: incomplete, once, or more than once

Episode	Incomplete		Once		More than once	
	N	%	*N*	%	*N*	%
1	5	4.2	80	67.8	33	28.0
2	8	6.8	81	68.6	29	24.6
3	3	2.5	92	78.0	23	19.5
4	9	7.6	92	78.0	17	14.4
5	6	5.1	87	73.7	25	21.2
6	4	3.4	95	80.5	19	16.1
7	1	0.9	96	81.3	21	17.8
8	3	2.6	104	88.1	11	9.3
9	0	0	101	85.6	17	14.4
10	7	5.9	96	81.4	15	12.7
11	5	4.2	97	82.2	16	13.6
12	5	4.2	105	89.0	8	6.8

$n = 118$ (one additional participant watched videos but did not attend the 3 month evaluation)

because the study was near completion. Three phones were lost. There were 56 phones reported stolen (30 in the video group, 26 in the text group). Of these, 48 were from those who received none or part of the treatment and were lost to follow-up. The remaining eight stolen devices were from those who contacted the study team with a credible report about the theft, and were reissued a phone in order to complete the study.

Discussion

This report describes the deployment of smartphones for use by a sample of 238 urban, low-income, young adult women who were predominately African American and who were at high risk for sexual transmission of HIV. In the intervention group, 117 accessed 15–20 min-long soap opera video episodes weekly for 12 weeks and responded to questions about each episode by entering their responses on the phones. The rest of the sample was randomized to receive written messages communicating HIV risk reduction on the phones.

By assigning a unique static IP address, the team was able to track who accessed the videos and written messages, as well as the length of time each video episode was watched. These data provided evidence of treatment adherence, as well as unauthorized access. Nearly all in the video intervention group enjoyed watching episodes of *Love, Sex, and Choices* on the smartphone, felt a subjective sense of privacy, and for the most part, viewed the videos on the smartphone at home and in privacy. They also appreciated the study related training. Monitoring by Helix™ Session Manager logs showed the episodes were rarely missed and most watched each episode once or more than once to replay a scene or re-watch the entire episode.

The smartphone, Motorola DROID™, was cutting edge technology at the time. The Droid™ was selected for the high resolution, wide rectangular screen and Android™ operating system, which facilitated programming. For the most part, the network was available and although some participants experienced asynchronous audio and video at times during streaming, data indicated that this did not seem to alter their comprehension or appreciation of viewing *Love, Sex, and Choices* on the smartphone.

Advantages and Disadvantages of Using the Smartphone

There were multiple advantages to using the smartphone. The phones were used to deliver the videos and the messages to the intervention and comparison group respectively, so these could be accessed at the participant's convenience and in privacy. The phones were also used by participants to respond to the content-related questions after each video episode. Using the Helix™ Session Manager, the start and stop time of watching the videos were tracked, so data were available to document that the intervention was delivered as intended. Both approaches served to support the internal validity of the study.

Further, the phone facilitated communication with the participant as part of the attrition reduction plan. When data indicated that a participant had not responded to her email and was falling behind in a video or written message, the attrition reduction plan was initiated (Fig. 2). A second email was sent, followed by phone call to the contact number. As others have found, reminder emails and follow-up calls are effective components of an attrition reduction plan [71].

However, there were also disadvantages to using smartphones (see Table 3). Most notably, a sizable number of phones were damaged or stolen. At the time of the study, video capable smartphones were not widely available. Although, nearly every participant owned or had access to her own cell phone, the use of personal phones for the study would have meant contending with variability in screen size and resolution, data plan, Internet access, and network coverage. The main purpose of the study was to test the effect of the videos on sex risk behavior. Standardizing the phone eliminated these potential sources of error. As future smartphone use and video streaming capability increase [15, 17, 72, 73], the need to rely on study provided smartphones to deliver a video intervention will be mitigated. However, disruption of wireless services through loss, theft, service cut-off,

and changing phone numbers will likely remain important considerations. Similar to our experience, a feasibility study in South Africa reported considerable turnover of cell phones [74]. A flexible timeline is advised in the event that there are temporary disruptions in phone service [25]. As a tool for communication, requesting alternate contact information and collaborating with local recruiters were found to be effective approaches when participants could not be reached by email. Finally, in addition to extrinsic motivation provided by an honorarium, the data indicated a high level of enjoyment in viewing the videos, suggesting intrinsic motivation to remain involved with the project.

Another disadvantage was the difficulty at times with asynchronous audio and video. Smartphone technology is moving toward networks with faster data speeds. Wireless carriers in the US have met the standards of the International Telecommunications Union (ITU) for the fourth generation (4G) technology, indicating that some of the wireless networks in the US are streaming data at speeds considerably faster than 3G [75]. With faster data transmission and 4G capable phones, the problems that occurred with asynchronous video will diminish.

An alternative to streaming video is to develop a phone application to run on the phone. An application can be programmed to send start-and-stop data back to the server database. Phone application development is a rapidly growing field. Currently, the average number of applications on smartphones is 27 [73]. However, smartphone applications utilize memory in a resource limited environment and connectivity remains a consideration [76] as does phone loss.

From Efficacy to Effectiveness [69]: The Future of Videos on Mobile Platforms

The requirements of this research to test a new approach of viewing a serialized soap opera video to reduce HIV risk behavior required a relatively homogeneous sample and care to standardize one of the most important technical variables, the smartphone. This was particularly so because of the complexities of streaming video that were relatively novel at the time. Glasgow et al. [69] describe this phase of research as efficacy testing, and argue for consideration of the effectiveness of the intervention, meaning how well can the effects of the intervention be generalized in the adoption phase when conditions are not well controlled and the technology is not standardized. Others have also recommended this approach [10]. There were core lessons in building the mobile platform for this study that can be generalized to an evolving wireless and technical environment. Further, there are ongoing trends that facilitate transferability.

Changing Solutions But Core Lessons Remain

The IT team were integral members of the research team. Although there were outside services available to accomplish platform development, the decision to work with the in-house technical team was based on talent, cost effectiveness, the preference to house the media and database servers on-site, and to secure the databases on the university internal network.

Similar to other efforts to develop an intervention on a computer-based platform [77], there was a steep curve in time and expense during the technical development phase. Internal and pilot testing were performed under assorted conditions and locations. When problems occurred that could not be resolved, engineers from, for example, Verizon Wireless™, or RealNetworks®, were consulted. As advancements in technical platforms continue to evolve, budgeting a realistic amount of development time to include internal and pilot testing in the population of interest will remain. This includes planning additional time to incorporate findings from pilot testing. Upon completion, there is a standardized intervention that can be widely distributed at low cost.

Greater Flexibility in Streaming Multimedia Means Expanding Opportunities for Health Promotion

Currently, a video intervention can be delivered in various formats, platforms, media environments, and wireless Internet-ready devices [68], meaning there is greater flexibility in streaming multimedia to various mobile environments [72]. The implication is that health promotion videos may be streamed on-demand from a website or a social networking video service, such as, YouTube™. Health promotion videos, such as *Love, Sex, and Choices,* may be presented as a miniseries, posted all at once, or periodically, and viewing may be restricted to private or wide-open access. For example, using YouTube™, one can create a playlist to play the episodes in order and individuals can post messages. The videos can be accessed on multiple devices, such as, computers, smartphones, and gaming consoles. Similarly, a miniseries can be streamed from a study team's website. Since data collection was completed, the study team has opened access to *Love, Sex, and Choices* for viewing by the full sample. Participants are accessing the video on their own devices. Additional programming was required to enable the server to detect the type of device and modify the video stream to that device.

With WiFi spaces available, access to *Love, Sex, and Choices*, and other video-based interventions can be more widely available without monthly carrying costs. Internationally, where electricity supplies may be expensive or

discontinuous and the cost of a PC prohibitive, Internet cafes offer the capability of having an email address and surfing the web over WiFi [78]. Others suggest that increased public access centers are needed to bridge the digital divide [79].

The implications of the findings concerning the acceptability of viewing the video series on the smartphone are limited to young adult women, particularly African American, in the urban Northeast. Accessing video on smartphones may present challenges in other populations, such as the elderly or those with vision deficits. However, the growing popularity of mobile technologies, together with increased capacity to deliver multimedia at a quality comparable to the wired environment, present investigators with new options to deliver innovative interventions to promote health via the smartphone. Additionally, since the effects of an intervention may attenuate over time [80] access on smartphones presents a viable solution to boosting the effect of the intervention.

Conclusion

This research represents the first effort to move a soap opera video series created as an intervention to reduce HIV risk, to a smartphone while providing a high quality viewing experience in privacy and with convenience. Video has the potential to increase the effect of an intervention because the viewer can be immersed in the multimedia experience, yet, the intervention is standardized, can be widely distributed, and access can be tracked. The approach described here may provide useful insights in assessing the advantages and disadvantages of using the smartphone and implementing a video-based intervention on a mobile device. As multimedia over wireless networks continue to improve, the successful deployment on a 3G network is highly suggestive of the potential to move to full feature video-based interventions on smartphones. The popularity of the smartphone and use of the Internet for multimedia provide a new channel to address health disparities in traditionally underserved populations.

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